AUERBACH
BUYERS'
GUIDE
TO...

BUSINESS MINICOMPUTER SYSTEMS

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The information contained herein has been obtained from reliable sources and has been evaluated by experienced technical personnel. Due to the rapidly changing nature of the technology and equipment, however, the information cannot be guaranteed.

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PREFACE

The **AUERBACH Buyers' Guide to Business Minicomputer Systems** is a one volume, looseleaf guide to business minicomputer systems produced and/or marketed in the United States. It is intended to direct the buyer, analyst, or producer of business minicomputer systems through the large number of currently available machines.

The information in this volume is provided in chart, tutorial, and report formats.

Search Charts. You will quickly find the Search Charts, which provide an easy way to compare and contrast many business minicomputer systems.

Introduction. For full background — in tutorial form — the Introduction to Business Minicomputer Systems delineates the several classes of business minis and provides a guide to their capabilities and applications.

Product Reports. The current-to-date Product Reports cover the major business minicomputer systems now available. To aid selection or analysis, each report gives a management-oriented overview, competitive product information, hardware and software specifications, end-user reactions, and configuration guidelines.

List of EDP Suppliers. As a further guide to the present market, this volume provides a full list (including phone numbers and addresses) of EDP suppliers.

AUERBACH On . . . .

Business Minicomputer Systems

INTRODUCTION

There is no ideal computer on the market; there is no business minicomputer with the lowest possible price/performance ratio; and, there is not a computer that is best for a particular user application. On the other hand, there are good computers available — many with good price/performance ratios and there are probably several computers that can do a particular job well.

The problem is, how does one find which computer can do the job for the least overall cost? Selecting a computer for a specific job is not easy. However, if done without panic and without haste, the search for the right minicomputer can raise the staff's technical competence, add to their understanding of the individual application, and build a firm foundation for the decision making that will accompany future developments in the application.

The wise selection of a computer depends on the selector's full knowledge of the application. A number of people are usually involved, and cooperation among the ultimate users is essential. This group of end-users must develop a set of criteria for selecting a suitable computer; and these criteria must reflect the needs of each user's application area, expressed in computer terms. Because it is human nature for each to consider his needs as more important than anyone else's, some member of the selecting group must be responsible for leading the group towards satisfactory compromises.

Developing selection criteria is an educational process. Application areas must be viewed in terms of how they are presently handled, what can be done better by computers, and what can be done in the future. Each person in the group must learn, from the functional point of view, what computers can do.

What the computer salesman says should be considered as input to the development of selection criteria and as an information source for his computer's characteristics. However, the potential user who lets computer salesmen tell him what his selection criteria should be is guaranteeing a less than satisfactory system.

THE BUSINESS MINICOMPUTER MARKET

The business minicomputer market is maturing. It is branching out in several directions leading to different categories of business minicomputers. Although there are not always hard and fast rules defining the groups, it is important to know the capabilities and limitations of each. There are three main classes of business minicomputer systems: the traditional small business computer, the interactive business minicomputer, and the office computer. A fourth class, the intelligent terminal system, can also be included in the business minicomputer family.

Traditional Small Business Computers. Traditional small business computers, on the whole, are produced by the major mainframe companies. They are the offspring of large-scale systems and, like them, are usually batch-oriented, though this is changing as on-line displays and interactive capabilities are introduced. Traditional small business computers are characterized by sophisticated operating systems, a large amount of disc storage and main memory, and a selection of higher-level languages. Also, the manufacturer offers a wide range of proven peripheral devices including several types of auxiliary storage (traditional types as well as the newer mass storage devices) and output equipment.

Interactive Business Minicomputers. Interactive business minicomputers are designed to talk with the user. Usually this interaction takes place at a CRT display with a typewriter keyboard. The terminal can be an integral part of the system or a standalone workstation. Most of the system's processing operations are oriented toward interaction. Entering data into files, inquiring into files, and updating files takes place in an interactive rather than a batch mode.

Interactive business minicomputers comprise the liveliest segment of the business computer marketplace. Mainframer, independent and minicomputer manufacturers are all turning out their own versions. The products are aimed at two kinds of users: the first-time computer user and the sophisticated user who will be buying multiple systems for use in branches of a distributed network.

The interactive system is usually assigned several functions, and is usually accessed by several people. To be truly effective in this kind of environment, the system must be able to run several independent programs simultaneously (multiprogramming), handle multiple interactive display terminals, accept data prepared on off-line devices, and print reports. When the system has finished its daily office job, it must become a terminal of a host computer or exchange data with another system in the network.

Office Computer. Born of the accounting machine and the traditional small business computer, the office computer is often used as a dedicated system. It is ac-

quired for the same reason as any other office machine — to perform a duty or solve a problem local to the office where it is installed. In most cases, therefore, the office computer operates without relying on a large central computer facility, although office computers equipped with communications facilities could be considered as an intelligent terminal substitute.

There are both traditional office computers and newer offsprings. The traditional office computer is used primarily for accounting functions such as accounts payable, accounts receivable, and payroll; and, it is often a direct replacement for an old electromechanical accounting device. These devices have been well-received by many small companies because they require little change in the daily office routine. The traditional office computer, or accounting computer, most often uses visible records as storage media (ledger cards and statement forms) like the electromechanical devices it replaces. Although the market for this type of device has been and remains quite large, many manufacturers of these systems have begun a concerted effort to have their users upgrade to more modern disc-based systems.

The personal, desk-top computer is the latest device to join the small business computer family. While not necessarily a new development, these so-called portable computers are well known to engineers and scientists; the personal desk-top computer is a new phenomenon in the commercial market. As more service bureaus support them as tie-ins to timesharing networks, they are sure to capture the business user's attention.

Intelligent Terminals. As intelligent terminal systems grow in sophistication and ease of use, they become viable substitutes for interactive business minicomputers, especially in applications where remote job entry will be the primary function of the system, with local processing held to a minimum.

Not all intelligent terminal vendors can offer the service and support required for the business user. However, with the advent of newer and cheaper technology in the form of microprocessors, the capabilities of intelligent terminals will continue to expand, and terminal manufacturers will be packaging their systems to accommodate local business processing environments.

DISTRIBUTED PROCESSING

If you are considering using a business minicomputer system as part of a distributed processing network, be aware of its capabilities and limitations.

There are four functions that a business minicomputer is well qualified to perform at local sites in a commercial distributed processing network.

- User-oriented data entry.
- Generation and processing of programs for local applications.
- Storage of local data bases.
- Communications to a host mainframe.

The business minicomputer is the go-between that links the people in the field (who have the raw data) with the system that will finally process the data. As such, the proper positioning of the business mini in a distributed network is the key to its success. Essentially it should act as a sub-distributed network in the local environment. It should offer a complement of data entry/workstation devices that can be scattered throughout user departments (sub-local sites), perform its own data preparation and editing (sub-processing), manage and store its own data (sub-data base),and finally transmit its collected data to a network controller (mini or mainframe) or directly to a host device.

PRICE AND APPLICATION CONSIDERATIONS

The price range for business minicomputer systems is wide -- a system can be purchased for anywhere between $9,000 and $150,000. This spread is an indication of the variety of capabilities available to the user who buys a system that falls into the business minicomputer class.

Assuming that price is not the only consideration when purchasing (or leasing) a business mini for use in standalone or distributed processing applications, here are some qualifications and tradeoffs to keep in mind.

Data Communications Capabilities. Most business minicomputers offer single line communications that allow them to act as a remote batch terminal (usually an IBM standard) to a host mainframe or to talk to another system like itself. Communications should be of a high speed and be able to take place while the system is processing or performing data entry applications.

Especially in the area of data communications, intelligent terminals are viable substitutes for business minicomputers. Many intelligent terminals rival business minis in capability; they often offer specialized data entry languages and editing capabilities, on-line disc storage, standard programming languages, and a complement of peripheral devices. They can be configured in large clusters (an average of four to 32 terminals), and offer emulation packages that allow the terminals to operate with different mainframe systems.

Software Support. Because the business minicomputer will most often be performing local processing for a variety of applications software is needed. Many manufacturers provide applications packages for vertical industries, turnkey systems, and user oriented languages. Look for application packages that are tailored to your specific industry and then find someone (programmer or systems house) that is qualified to adapt it to your particular needs.

Growth. In order for a business minicomputer to be a truly cost effective machine, it must be able to grow and expand with the users' needs; a system should be expandable in some manner, or it should be upward compatible with some other device in a manufacturers' product line.

KNOW THE VENDOR

With increasing frequency, users are selecting their equipment on the basis of vendor reputation. The ingredients that determine a vendor's reputation are hard to define. In fact, two equally perceptive users may strongly disagree about the qualities of a specific vendor or of his products. However, there are factors that will help you determine a vendor's stability and responsiveness to his customers' needs.

You can gauge the past performance of a vendor by checking how long the firm has been in business. Presumably, an established firm has been providing satisfactory products to its customers; the firm will probably remain in business and continue to provide service, maintenance, and product upgrading. However, a new product can have bugs even if introduced by an established vendor, so you should know when the product was first delivered, so you can decide whether it's been in the field long enough to perform satisfactorily.

As part of your investigation of the firm, find out the location of its sales offices; you'll tend to get better service from a local vendor. Since the vendor is not necessarily the manufacturer, investigate this point and learn the manufacturer's history. For example, what other equipment does the manufacturer produce? Does he also sell equipment to other manufacturers who use his product as components in their own systems? (This particular market is commonly called OEM for original equipment manufacturer.)

A significant OEM market can be a plus factor in favor of the vendor. OEM business expands a manufacturer's production volume, lowers his costs, and can improve his profitability via a more positive cash flow. As a result, the manufacturer is more financially sound and has a greater probability of survival. In addition, OEMs tend to make more technical demands than end-users. Consequently, a manufacturer's involvement with OEM business leads to increased technical expertise and further product improvements.

A large company can usually offer considerably more services than a small manufacturer. Yet, a novice user will sometimes be of little importance to those same giants; his trade may be more important to a smaller outfit. The vital point to keep in mind is that you should try to avoid being little more than an account number to the computer manufacturer. From the outset, try to gauge each supplier's future interest in and responsiveness to your problems, based as much face-to-face discussion as possible.

We've presented general guidelines, but it's a good rule to make a full investigation of the vendor. If you're not satisfied with the vendor's credentials, look elsewhere.

INSTALLATION AND MAINTENANCE

The quality of a vendor's maintenance and service facilities can be as difficult to quantify as is its reputation. But as mentioned in the discussion of vendor history, guidelines can give you some feeling for the type of service you can expect.

A number of vendors don't have their own maintenance facilities. Instead they contract with third-party firms to provide installation and maintenance service. On the whole, third-party maintenance firms generally offer no better or worse service than received from a vendor's maintenance personnel. The quality of service depends upon the specific firm.

It's very necessary to have good cooperation and scheduling between your staff and vendor field service personnel during the computer's installation. Unforeseen pitfalls can sometimes develop and delay installation. Before the equipment arrives, try to have some assurance against unexpected bugs. For example, rather than discontinue your old operation, continue with it until the new installation is working. This approach can sometimes be expensive since you'll be paying for two installations while only one is being used. A less expensive approach would be to check whether the vendor has a backup system located nearby. In case of delays, the backup system can be used while the new system is debugged. Even after installation, a backup system located nearby can prove useful in case your system malfunctions. In fact, if you know that a system similar to yours is located within a reasonable traveling distance, try to arrange reciprocal privileges, with each installation included in the other's disaster plans.

Another aspect of installation that should not be overlooked is the type of training provided by the vendor. Although most training can be provided by the vendor at his classroom facility, the vendor should also be expected to provide on-site training as part of the installation procedure. Training should be detailed and supported by first-rate manuals covering both the hardware and software. Well-organized, well-written documentation is also vital if your computer is ever to be used to its full potential.

Maintenance can include a variety of services. Ask the vendor to enumerate them. Are parts replaced free of charge? How often is preventive maintenance performed and when — prime shift only or at the user's convenience? How long must you wait between placement of a service call and arrival of a technical representative? Are there additional costs, such as traveling expenses? If so, how are these costs calculated? In determining expected downtime, find out the distance between your firm and a spare parts depot.

A service representative can respond to your call in a short time if he's located nearby, so a list of the cities housing service centers is important. Additional information that impacts a firm's service capabilities includes the number of service representatives employed and the different levels of employee experience. Do customer engineers have prior experience with business minicomputers? How are customer engineers trained (formal class, on-the-job-training, etc.)?

Business Minicomputer System Checklist

Corporate Data

Headquarters _____ name

_____ address

_____

_____ city, state

_____ telephone

National marketing contact _____ name

_____ title

_____ telephone

Local sales office _____ name

_____ address

_____

_____ city, state

_____ telephone

Local marketing contact _____ name

_____ title

_____ telephone

Date system first announced _____

Date system first delivered _____

Number installed _____

Current System Users

Configuration	Corporate Name	Address	Telephone

Questions for References

Is vendor pleasant to deal with _____; does he have a good record of resolving problems _____, meet commitments _____, deliver system on time _____?

Vendor's Control over Products

Does he design _____, manufacture _____, inspect _____, test _____, recondition _____?

If subject to other firm's: Name _____,

Address _____, Telephone _____,

Functions performed _____,

_____.

Hardware System

Central Processor

Model _____

Word size (bits) _____, Main memory size (K bytes) _____,

Cycle time (μsec) _____, Add time (μsec) _____,

No. of instructions _____, Hardware multiply/divide _____,

Interrupts: Hardware/software _____, No. levels _____.

Data Input/Output

Type	Input/Output	Model No.	Speed
Punched card			
Punched paper tape			
Magnetic cassette			
Line printer			
Character printer			
Video display			
Other			

Auxiliary Storage

	Model	Model No.	Capacity	Speed
Disc				
Diskette				
Drum				
Tape				
Magnetic Ledger				
Other				

Software

	Name	Description
Operating system		
Assembler		
Compiler		
Application packages		

User Support

Ordering Assistance

	Title	Length (days)	Cost
Training Courses			

	Title	Type
Documentation		

Maintenance

Preventive

How often performed _____, days of week _____, hours _____

Emergency

Quoted reponse time (hours) _____ hours of availability _____

Customer Engineer Experience

Training: formal _____, on the job _____

Prior experience: previous work with business minicomputers _____

Backup Facilities

Location of alternate site with comparable installation _____

Location of spare parts depot _____

Pricing Policy

Installation charge _____

Cancellation penalties _____

Upgrade and downgrade: alternatives _____

restrictions _____

penalties _____

Purchase agreement _____

Rental, lease agreement (maintenance included) _____

Effect of future price change _____

Delivery guarantees _____

Performance guarantees _____

Purchase options _____

Order cancellation before delivery _____

Acceptance period (days) _____

Policy on replacement hardware _____

SEARCH CHART
Business Minicomputer Systems

MANUFACTURER AND MODEL NUMBER	Year of First Delivery	COVERED IN			MAX MAIN MEM		AUX STORAGE AND PERIPHERALS							PROG LAN-GUAGES			MAJOR MARKETS					
		Small Business	Minicomputers	Intelligent Terminals	Under 32K Bytes	32K Bytes and Over	Disc/Drum	Magnetic Tape	Magnetic Ledger	Punched Cards	Paper Tape	Char Printer	Line Printer	Cobol	RPG	Other	Fed. Rep. of Germany	France	Italy	United Kingdom	United States	Other
Triumph-Adler																						
TA 10	71				X			X				X				X	X	X	X	X		X
TA 100	68	X			X			X	X	X	X	X				X	X	X	X	X		X
TA 1000	73	X				X	X	X	X	X	X	X				X	X	X	X	X		X
TA 1000 Model 20	73	X				X		X		X		X				X	X	X	X	X		X
TA 1000 Model 30	74	X				X		X	X	X		X				X	X	X	X	X		X
ADS 2100	68	X			X			X	X	X	X	X				X	X	X	X	X		X
Advanced Information Access																						
ADAM	73	X				X	X	X			X	X	X			X				X		
ALVAN	73	X				X		X				X						X				
Allied Bus Sys Multibus	72	X				X	X	X			X	X	X			X	X			X		
Basic Four																						
350	71	X				X	X	X		X	X	X	X			X	X			X	X	X
400	71	X				X	X	X		X	X	X	X			X	X			X	X	X
500	71	X				X	X	X		X	X	X	X			X	X			X	X	X
BME																						
daro-Soemtron 382	73	X			X		X				X	X				X	X	X		X		X
1842	73	X			X		X				X	X				X	X	X		X		X
Business Computers Ltd. (BCL)																						
Molecular 6M	73	X				X	X					X	X			X	X	X		X		X
Molecular 18		X				X	X	X	X	X	X	X	X		X		X	X		X	X	X
SADIE					X						X	X				X				X		
SADIE 10	74				X							X									X		
SUSIE					X						X	X				X				X		
Burroughs																						
700	73	X				X	X	X		X	X		X	X	X		X	X	X	X	X	X
1728	73	X				X	X	X		X	X		X	X	X	X	X	X	X	X	X	X
1712		X				X	X	X		X			X	X	X	X	X	X	X	X	X	X
1714		X				X	X	X		X			X	X	X	X	X	X	X	X	X	X
1726		X				X	X	X		X			X	X	X	X	X	X	X	X	X	X
L2000		X			X					X	X	X		X	X	X	X	X	X	X	X	X
L3000		X			X					X	X	X		X			X	X	X	X	X	X
L4000	70	X			X					X	X	X		X			X	X	X	X	X	X
L5000	70	X			X				X	X	X	X		X			X	X	X	X	X	X
L7000	71	X			X		X		X	X	X	X		X			X	X	X	X	X	X
L8000		X			X				X		X	X		X			X	X	X	X	X	X
Cascade Data																						
Cascade 80 Series	70	X				X	X	X		X	X		X		X						X	
Concept II Series		X				X	X	X		X	X		X		X	X					X	
Compudata 500		X			X			X	X	X	X	X				X	X	X				X
Codon CB 100		X				X	X	X			X		X		X	X				X		
CTM																						
70/400	72	X				X		X	X	X	X	X				X	X	X				X
70/500	73	X				X		X	X	X	X	X				X	X	X				X
70/600	73	X				X	X	X	X	X	X	X				X	X	X				X

MANUFACTURER AND MODEL NUMBER	Year of First Delivery	COVERED IN			MAX MAIN MEM		AUX STORAGE AND PERIPHERALS							PROG LAN-GUAGES			MAJOR MARKETS					
		Small Business	Minicomputers	Intelligent Terminals	Under 32K Bytes	32K Bytes and Over	Disc/Drum	Magnetic Tape	Magnetic Ledger	Punched Cards	Paper Tape	Char Printer	Line Printer	Cobol	RPG	Other	Fed. Rep. of Germany	France	Italy	United Kingdom	United States	Other
Datapoint 2200	71	X			X		X	X		X		X	X		X	X	X	X		X	X	X
Datasaab-Facit																						
D 5/10				X	X						X	X			X		X	X	X	X	X	X
D 5/20				X	X		X	X			X	X			X		X	X	X	X	X	X
D 5/30		X				X	X	X			X	X	X			X	X	X	X	X	X	X
6501	72	X				X	X	X			X	X		X			X	X	X	X		X
Addo System M15	73	X			X			X			X	X				X	X	X	X	X		X
Datasystem Series 500	73	X				X	X	X		X	X	X			X	X	X	X	X	X	X	X
DEC Datasystem Series 300	73	X				X	X	X		X	X	X	X			X	X	X	X	X	X	X
Eldorado Electrodata Mdl 140		X				X	X	X		X	X	X	X			X						
Feiler		X			X				X		X	X					X	X				X
Four-Phase																						
IV/40	73	X				X	X					X	X	X		X					X	
IV/70	71	X				X	X	X		X		X	X	X		X					X	
Fujitsu Facom Mate	71	X			X		X	X			X	X		X								X
Hermes Datasystem 210	73	X			X			X	X			X				X	X	X	X	X		X
Hitachi																						
Hitac 1	70	X			X						X	X				X						X
Hitac 80/10	70	X			X						X	X				X						X
Hohner																						
GDC 505	72	X			X			X			X	X				X	X					
2000 S	71	X			X						X	X				X	X					
5000	70	X				X		X		X	X	X				X	X	X	X	X		X
6000	70	X				X		X		X	X	X				X	X	X	X	X		X
7000	72	X			X				X		X	X				X	X					
8000	70	X				X		X	X	X	X	X				X	X	X	X	X		X
9000	72	X				X	X	X		X	X	X				X	X					
Honeywell																						
53	68	X			X			X		X		X	X					X	X		X	X
55	66	X			X			X		X		X	X					X	X		X	X
Series 100, Mdl 15	71	X				X	X	X		X	X		X	X	X	X					X	
Series 50, Mdl 58	70	X			X		X	X		X	X	X	X	X		X	X	X	X	X	X	X
Series 200, Mdl 105	71	X			X		X	X		X	X	X	X	X	X	X					X	
Series 200, Mdl 115	70	X			X		X	X		X	X		X	X	X	X	X	X	X	X	X	X
Series 2000, Mdl 2020 & 2030	72	X				X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
G105	69	X			X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
G115	66	X			X		X	X		X	X		X	X	X	X	X	X	X	X	X	X
G118		X				X	X	X		X	X		X	X	X	X	X	X	X	X		X
G120	66	X												X	X	X	X	X	X	X	X	X
G130	68	X												X	X	X	X	X	X	X	X	X
H115	70	X			X		X	X		X	X		X	X	X	X	X	X	X	X	X	X
IBM																						
System/3 Mdl 6	70	X			X		X			X		X			X	X	X	X	X	X	X	X
System/3 Mdl 10	70	X				X				X		X	X	X	X	X	X	X	X	X	X	X

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IBM (Contd.)																						
System/3 Model 15	74	X				X	X	X		X			X	X	X	X	X	X	X	X	X	X
360/20 Submdl 5	69	X				X	X	X		X		X	X		X	X	X	X	X	X	X	X
360/20 Submdl 6	71	X			X		X	X		X		X	X		X	X	X	X	X	X	X	X
370/115	74	X				X	X	X		X			X	X	X	X	X	X	X	X	X	X
ICL																						
1901	66	X				X	X	X		X	X		X	X		X	X	X		X		X
1901A	68	X				X	X	X		X	X		X	X		X	X	X		X		X
1901S	73	X				X	X	X		X	X		X	X		X	X	X				X
1901T	74	X				X	X	X		X	X		X	X		X	X	X		X		X
1902A	68					X	X	X		X	X		X	X		X	X	X		X		X
2903	74	X				X	X	X		X	X	X	X	X	X	X	X	X		X		X
iCS System 755	74	X				X	X		X	X	X	X	X			X	X	X				
IME 10001	73	X			X			X	X		X	X	X			X	X	X	X	X		X
Informatek Matek 1026	73	X				X	X					X	X			X		X				
Insel MAEL																						
3000	73	X			X				C		X	X						X	X	X		X
4000	70	X			X		X	X	X	X	X	X				X	X	X	X	X		X
4200	71	X			X				X	X	X	X					X	X	X	X		X
4400	73	X			X				X	X	X	X						X	X	X		X
4420	73	X			X			X	X	X	X	X						X	X	X		X
4425	73	X			X			X		X	X	X						X	X	X		X
4800	72	X			X				X	X	X	X					X	X	X	X		X
4820	73	X			X			X	X	X	X	X					X	X	X	X		X
4825	73	X			X			X		X	X	X					X	X	X	X		X
4850	73	X			X		X	X	X	X	X	X					X	X	X	X		X
4855	74	X			X		X	X		X	X	X					X	X	X	X		X
ISE																						
10/32	73	X			X							X				X	X					
20/64	73	X			X							X				X	X					
3000	72	X			X			X	X			X				X	X					
Kienzle Apparate																						
System 800	65	X			X				X	X	X	X					X	X	X	X		X
4300	73	X			X					X	X	X				X	X	X				X
4500	73	X			X					X		X				X	X	X				X
5000	68	X			X			X		X	X	X				X	X					X
5600	69	X			X			X		X	X	X				X	X	X	X	X		X
6000E	72	X				X		X	X	X	X	X				X	X	X	X	X		X
6000M	72	X			X				X	X	X	X				X	X	X	X	X		X
6000R	72	X			X				X	X	X	X				X	X	X	X	X		X
6000S	68	X			X			X	X	X	X	X				X	X	X	X	X		X
6100	72	X				X	X	X	X	X	X	X	X			X	X	X	X	X		X
Litton ABS																						
1220/1221		X			X						X	X					X	X	X	X	X	X
1231		X			X					X	X					X	X	X	X	X		
1241		X			X		X				X	X					X	X	X	X	X	X

MANUFACTURER AND MODEL NUMBER	Year of First Delivery	COVERED IN			MAX MAIN MEM		AUX STORAGE AND PERIPHERALS							PROG LAN-GUAGES			MAJOR MARKETS					
		Small Business	Minicomputers	Intelligent Terminals	Under 32K Bytes	32K Bytes and Over	Disc/Drum	Magnetic Tape	Magnetic Ledger	Punched Cards	Paper Tape	Char Printer	Line Printer	Cobol	RPG	Other	Fed. Rep. of Germany	France	Italy	United Kingdom	United States	Other
Litton ABS (Contd.)																						
1252		X			X		X				X	X				X	X	X	X	X	X	X
1281		X			X				X	X	X	X				X	X	X	X	X	X	X
Lockheed System III	73	X				X	X	X		X			X		X						X	
LogAbax																						
LX 2200	70	X			X			X				X					X	X	X	X		X
LX 2600	73	X			X			X			X	X					X	X	X	X		X
LX 4100	72	X			X				X			X				X	X	X	X	X		X
LX 4200	71	X			X		X	X	X	X	X	X	X		X	X	X	X	X	X		X
Marme GMG 5000	73	X				X	X	X		X	X	X	X	X		X		X				
MBM Computers																						
MBM 7000 (PDP 11/05)	73	X			X		X			X	X	X	X	X		X				X		
MBM 7000 (PDP 11/35)	73	X				X	X			X	X	X	X	X		X				X		
Melcom System MCS 1600	74	X				X	X	X		X	X	X	X		X	X				X		
Mitsubishi Denke Melcom																						
81	68	X			X						X					X						X
82	68	X			X						X	X				X						X
83	69	X	X		X		X	X			X	X				X	X	X		X		X
84	70	X			X		X	X	X		X	X				X	X	X		X		X
88	71	X				X	X	X			X	X	X	X	X	X						X
NCR Century																						
50	71	X				X	X	X		X	X		X	X		X					X	
75, 101		X				X	X	X		X	X		X	X		X	X	X	X	X	X	X
100	68	X				X	X	X		X	X		X	X		X	X	X	X	X	X	X
150-656	73	X				X	X	X		X	X		X	X	X	X				X		X
399	73			X													X	X	X	X	X	X
N-500	65	X			X			X	X	X	X	X				X	X	X	X	X	X	X
Nihon-Denke Neac																						
1210	67	X			X						X	X		X		X						X
1240	67	X			X		X			X	X	X	X	X		X						X
Nihon-Musen Jac																						
110	67	X			X					X	X	X				X						X
322	67	X			X					X	X	X				X						X
322A	67	X			X		X			X	X	X				X						X
110G	68	X			X					X	X	X				X						X
110K	69	X			X						X	X				X						X
120	70	X				X	X	X		X	X	X		F	X	X						X
120M/520	70	X	X			X	X	X			X	X		F		X						X
Nihon-Shingo Pasca 3000	70	X				X	X				X	X				X						X
Nixdorf System																						
820/15	70	X			X			X	X	X	X	X				X	X	X	X	X	X	X
820/25	70	X			X			X	X	X	X	X				X	X	X	X	X	X	X
820/35	70	X			X			X	X	X	X	X				X	X	X	X	X	X	X
840/15	72	X			X			X	X	X	X	X				X	X	X	X	X		X

MANUFACTURER AND MODEL NUMBER	Year of First Delivery	COVERED IN			MAX MAIN MEM		AUX STORAGE AND PERIPHERALS							PROG LANGUAGES			MAJOR MARKETS					
		Small Business	Minicomputers	Intelligent Terminals	Under 32K Bytes	32K Bytes and Over	Disc/Drum	Magnetic Tape	Magnetic Ledger	Punched Cards	Paper Tape	Char Printer	Line Printer	Cobol	RPG	Other	Fed. Rep. of Germany	France	Italy	United Kingdom	United States	Other
Nixdorf System (Contd.)																						
840/25	72	X			X			X	X	X	X	X	X			X	X	X	X	X		X
840/35	72	X			X			X	X	X	X	X	X	X		X	X	X	X	X		X
880/45	73	X			X		X	X	X	X	X	X				X	X	X	X	X		X
880/55	71	X			X		X	X	X	X	X	X		X		X	X	X	X	X		X
880/65	72	X				X	X	X		X	X	X	X	X	X	X	X	X	X	X		X
880/85	72	X			X		X	X	X	X	X	X		X		X	X	X	X	X		X
Obbomatic		X			X							X						X				
Oki-Denki Okiminitac																						
500		X			X							X				X						X
510		X			X							X				X						X
610		X			X							X				X						X
710		X			X						X	X				X						X
Olivetti																						
P602	72	X			X			X			X	X				X	X	X	X	X		X
P603	73	X			X			X	X		X	X				X	X	X	X	X		X
P652	73	X			X			X	X		X	X				X	X	X	X	X		X
Auditronic 730	71	X			X						X	X				X	X	X	X	X	X	X
Auditronic 770	69	X				X			X		X	X				X	X	X	X	X	X	X
Olympia KC 7000	73	X			X							X				X	X					
Philips Electrologica																						
P351	70	X			X							X				X	X	X	X	X	X	X
P352	70	X			X		X	X		X	X	X				X	X	X	X	X	X	X
P353		X			X			X	X	X	X	X					X	X	X	X		X
P354		X			X		X	X	X	X	X	X				X	X	X	X	X	X	X
P355	73	X			X		X	X	X	X	X	X				X	X	X	X	X	X	X
P356		X			X		X	X		X	X	X				X	X	X	X	X	X	X
P358	71	X			X		X	X	X	X	X	X				X	X	X	X	X	X	X
P359	71	X			X		X	X	X	X	X	X				X	X	X	X	X	X	X
Qantel System		X				X	X	X		X	X	X	X		X	X					X	
Remington Rand OCS 1	73	X			X							X				X	X	X	X	X		X
Ricoh Ricom-8	71	X	X		X		X					X				X						X
Ricoh Typac																						
8B		X			X							X										X
16B		X			X							X										X
Ricoh Typer																						
200		X			X						X	X				X						X
240		X			X						X	X				X						X
600		X			X						X	X				X						X
Ruf Datensysteme																						
Series 40	73				X			X	X	X	X	X	X			X	X					
Series 70	70				X			X	X	X	X	X				X	X					
Series 80	73				X		X	X	X	X	X	X				X	X					

MANUFACTURER AND MODEL NUMBER	Year of First Delivery	COVERED IN			MAX MAIN MEM		AUX STORAGE AND PERIPHERALS							PROG LAN-GUAGES			MAJOR MARKETS					
		Small Business	Minicomputers	Intelligent Terminals	Under 32K Bytes	32K Bytes and Over	Disc/Drum	Magnetic Tape	Magnetic Ledger	Punched Cards	Paper Tape	Char Printer	Line Printer	Cobol	RPG	Other	Fed. Rep. of Germany	France	Italy	United Kingdom	United States	Other
Ruf Praetor																						
3000	69	X			X					X	X	X				X		X				X
4000	69	X			X						X	X				X		X				X
5000	69	X				X		X		X	X	X				X		X				X
6000	69	X				X		X		X	X	X				X		X				X
8000	69	X				X		X		X	X	X				X		X				X
Sharp Hayac — 3000		X			X																	X
Siemens System																						
404/3	70	X	X			X	X			X	X	X	X	X	X	X	X					
4004/16	68	X			X		X	X		X	X		X		X	X	X	X	X			X
4004/26	68	X				X	X	X		X	X		X		X	X	X	X	X			X
4004/220	75	X				X	X	X		X	X		X	X	X	X	X	X	X			X
Singer																						
5800	71	X			X				X		X	X					X	X	X	X	X	X
6800	73	X			X		X						X			X					X	
System Ten Models 20 & 21	70	X				X	X	X		X	X	X	X		X		X	X	X	X	X	X
Sumlock Comptometer																						
R Series	70	X				X		X		X	X	X								X		
R3000	72	X			X					X	X	X				X				X		
R4000	72	X			X					X	X	X				X				X		
R5000	71	X				X		X		X	X	X				X				X		
R6000	71	X				X		X		X	X	X				X				X		
R8000	71	X				X		X	X	X	X	X				X				X		
SYNELEC SYN 9	74	X				X	X	X		X	X	X	X			X	X	X				
TEL System 720	73	X			X		X	X	X		X	X	X			X		X		X		
Terminal Display Systems (TDS)																						
System 4007	73	X				X	X	X		X	X	X	X			X				X		
Toshiba Tosbac																						
1100 D		X			X						X	X				X						X
1100 E		X			X						X	X				X						X
1250		X			X		X	X		X	X	X	X			X						X
1200		X			X			X			X	X				X						X
RT-150	71	X																				X
Uchida-Yoco Usac																						
300		X			X																	X
400	70	X			X						X											X
720	71	X			X		X	X	X		X	X				X						X
1500	69	X			X		X			X	X	X		X		X						X
2500	68	X				X	X			X	X					X						X
5010	61	X				X		X				X				X						X
Ultimacc																						
Tape System	70	X				X	X					X	X			X					X	
Disc System	71	X																			X	
Unidata 7.720	75	X				X	X	X		X	X	X	X	X	X	X	X	X	X			X

MANUFACTURER AND MODEL NUMBER	Year of First Delivery	COVERED IN			MAX MAIN MEM		AUX STORAGE AND PERIPHERALS							PROG LANGUAGES			MAJOR MARKETS					
		Small Business	Minicomputers	Intelligent Terminals	Under 32K Bytes	32K Bytes and Over	Disc/Drum	Magnetic Tape	Magnetic Ledger	Punched Cards	Paper Tape	Char Printer	Line Printer	Cobol	RPG	Other	Fed. Rep. of Germany	France	Italy	United Kingdom	United States	Other
Univac																						
9200	67	X			X		X			X	X		X	X	X	X	X	X	X	X	X	X
9200 II		X				X	X	X		X	X		X	X	X	X	X	X	X	X	X	X
USAC System 720	73	X			X		X	X	X		X	X				X		X		X		
Wagner																						
WACTRONIC	70	X			X				X		X	X				X	X					
WAC 40	72	X				X	X	X	X	X	X	X				X	X					
WAC 400	72	X				X	X	X		X	X	X	X		X	X	X					
Wang 2200	73	X				X	X	X		X		X	X			X					X	

BASIC/FOUR
Basic/Four System

OVERVIEW

The Basic/Four series of small business computers is primarily marketed as a system for first-time users of electronic data processing. Firms that use Basic/Four systems range from banks and savings and loan institutions to truckers and wholesalers. Basic/Four indicates that the majority of their customers are firms with annual sales of $500,000 to $20 million. Basic/Four has slotted their systems to fill the gap between the simple, typewriter-oriented accounting machines and the larger batch-oriented small business computers. The Basic/Four series is designed for single and multiple terminal environments with interactive processing requirements. Standard accounting-type applications such as invoicing and payroll are available from Basic/Four in customized form. In addition the Basic/Four system provides a programmed means of report generation, which is useful to the small business outgrowing simple management techniques.

The systems were introduced in 1971 and are presently marketed domestically by Basic/Four and in more than 20 foreign countries throughout the world by affiliated companies, Basic/Four International and MAI International Corporation. All three are subsidiaries of Management Assistance, Inc.

Basic/Four originally offered three models, the 350, 400 and 500. These systems are field expandable, so that the simplest configuration can be converted to the most powerful as the user's requirements grow. In February 1975 a new Model 600 was announced. The new system has all of the features of the original models, plus expanded disc storage and on-line synchronous communications and expanded user memory. The Model 600 is being marketed as a multi-terminal, interactive, front-end processor for a large computer facility, and as a standalone business computer system.

The 350 is the smallest model of the series; it supports a single interactive video display terminal. The other three models, the 400, 500 and 600, can support networks of video display terminals. Each terminal can process a different operation on a simultaneous basis. This timeshared, multi-programming capability allows multi-use of the CPU by up to eight interactive terminals, all doing the same or different tasks from a common data base on magnetic disc drives.

The series is available with operating system software and customized application programs, or with operating system software alone. The user's staff can develop application programs in the system's conversational programming Business BASIC language. In addition, Basic/Four offers a variety of support and programmer training services.

See Table 1 for a list of the Basic/Four mainframe characteristics.

COMPATIBILITY

A major feature of this series is that Models 350 and 400 can be upgraded to Model 500. A user can initially acquire the smallest configuration that meets his needs. As his requirements grow, the system can be modularly expanded accordingly. All application programs for Models 350, 400 and 500 are upward compatible to the Model 600 system through a translator program.

PERFORMANCE AND COMPETITIVE POSITION

The chief design feature of the Basic/Four series is the main memory partitioning that its operating system

HEADQUARTERS

Basic/Four
18552 MacArthur Blvd.
Santa Ana CA 92702
(714) 833-9530

Table 1. Basic/Four System: Mainframe Characteristics

MODEL	Characteristics
Central Processor	
General-Purpose Registers	5
Addressing	
Direct (wds)	All of memory
Indexed	All of memory
Instruction Set	
Number (std)	
Decimal Arithmetic	Yes
Priority Interrupt System Levels (std; max)	8
Main Storage	
Type	Core
Cycle Time (μsec)	1.0
Basic Addressable Unit	Word
Bytes/Access	2
Min Capacity (bytes) Model 350, 400, 500	24K
Min Capacity (bytes) Model 600	32K
Max Capacity (bytes)	64K
Installation Limit	4 modules
Increment Size (bytes)	8K
Memory Parity	No
Memory Protect	Std; 16K byte
ROM	Yes
Use	Firmware
Capacity (words)	2,560
RAM:	
Use	Operating system and applications programs
Capacity Model 350, 400 and 500	24-64K
Capacity Model 600	32-64K
I/O Channels	
Programmed I/O	Yes
DMA Channels	1
Max Transfer Rate (bytes/sec):	
Model 350, 400 & 500	
—within memory	20K
—over DMA	195K
Model 600	
—within memory	20K
—over DMA	312.5K
Software	
Assembler	No
Operating System	Yes; BOSS available in single- and multi-terminal versions.
Language	Business BASIC (instructions for: formatting input data and system printout; management of disc data files; incl password security arrangements fixed-point standard decimal number representation and computation)

performs on a dynamic basis. This feature permits multiprogramming on a timeshared basis without the complex program software normally associated with such an operation. A terminal can call up any of the programs stored in the disc file library with output data from each program buffered in core or on disc and printed out in turn.

Competition for the Basic/Four system is the Honeywell 61/58 and 61/60, Singer System Ten Model 110, Burroughs B 700 Series, DEC Datasystem 300 Models and, upon occasion, the IBM System/3 and IBM System/32.

USER REACTIONS

Basic/Four can boast a very satisfied clientele. It's users report simplicity of operation, minimal downtime, excellent maintenance response supplied by Sorbus, Inc. (a subsidiary of Management Assistance Inc.), ease of programming, and the overall flexibility of the system. The customers contacted agreed they would buy another Basic/Four system or add to the system if the need arose. Half of these contacted have done so recently.

One of those customers, a distributor of electrical components, employs six Video Display Terminals in a supermarket-type arrangement. With the aid of the VDTs, an

invoice can be ready for the customer by the time he leaves the supply house. This procedure also performs inventory control for the distributor. He previously had used an IBM System/3 Model 6 for his business and found that it was not versatile enough. He then purchased the Basic/Four system and recently expanded his original system of four VDTs to six VDTs.

A Chicago-based CPA firm develops client accounting packages and maintains the clients' books of entry with a Model 500 and two VDTs. The company finds the system so easily programmed that it develops software for its clients for adjustments, accounts receivable and sales reports.

A New York publishing firm uses a Model 400 with two video terminals for all its billing, inventory, royalties, accounts receivable and sales procedures. Compared with the Singer Friden and an outside service, the Basic/Four system has saved this company money and personnel. The operators noticed a slower response time with the addition of a second terminal, but updated BOSS (Basic Operating System Software) speeded up response time beyond that of the one-terminal system. The company likes the ease with which components can be added, but would prefer faster I/O time.

A major New York life insurance company, claiming to be one of the largest Basic/Four system installations, uses five VDTs to process all group premium collection accumulations and to reconcile its incoming bank accounts. The firm likes the capability of entering data immediately, though it wishes the system were faster. This company has experienced scattered hardware problems, but downtime has been minimal and the maintenance response excellent.

Maintenance for the Basic/Four systems is available through Sorbus, a broad-based service company with offices in more than 130 cities across the country. Service is provided by contract either during regular business hours, or on a 24-hour basis.

CONFIGURATION GUIDE

The Basic/Four product line consists of four models: the 350, 400, 500 and 600. The minimum configuration is the 350, which consists of a CPU with 8K bytes of user memory, a Video Display Terminal (VDT), a disc memory unit and a dot matrix printer. The printer uses a fully buffered 132-character line and prints at 165 characters per second. The CPU cabinet houses the basic disc memory unit, a dual-disc configuration with 2.1 million bytes of storage, as well as read/write memory.

Models 350, 400 and 500

The CPU includes 2,560 bytes of read-only memory and 16K bytes of read/write memory reserved for the Basic Operating System Software (BOSS). It is a disc-oriented operating system that includes the interpreter for Business BASIC, the conversational mode programming language, as well as the system's executive and monitoring software.

Two channels are provided to connect all peripheral devices to the CPU. For high-speed access, a DMA channel can interface up to four disc drives (eight discs); transfer rate is 195K bytes per second. A programmed I/O channel transfers data at 20K bytes per second between the CPU and peripherals. Communication adapters, operating over dial-up or leased lines, can connect the CPU with remotely located terminals. Extra controllers for printers, magnetic tape drives, card readers, and paper tape readers and punches are installed in the CPU as needed. Table 1 contains peripheral device characteristics information.

The Model 350's memory is expandable by modules to a maximum of 64K bytes, of which 48K bytes are user read/write core. In addition, three disc drives, each with 6.0 million bytes (4.2 million net) of disc storage can be added for a total of 24 million bytes (16.8 million net) of on-line disc capacity. The following peripherals are available: a buffered 200 line-per-minute printer with a 132-character line; 7-track or 9-track magnetic tape transports; a communication controller to link a remote VDT to the CPU; and punched card readers for 80- or 96-column cards with peak speeds of 800 cards per minute. A paper tape reader (300 characters per second) and punch (75 characters per second) are also available.

The video display terminal's CRT can display 1,920 characters in an 80-column by 24-row format at up to 240 characters per second. The VDT has an alphanumeric keyboard and numeric keypad for data entry. In addition to its use as an interactive communications device, the CRT's 12-inch screen can be used to display data for review and correction prior to entering it into the CPU. Blank forms can be displayed, their outlines and section headings at reduced intensity, so that the operator can fill in the blanks with information in the desired format.

The Model 400 is capable of accommodating up to four interactive terminals. These terminals can be remotely located and linked to the CPU by telephone lines, and all can process the same or different programs concurrently.

Model 500 has the same basic components as Models 350 and 400, but it can handle up to eight interactive terminals simultaneously. Terminals linked to Model 400 and Model 500 are serviced concurrently. All models have a maximum memory capacity of 64K bytes, and all can be expanded in the field to the level of a Model 500 by adding the necessary components.

Multi-terminal configurations in the series can support a far higher volume of business activity than a single terminal system. Each terminal can function as an independent I/O device for order entry, invoice preparation and inventory monitoring; data entered once is always available

to any authorized access for program execution. This feature eliminates multiple handling of files and the subsequent possibilities of error.

Model 600

The configuration of the Model 600 is similar to the Model 500 with the following enhancements:

The CPU includes 32K minimum of read/write core memory divided into 13K bytes of user memory and 19K bytes of protected memory for the expanded operating system (BOSS II). The expanded version of the proven Business BASIC programming language is called Business BASIC II.

The disc drive has a gross capacity of 12 million bytes, and a net capacity of 10 million bytes. The disc drive includes an intelligent disc controller (microprogrammed processor) that performs multiple seeks concurrently with full track search. The transfer rate is 312,500 bytes per second, a 60 percent improvement over other models.

In addition to asynchronous communications, the 600 will support the Synchronous Communications Feature (SCF). When properly implemented with the necessary applications programming, SCF contains the hardware and system software features to support communications between two Model 600 systems or a Model 600 and a foreign computer.

The synchronous communications feature supports both ASCII and EBCDIC coding on a point-to-point, half-duplex switched network at 2,000 baud.

The Model 600's memory is expandable in 8K byte modules to a maximum of 64K bytes, of which 45K are user memory. Additional disc drives may be added for a total on-line capacity of 48 million bytes (40 million bytes net).

PERIPHERALS

Table 2 describes the peripherals available with the Basic/Four system.

Table 2. Basic/Four System: Peripherals

Peripheral Device	Performance Characteristics	Comments
Auxiliary Storage		
Model 2215-100 Disc Drive	2 discs: 1 fixed, 1 removable; gross capacity each 3.0M bytes, net capacity each 2.1M bytes; access time 15 msec (min) and 38 msec (avg); peak transfer rate 195,000 bytes/sec	Model 2215-100 400-track/disc: 110 bytes/sector; 5,280 bytes/track.
Model 2315-200 Disc Drive	2 discs: 1 fixed, 1 removable; gross capacity each 6M bytes, net capacity each 4.2M bytes; access time 15 msec (min) and 38 msec (avg); peak transfer rate 195,000 bytes/sec	Model 2315-200 800-track/disc; 110 bytes/sector; 5,280 bytes/track.
Model 2324-200 Disc Drive (for Model 600 System Only)	2 discs: 1 fixed, 1 removable; gross capacity each 6.0M bytes, net capacity each 5.0M bytes; access time 15 msec (min) and 38 msec (avg); peak transfer rate 312,500 bytes/sec	Model 2324-200 812-track/disc; 256 bytes/sector; 6144 bytes/track.
Magnetic Tape		
Model 6100	9 track; 800 bpi	Models 6100 and 6200 Installation limit: 2 Recording: 800 bpi, NRZI, 12.5 ips. Compatibility: 7 or 9-track ASCII, Industry compatible. Rewind: 50 ips. 7-inch reel; IBM hub compatible.
Model 6200	7 track; 800 bpi	
Printers		
Model 3101	Matrix; 165 cps; 60 lpm (132-char lines) to 150 lpm (short lines); 64-char subset of ASCII. Full line buffer, 132 characters	Model 3101 Installation limit: 2 Original plus 4 copies; 9 x 7 dot matrix
Model 3410	Line printer (200 lpm avg); 64-char subset of ASCII (48-96/char opt) full line buffer, 132 characters	Model 3410 Installation limit: 2 Original plus 5 copies; belt printing mechanism.
Punched Card		
Model 4100 Card Reader	80-col	Models 4100 and 4200 Installation limit: 1 Hopper/Stacker capacity: 1,000 cards

Table 2. Basic/Four System: Peripherals (Contd.)

Peripheral Device	Performance Characteristics	Comments
Model 4200 Card Reader	80/96 col Dual capability by changing the hopper/stacker	
Reading Speed:		
Model 4100	80-col cards	
Continuous	400 cpm	
On Demand	300 cpm	
Model 4200	80-col cards and 96-col cards	
Continuous	400 cpm 800 cpm	
On Demand	300 cpm 600 cpm	
Terminals		
Video Display Terminal Model 7220	Keyboard: 128-char set (ASCII) std. typewriter keyboard & numeric 10-key pad. Capacity of 1,920 char, 24 lines/64 char; Integral semiconductor memory	Models 7220 and 7400 Display: 64-char subset of ASCII, and an inverted character mode for lower case display. Data transfer rate of 240 cps
Executive Display Terminal Model 7400	Keyboard: 64-char set (ASCII); capacity of 512 char, 16 lines/ 32 char; solid state random access memory	
Serial Printer Terminal Model 3102	Same as printer Model 3101 except operated remotely; hardwired up to 1,000 ft from the CPU, or via telephone lines	Models 7220, 7400 and 3102 Installation Limit: Model 350: 1 Model 400: 4* Model 500: 8* Model 600: 8* *May be any combination of the three terminal models
Paper Tape		
Model 5110 Paper Tape Reader	Standard feed, 1-in. wide 5, 6, 7, or 8-chan, straight feed or fanfold	Models 5110 and 5120 Installation limit: 1 Photoelectric Reader, 300 cps sync.
Model 5120 Paper Tape Reader	Advance feed 6-chan (7/8 in. width); auto reel take-up and supply	
Model 5200 Paper Tape Punch	Standard feed, 5-chan (11/16-in. width) and 8-chan (1-in. width)	Models 5200 and 5210 Installation limit: 1
Model 5210	Advance feed 6-chan and 7-channel (7/8-in. width)	Error Control: Incremental backspacing 4-10 steps Punching: all speeds up to 75 cps ASCII standard coding structure 1,000-ft tape spools, for take-up and supply Senses and indicates jammed tape, broken tape and low supply

SOFTWARE

The Basic/Four series uses the Business BASIC programming language in the conversational mode and in the operating system. Business BASIC is Basic/Four's extended version of the widely known BASIC language, developed at Dartmouth College to provide novice programmers with easy-to-learn language. The additional features of Business BASIC include: instructions for formatting input data and system printout to provide easily understood reports; instructions for management of disc data files, including password security arrangements to prevent unauthorized access to or alteration of stored data; and fixed-point (standard decimal) number representation and computation.

The Basic Operating System Software (BOSS) is available in two versions — one for the Models 350, 400 and 500 systems and the other for the Model 600 system. BOSS assigns areas in core memory to the various users, implements the data file security features, manages the data files and supports utility routines that include data format conversion, file copying and listing, and file updates. BOSS also contains the Business BASIC interpreter and exercises control over all I/O devices, including the scheduling of tasks.

Basic/Four offers a variety of applications programs and packages. All applications are written in Business BASIC and are flexible to general business needs. The programs available are payroll, general ledger, accounts payable and accounts receivable with invoicing, sales analysis report printing, order entry, and inventory control. Application program packages have been developed for specific environments such as: fuel oil dealers, travel

agencies, Certified Public Accountants (CPAS) and property management. Additionally, dozens of software companies have tailored software packages to Basic/Four systems in such applications as temporary employment agencies and medical laboratory systems.

Basic/Four stresses the versatility of its application software and its interest in developing existing programs to meet changing needs.

PRICE DATA

Model Number	Description	Purchase Price $	Typical 66-Monthly Rental $	Monthly Maint. $	Monthly Rental (includes Maint.) $
	SYSTEMS				
350	Single User Video Display Terminal (consists of a CPU with 8K bytes user memory, low capacity 2.1M-byte disc drive and video display terminal including desk. Serial printer with stand is also included)	32,400	745	183	928
400	Multiple User System — 4 Terminals Maximum (consists of a CPU with 8K bytes user memory, low capacity 2.1M byte disc drive and video display terminal including desk; serial printer with stand is also included)	34,900	803	186	989
500	Multiple User System — 8 Terminals Maximum (consists of a CPU with 8K bytes user memory, low capacity 2.1M byte disc drive and video display terminal including desk; serial printer with stand also included)	37,900	872	189	1,061
600	Multiple User System — 8 Terminals Maximum (consists of CPU with 13K bytes of user memory, a 2,400 rpm, 200 TPI disc drive containing 12M bytes gross capacity and 10M bytes net capacity; video display terminal with desk and serial printer with stand are also included; Asynchronous communication feature is also standard)	54,400	1,251	232	1,483
	Substitutions				
902	4.2 Byte Disc Storage Substitution (capacity of the first (standard) disc drive on any Basic/Four Model 350, 400 or 500 may be modified from 2.1M bytes to 4.2M bytes)	2,000	46	12	58
910	200 lpm Printer and Cabinet Substitution for Serial Printer	6,950	160	16	176
912	Disc Storage Substitution (capacity of the first — standard — disc drive on any Basic/Four Model 350, 400 or 500 may be upgraded from 2.1M bytes to 8.4M bytes)	6,500	150	12	162
1000	Peripherals and Features Foreground/Background Option (provides the capability of concurrently running two tasks from a single terminal; available for all Basic/Four systems)	2,000	46	NA	46
1102	Memory — 8,192 Bytes (additional memory in 8K modules is available up to 48K user core; 45K in Model 600 Systems)	4,450	102	31	133
2215-100	Disc Storage, 4.2M Bytes (100 tpi, 1,500 rpm; up to 3 additional 2215-100 disc storage drives may be added to the Model 350, 400, or 500 systems; each has a 4.2M byte capacity)	9,950	229	60	289
2315-200	Disc Storage, 8.4M Bytes (200 tpi, 1,500 rpm; one 2315-200 disc storage drive may be added to the 350, 400 or 500 systems if the first drive on the system is a 200 tpi, 1,500 rpm drive)	14,900	343	60	403
2324-200	Disc storage, 10M Bytes (200 tpi, 2,400 rpm (600 System Only) Up to 3 additional 2324-200 disc storage drives may be added to the 600 system; drives have a 10M byte net capacity)	14,900	343	60	403
3100	Serial Printer Series (Model 3100 Serial Printer is standard on all Basic/Four systems and as much cannot be ordered as a separate item)	NA	NA	NA	NA
3101	Serial Printer (all systems)	6,450	148	50	198
3400	200 lpm Printer Series (rated at 200 lpm for a 64-character print chain with Gothic font; A 96-character print chain for upper- and lowercase printing is optionally available in a Courier font)	NA	NA	NA	NA
3410	200 lpm Print and Cabinet	10,950	252	66	318
4100	Card Reader, 80 column (400 cpm)	4,450	102	57	159
4200	Card Reader, 80/96 Column (400/800 cpm)	4,950	114	57	171
5110	Paper Tape Reader (Standard Feed Hole)	4,450	102	26	128
5120	Paper Tape Reader (Advanced Feed Option)	4,450	102	26	128
5200	Paper Tape Punch (5 Channel and 8 Channel rated at up to 75 cps)	4,450	102	26	128
5210	Paper Tape Punch (6 Channel Advance Feed and 7 Channel rated at up to 75 cps)	4,450	102	26	128
6100	Magnetic Tape Unit (9-track, 800 bpi (NRZI), 7 in. reel)	7,950	183	68	251
6200	Magnetic Tape Unit (7-track, 800 bpi (NRZI), 7 in. reel)	7,950	183	68	251
7220	Video Display Terminal	4,950	114	23	137
7400	Executive Display Terminal	2,450	56	20	76
8100	Communications Feature, Asynchronous — 400, 500 and 600 Systems (modification provides for CPU asynchronous communication over a telephone line)	1,950	45	14	59

BSL NORTHROP

BDS Series Preliminary Report

BSL Northrop is offering three small business systems based on the Microdata 1600 minicomputer. BSL is marketing turnkey systems for medical manufacturing and real estate applications. At present BSL is restricting their direct marketing efforts to the west coast and southeastern United States. BSL does not operate through agents or dealers; all marketing, software support and hardware maintenance is performed directly by the firm.

The three BSL Northrop systems, the BDS 1000, BDS 2000 and BDS 3000, differ from one another in the amount of main memory they host, in the numbers of I/O channels, and in the video terminals. The BDS 1000 and 2000 are single processor models; the BDS 3000 is a dual processor model. The systems were first delivered in 1972 and more than 40 systems are currently installed.

The common mainframe ancestry insures complete compatibility among the models. The systems use a BSL-developed operating system, and the application programs are written in Microdata 1600 macro assembler language.

The use of a macro assembler language and the turnkey nature of BSL's marketing has precluded any programming activity by the current users. However, by the end of 1975 BSL will be offering a second version of the operating system with a basic compiler. The basic compiler will simplify program development for both BSL and the user.

All three models offer communications facilities. They support local (up to 300 feet from host), private line and dial-up communication lines for asynchronous devices at line speeds of 1,200 to 9,600 bps.

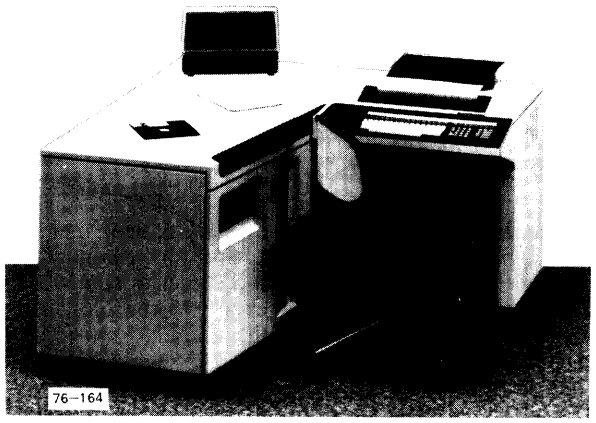
The specific industry applications supported by BSL include packages for the furniture manufacturing industry, medical patient accounting and real estate property management. The furniture manufacturing package is designed to automate sales order processing, inventory control, production scheduling, billing, accounts receivable, accounts payable and general ledger entries. In addition, BSL offers a style costing package to automatically adjust style costs when the price of any of its component materials changes. For the medical market BSL offers a two-computer approach to automation. One computer is a BDS system for the business applications; the second is another BSL Northrop product, the Clindata Series, designed for the acquisition of clinical data. The business applications are specifically aimed at medical group practices, clinics and laboratories. The real estate application is a property management package for apartments and condominiums.

BSL Northrop is representative of a new and growing phenomenon in the small business computer market. Companies offering localized marketing and service coupled with specialized application packages for a limited number of selected industries are beginning to appear in greater numbers. These companies join the independent software houses, who act as agents and distributors for minicomputers, which are packaged with proprietary software in competition with the major small business computer manufacturers. The major manufacturers have the advantage of immediate market recognition and the user confidence that attends that visibility. However, they offer generalized solutions for a wide variety of industry applications. The regional small business computer companies and independent distributors can offer a tailored and personalized approach to customer requirements. See Table 1 for model specifications.

Table 1. BSL Northrop BSL Series: Model Specifications

	Models		
Features	**BDS 1000**	**BDS 2000**	**BDS 3000**
No. of Proc.	1	1	2
Amt of Main Memory (core)	16K	16-24K	24-32K
No. of I/O char	4	8	8/proc
No. of Print Channels	1	1	1/proc
No. of Video Terminals	1-4	1-6	1-16
Screen Size (char/lines)	74 x 27	74 x 27	74 x 27
No. of Disc Drives	1	1-2	2-4
Disc Storage Capacity	10mb	10-20mb	20-40
Matrix Printer Speed (lpm)	200	NA	NA
Drum Printer Speed (lpm)	200-600	200-600	200-600
Opt Peripherals			
Video Terminal Printer	30 cps	30 cps	30 cps
Mag Tape Drive	1-800 bpi	1-800 bpi	1-800 bpi
Optical Mark Reader	NA	300 cpm	300 cpm

BURROUGHS CORP.
B 80 Series



A VERY SMALL GENERAL-PURPOSE COMPUTER SYSTEM

Burroughs, in a much-awaited announcement, introduced the B 80 Series, the smallest member (to date) of the new Burroughs 800 Systems family. The B 80, described as a "very small general-purpose computer system," offers many of the operating system features of Burroughs' larger systems, the B 1700 (the high end of the small business system market) and the B 6700/7700 (large-scale mainframes). Describing a system the size of the B 80 as a very small general-purpose computer system is a new way of thinking about the low end of the computer market, and here the usually conservative Burroughs is taking a leading step.

What makes the B 80 different? Mostly its conception. Burroughs promises a high level of compatibility with present large-scale machines, as well as compatibility with future large-scale systems that are introduced as new members of the 800 Systems family. The promise of compatibility is possible because of the B 80's sophisticated operating system, its use of memory technology similar to that of the large-scale systems, and its use of individual language interpreters for COBOL, RPG, Network Definition Language (NDL), and Message Processing Language (MPL). This means that the B 80 can provide the small user who starts with a minimum system and the large user who employs several B 80s as part of a distributed network with the features offered on Burroughs' line of large-scale general-purpose computers. See Table 1 for system specifications.

THE BEST OF EVERYTHING

For the B 80, Burroughs has brought together some of the best and most mature features of its product line. These include:

- Master Control Program (MCP) — this is functionally most similar to the B 1700's MCP, and from the operator's standpoint most similar to the B 6700/7700's MCP.
- Business Management Systems (BMS) — programs that have been released for the B 80 are already proven and tried on the B 700 systems.
- Peripherals — disc cartridges, line printers, terminals, and industry-compatible mini-discs are used with other Burroughs products (mostly the B 700 Series).
- Languages — COBOL and RPG are used for all Burroughs products. Network Definition Language (NDL) and Message Processing Language (MPL) have been in use on the Burroughs large systems and the Burroughs System and Communications Processors (B 771, 772, 774, and 776).
- Keyboard — the B 80 keyboard is the keyboard that made Burroughs famous. It is used on the L Series, the Audit Entry Series, the TC Series, etc.
- Processor — the processor used for the B 80 is already in use on the Burroughs TC 5100 intelligent terminal, the AE 500 Series, and the S 1000 Document Processing System.

HOW DOES IT COMPETE?

Initially, as with any new product, the B 80's competitive stance in the marketplace will be difficult to judge. From a theoretical point of view, Burroughs is offering the market just what it wants — a product equipped with mature software and priced at the minicomputer level that will serve both the entry-level and the sophisticated end user. Burroughs is promoting a dual marketing effort — single systems for new users and for

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Table 1. B 80: System Specifications

CENTRAL PROCESSING UNIT	
Processor (MHz)	1
Main Memory (KB)	32-61
Main Memory Access Time (ms)	1
Main Memory Technology	Metal Oxide Silicon (MOS)
CONSOLE	
Keyboard	Alphanumeric/numeric
Matrix Printer (cps)	60 or 180
SELF-SCAN Display (char)	256
DATA COMMUNICATIONS	
No. of Lines	Up to 4
Mode	Async, sync, or BDLC
Speed (bps)	75-9,600
SOFTWARE	
Operating System	Master Control Program (MCP)
Data Entry Lang	Data Control System (DCS)
High-Level Langs	COBOL, RPG, Network Definition Language (NDL), Message Processing Language (MPL)

those estimated 130,000 Burroughs L and TC Series users who are looking for a more powerful machine, and selling the B 80 in bunches to large users who will scatter the system around the country as parts of a network at local user sites.

Within Burroughs' own product line the B 80 will undoubtedly be a tough competitor. It should prove an effective and well-received upgrade system for those users of the L Series who are willing to give up their magnetic ledger cards. However, the B 80 must have stimulated some serious strategy meetings within the Burroughs organization when its impact on the B 700 Series (now the B 730 Series) was considered. This series, which has been around since March 1973, is Burroughs' main contestant in the disc-based, small systems market. With a basic price of $34,900 for a packaged system that includes 32KB of main memory, six I/O ports, a 60-character-per-second matrix printer, a 4.6MB disc drive, and an 85-line-per-minute printer, the B 730 Series has a lot to offer the user. For right now its peripheral capabilities are much more varied and expansive than those of the B 80; however this is most likely a marketing move rather than a technological restriction on the B 80, because MCP is designed to handle a large complement of peripherals. Knowing that Burroughs plans to grow the B 80, the restrictions will probably be dropped once the B 730 system is replaced by the future product line promised by Burroughs.

Burroughs, like everyone else in the industry, has targeted IBM's System/32 as its major competitor. Base price for a System/32 with 16KB of main memory, 5MB of disc, a 240-character display screen, and a 40-character-per-second console printer is priced at $34,410. Base price for a B 80 with 32KB of main memory, 2MB of removable disc, a 60-character-per-second console printer, and a 256-character screen is $19,510 plus $2,500 for the MCP operating system. Burroughs, for its price, is giving the user more memory and removable disc storage. But being cheaper than IBM is nothing new. To beat IBM at its own game, a manufacturer has to offer something better. In Burroughs' case, this something better is its well-known name among small users and its MCP operating system, which could prove to be a valuable asset or a severe liability — depending on its performance in the user's hands (see SOFTWARE following for a description of MCP). System/32 is not a multiprogramming system; it is primarily designed as a batch machine. It will support only one on-line display terminal, and handles inquiry from that terminal on a roll-in, roll-out basis.

SYSTEM DESIGN

The basic B 80 system consists of 32KB of main memory (expandable to 64KB in 4KB increments), one magnetic tape station (expandable to four), a 256-character SELF-SCAN® visual display, and either of two consoles. Both consoles are equipped with the familiar Burroughs keyboard (alphanumeric and numeric) used on the L Series of business minicomputers and the TC Series of intelligent terminals. One console has a 15-inch single-pinfeed forms handler, 150 print positions, and a 60-character-per-second matrix printer that positions at a rate of 160 characters per second. The other optional console has a 25.6-inch dual-pinfeed forms handler, 256 print positions, and a 180-character-per-second matrix printer that positions at a rate of 450 characters per second. A third pinfeed device is optional.

A B 80 can be configured with up to six optional, new "super" mini-disc drives. The mini-disc (diskette) has a capacity of 1MB; total mini-disc capacity on a B 80 is 6MB.

As an alternative to the mini-disc, the B 80 can be configured with 4.6MB or 9.2MB removable dual cartridge disc drives (the same drives that are used with the B 700 systems). Total system capacity is 27.6MB of disc cartridge. Also, the B 80 can use the freestanding 243K-byte industry-compatible mini-disc drive that has been used for the Burroughs L Series and B 700 Series. Burroughs views the industry-compatible mini-disc as a transfer medium.

A maximum B 80 configuration can also include up to two line printers (160 or 250 lines per minute) and four data communications channels (two which are high-speed synchronous lines).

Processor

The B 80 uses nine Large-Scale Integrated (LSI) circuits that are contained on a single board. The circuits include a nano memory, a micro stack, input/output logic, and system registers.

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The processor operates at 1 megahertz or one million cycles per second; it has an "overlap" feature that looks ahead to the next microinstruction that is to be processed.

Main Memory

Main memory is expandable from 32,768 bytes to 61,440 bytes in 4KB increments. Memory technology is Metal Oxide Silicon (MOS); access time is 1 microsecond.

Input/Output

The B 80 has eight standard buffered controls for handling input/output devices. An optional channel expander can be added for a total of 11 I/O controls. Via a hardware interrupt system, each I/O channel alerts the processor when it is ready to process or transmit data. This eliminates the need for the processor to scan the I/O channels.

PERIPHERALS

Except for the super mini-disc and the 180-character-per-second console printer, the B 80 uses peripherals that were previously released for the B 700 Series. See Table 2 for a listing of B 80 peripherals.

Table 2. B 80: Peripherals

AUXILIARY STORAGE	
Mini-Disc (industry compatible)	243KB; 343-msec access time
Super Mini-Disc	1MB; 266-msec access time
Dual Cartridge Disc Drive	4.6MB; 145-msec access time 4.6MB; 80-msec access time 9.2MB; 100-msec access time
MAGNETIC TAPE CASSETTE	NA
Printers	
Line printers	160 or 250 lpm
Console printers	60 or 180 cps
DISPLAYS	
Console Display (SELF-SCAN)	256 chars
TD 700	256 chars
TD 800	960/1,920 chars

NA — Not available

DATA COMMUNICATIONS

The B 80 can support up to four data communications channels. It can communicate in asynchronous or synchronous mode at 75 to 9,600 bits per second over leased, switched, or direct connect lines. In addition, Burroughs' own protocol, Burroughs Data Link Control (BDLC), can be used. In a network environment, the B 80 can act as a remote terminal to a larger mainframe, communicate with other B 80 systems, or control its own terminals.

SOFTWARE

Burroughs calls the total collection of operating and application software, higher level language compilers, interpreters, and utility programs the Computer Management System (CMS). It seems likely that future systems will also have a CMS similar to the B 80's, because Burroughs suggests that CMS is the key to the B 80's upward compatibility.

Operating System

The B 80 operates under the control of the Master Control Program (MCP). MCP has gained a loyal following of users of the present-day B 1700 systems, the Burroughs medium-scale systems (B 2800, 3800, and 4800), and the large-scale systems (B 6700/7700). When first introduced, MCP was a technological innovation; now it is known as a very stable and reliable operating system.

MCP's normal mode of operation is multiprogramming. It is designed to control main memory allocations dynamically as part of its regular routine. MCP also handles:

- Job scheduling.
- Logging of system use.
- Loading of programs.
- Maintenance of a file library.
- The generation of variable-length pages of object programs (Burroughs' form of virtual memory). Pages are rolled in and out of memory according to the user's program needs. Burroughs explains that programs will usually be segmented by input/output functions, constant data, variable data, and executable logic code.

Undoubtedly, an MCP so similar to the one used on big mainframe systems sounds a bit heavy for a system the size of the B 80. However, MCP is a proven operating system, and on a properly configured B 80, the operation of MCP should be transparent to the user, but use in the field will be the true test of the B 80's MCP.

At its announcement in Detroit, the B 80 performed three print jobs simultaneously. Two line printers (the maximum number on a B 80) were in full operation when a third print job was called for from the operator's console. Since both line printers were operating, the 60-character-per-second matrix printer picked up the job and began printing.

Languages

Available for the B 80 are:

- COBOL.
- RPG.
- Network Definition Language (NDL) — an ALGOL-like language that allows the user to

describe a network physically, logically, and functionally. It allows the user to deal with communications devices as if they were conventional peripherals.

- Message Processing Language (MPL) — this develops message processing programs for controlling messages entering the data communications system.
- Data Control System (DCS).

The first four languages are higher level languages and the last language, DCS, is a new language designed for transaction input, reporting, and inquiry on the B 80.

Burroughs Data Base Bridging System

The Data Base Bridging System is a series of programs that arrange data bases from the Burroughs L Series systems and other manufacturers' systems into a format that can be used with the B 80's disc storage. Magnetic tape cassettes are used as the standard media for data transfer.

Application Programs

The B 80 uses standard Burroughs Business Management Systems (BMS). The program products that have been released for the B 80 are well-pproven and mature programs that have been used on the B 700 systems. BMS programs are written in COBOL and RPG; available programs include those for wholesalers, distributors, manufacturers, hospitals, and government and financial institutions.

PRICE DATA

At the time of the B 80's announcement, Burroughs did not have full pricing available for release. However, it should be noted that the B 80 presents a new pricing concept for Burroughs. All software and language compilers are unbundled. The price for a minimum B 80 system (32KB of memory, 2MB of super mini-disc, a SELF-SCAN® screen, and a 60-character-per-second matrix printer) is $19,510 plus $2,500 for the MCP operating system. Monthly lease for the hardware will be about $618. A typical large configuration will cost about $150,270 purchase price and $4,500 on a monthly lease.

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BURROUGHS CORP.

B 700 Series

OVERVIEW

The Burroughs B 700 Series are disc-based small business systems aimed at the first-time user. All models of the series use the familiar Burroughs accounting keyboard and have both interactive and batch processing capabilities. Available with the upper end of the series is an off-line, independent data entry terminal; a magnetic ink character recognition (MICR) unit; and up to four data communication lines.

Burroughs offers the B 700 product line as part of a progressive series of steps. With the B 700, Burroughs has created an intermediate level for the user who finds that neither Burroughs' smaller L 8000 nor larger B 1700 Series meets his specific needs. The attractiveness of the B 700 for the small business user lies in the variety of easy-to-use input methods (cassette, magnetic tape, card reader, and keyboard), and the modern disc based storage (up to four discs with up to 9.2 million bytes each). Typical uses for the B 700 include business accounting applications, wholesale applications (invoicing, accounts receivable/payable), and specialized turnkey business applications.

The newest models of the B 700 Series, which were announced in February 1975, fall into two general categories designated by Burroughs as basic systems and packaged systems. The basic systems include only a processor and I/O ports and allow the user to design a system that matches his needs. Models B 705, B 711, and B 721 are of this type. Packaged systems, which are defined by device restrictions, include Models B 702, B 703, B 704, B 709, B 713, and B 723. These models are delineated further into submodels by their line print speeds.

All systems can avail themselves of a comprehensive software base to develop turnkey systems. Available software packages for the user's selection include: Business Management System (BMS), the Commercial Business Management System (Keyboard Oriented) for simpler interactive processing, a Hospital Business Management System, a production control system (PCSI), a fuel oil

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package, and the automotive modules (tire, battery, and auto accessory packages). A complete list of manufacturer developed packages can be found in the SOFTWARE section of this report. Of particular interest to the financial community is a complete financial system for demand deposit accounting. The financial package includes a MICR reader-sorter, and communications capabilities suitable for small and medium-sized banks.

In addition to these nationally supported software packages, there are individual packages available from district offices. Since 1973 Burroughs has worked to develop the B 700 software base (which also extends to the L 8000 and B 1700 series).

See Table 1 for system specifications.

Table 1. Burroughs B 700 Series: System Specifications

Central Processor	
Capacity	32-96K
Cycle Time (μsec)	1.0 or 2.0
Working Storage	Core or MOS (B 721 and 723)
Auxiliary Storage	
Dual Disc Drive A 9480-12	4,667,120 bytes/180-byte segments; 80-msec
Dual Disc Drive A 9480-22	4,667,120 bytes/180 byte segments; 145-ms drive
Dual Disc Drive A 9481-12	9,354,240 bytes/180 byte segments; 101-msec drive
Mini-Disc	Industry-compatible floppy discs (243,000 bytes)
Magnetic Tape Cassette	30 ips
Magnetic Tape Unit	9-track, 800 bpi
Data Output	
Line Printer (lpm)	85, 160, 250, 400, 750
Serial Printer	Yes
Card (cpm)	60
Paper Tape	Yes
Other	MICR reader/sorter
Data Input	
Keyboard	Std
Card (cpm)	200, 300, 600
Paper Tape	Yes
Software	
Assembler	No
Operating System	SCP
Compiler	Network Definition Language, COBOL, RPG
Communications	
Single-Line	Sync or async up to 9600 bps
Four-Line (B 720)	Sync or async at 75 to 9600 bps

COMPATIBILITY

All B 700 models are source and object code compatible with one another. However, the B 700 models are not directly source or object code compatible with COBOL on the smaller L series or RPG and COBOL on the larger B 1700. Burroughs feels that the conversion process between the L Series, B 700 Series, and B 1700 Series is minimal at best and does not warrant even a filter program.

Burroughs' RPG II is industry compatible; however, the COBOL used by the Burroughs systems is not totally compatible with other manufacturers' versions of the same language. The language differences are generally straightforward; incompatible languages are easily adjusted to run on the B 700 systems.

PERFORMANCE AND COMPETITIVE POSITION

The wide variety of peripherals and software that the B 700 Series supports permits the Burroughs line to compete with a large number of disc processing small business computers (as well as other members of Burroughs' own product line). Burroughs' primary marketing emphasis for its packaged B 700 Series is directed against IBM's System/32. Although the System/32 is a Johnny-come-lately to the small business market, it is the keyboard-oriented disc processing system that is setting the trend for the small business market. In basic system prices, Burroughs has priced the basic B 700 (at $33,900) below the price for an IBM System/32 with a 32K memory ($41,600).

All of the packaged B 700 systems can have up to four operators' positions without making use of the Burroughs off-line data entry stations, the AE 301, AE 306, or AE 501 Audit Entry Computer. The AE 306, which uses a tape cassette for storage, can be obtained as part of a packaged configuration ($43,800 for a basic B 709 Audit Entry System) or as a stand-alone unit ($7,490). The AE 501, which is a new version of the AE 301 and 306, has a 60 character-per-second printer, 16K bytes of memory, and a tape cassette unit. Asynchronous or synchronous communications are optional offerings with the AE 501.

Without the IBM 3740 Diskette Data Station (used off-line or on-line as an optional device when attached to a bi-sync communications adapter), the IBM System/32 offers only one operator position. With the 3740 Data Entry System (3741 Model 1, $6,000; 3741 Model 2, $7,250; 3741 Model 3, $8,600; and 3741 Model 4, $9,850), the System/32 can add another operator's position and store input data on a diskette.

Both the B 700 and System/32 operate under a control program that performs operating system functions; such utilities as sort and data conversion are equivalent. Roughly corresponding turnkey software packages exist for both systems. System/32's Industry Application Packages (IAP) offer RPG II programs for construction, medical, membership and food industries. A new application package has been announced for System/32. The Manufacturing Management Accounting System (MMAS) includes nine separate manufacturing applications. The B 700 Series offers six basic turnkey packages written in RPG or COBOL. B 700 packages that are not matched by System/32 packages include the tire, battery, and accessory modules and the fuel oil package.

Major factors considered, the B 700 Series offers cost and functional features that match and outdistance most of

those offered by its most formidable competitor, IBM's System/32.

Other disc-based small business systems that the packaged B 700 competes with are the NCR 399, NCR 8200, Basic/Four System, and Qantel System. All of these systems offer between 16 and 48K bytes of user memory and between 4.2 and 120 million bytes of disc storage. Purchase prices for these systems do not range above $45,000 for configurations equal to those offered in the B 700 Series.

Properly configured, the Burroughs L 8000 Series competes with some models of the packaged B 700 Series. The L 8000 Series is primarily designed as a visible record computer for those businesses that prefer to deal with magnetic stripe ledger cards. The L 8000 is similar to the B 700 in many ways, except it does not support disc.

Competing with the B 704, B 709, B 713, and B 723 are the Honeywell 61/58 and the IBM System/3 Model 6. The NCR Century 50-1 and the Honeywell 2020 traditionally have been considered B 700 competitors. However, the newly repackaged B 700 models seem to have eliminated these two systems from the scope of their competitive market.

Burroughs sees the Honeywell 61/58 and System/3 Model 6 competing with the B 709. A basic B 709 unit with 32K bytes of memory, 145 millisecond access time, disc drive, tape cassette drive, 85 line-per-minute printer, and the AE 306 Audit Entry System sells for $43,800.

A Honeywell 61/58 multistation disc unit with 10.2K bytes of memory, removable 5.76 million bytes of disc storage and card console unit sells for $91,400.

In the family of keyboard-oriented disc processing systems, the B 709 also competes against the IBM System/3 Model 6. The System/3 Model 6 is limited to 16K memory and one operator position (plus one on-line operator position on the 3741 Data Entry Station). The price for a System/3 Model 6 configuration with 16K memory, 2.45 million bytes of disc storage and printer is $35,900.

CONFIGURATION GUIDE

Regardless of functional orientation, packaged configurations B 702 through B 713 include at least 32K bytes of core memory, a console, and a removable disc cartridge drive with 4.6 million bytes of storage. The processor logic, memory, peripheral controls, and power supplies are all included in one cabinet. The B 723 includes 32 to 96K bytes of MOS memory, a console, a MICR reader/sorter control, a 160 lpm printer, and 80 ms disc drive. A B 720 Communications Processor may be optionally connected to a B 723.

There are three processors for the B 700 Series: the B 705, the B 711, and the B 721. The B 705 processor is available to the user; however, it is not used in any packaged configurations. The processors, or basic systems, as Burroughs designates them, are distinguished as follows:

- B 705 has a 2-microsecond cycle time; word size is an 8-bit byte. It has 16K bytes of core memory and eight I/O ports.
- B 711 has a 1-microsecond cycle time; word size is an 8-bit byte. It has 16K bytes of core memory and eight I/O ports.
- B 721 has a 1-microsecond cycle time; word size is an 8-bit byte. It has 32K bytes of MOS memory and six I/O ports.

Two buffered I/O controls (the minimum number per processor) may be expanded to six I/O controls on packaged configurations, except for the B 713, which has 8 I/O controls and the B 723, which has 11 I/O controls. Each control operates one I/O unit, except for those that control the dual disc drives. The 702, 703, 704, 709, and 713 provide for single-line data communications. The data communications processor used with the B 723 model can handle up to four data communications lines.

Packaged configurations (B 702, B 703, B 704, and B 709) are designated by model number as well as line print speed; for example, B 702-085 denotes an 85 line-per-minute printer as part of the configuration and B 702-160 denotes a 160 line-per-minute printer as part of the configuration. The B 713 is designated solely by model number. The packaged financial model, B 723, is designated as the B 723-036 and B 723-035.

The following is a list of models that Burroughs designates as the packaged B 700 systems:

- B 702-085 and B 702-160. Both are entry-level systems with 32K bytes of memory, an operator's console (includes 20 cps printer and keyboard), 85 or 160 lpm printer, and 4.6M-byte dual cartridge disc with 145-msec disc drive.
- B 703-085. A data-entry terminal with 32K bytes of memory, an operator's console (includes 20 cps printer and keyboard), 85 lpm printer, 4.6M-byte dual cartridge disc with 145-msec disc drive, and one TD 700 Input and Display Unit. Up to three more TD 700s can be added.
- B 704-085 and B 704-160. Both are data entry terminals with 48K bytes of memory, an operator's console (includes 20 cps printer and keyboard), 85 or 160 lpm printer, 4.6M-bytes dual cartridge disc with 145-msec disc drive, and two TD 700 Input and Display Units. Two more TD 700s can be added.
- B 709-085 and B 709-160. Both are audit entry systems that use the AE 306 Audit Entry Computer for off-line audit entry. The B 709 is equipped with 32K bytes of memory, an operator's console (includes 20 cps printer and keyboard), 85 or 160 lpm printer, 4.6M-bytes dual cartridge disc with 146-msec disc drive, and a 9-track, 800 bpi magnetic tape unit.
- B 713. This is a model with 32K bytes of memory, an operator's console (includes 20 cps printer and keyboard), 160 lpm printer and 4.6M-byte dual cartridge disc with an 80-msec disc drive.
- B 723. This is a financial system with 32K bytes of MOS memory expandable to 96K bytes, an operator's

console (with 20 cps printer and keyboard), a 160 lpm printer, 80-msec disc drive, and a MICR reader/sorter.

PERIPHERALS

Peripherals for the B 700 Series include both slow-speed and high-speed devices. There are also several L 8000 peripherals available for use on the B 700 Series. See Table 2 for a general comparison between B 700 peripherals and L 8000 and B 1700 peripherals.

Table 2. Burroughs B 700 Series: Peripheral Devices

B 700 Device	Compatible with L 8000	Compatible with 1712/1714/ 1728
B 9343 Console	Yes	No
AE 300 and AE 500 Audit Entry Computer	No	Yes
TD 700	Yes	Yes
TD 800 CRT Display & Keyboard	No	Yes
Disc Cartridge		
A 9480 (4.6 MB)	No	Yes
A 9481 (9.2 MB)	No	Yes
Mini-Disc	Yes	Yes
Magnetic Tape Cassette	No	Yes
A 9490-25 (240,000 char, 800 bpi, 10 ips)	Yes	Yes
A 9491-2 (9-channel, 800 bpi, NRZI, 10KB)	No	Yes
Line Printers		
A 9249-1 (85 lpm, 132-char print line)	Yes	Yes
A 9249-2 (160 lpm, 132-char print line)	Yes	Yes
A 9249-3 (250 lpm, 132-char print line)	Yes	Yes
B 9247-2 (400 lpm, 120- or 132-char print line)	No	Yes
B 9247-3 (750 lpm, 120- or 132-char print line)	No	Yes
Card Reader		
A 9114-1 (80-col, 200 cpm)	Yes	No
A 9115-1 (80-col, 300 cpm)	No	Yes
A 9116-1 (80-col, 600 cpm)	No	Yes
A 9119-1 (96-col, 300 cpm)	No	Yes
Card Reader/Punch/Data Recorder		
A 9419-2 or -6 (96-col, 300/600 cpm)	No	Yes
Paper Tape Reader		
A 9122	No	No
Paper Tape Perforator		
A 9222-1	No	No
MICR Reader/Sorters		
A 9135 (8 or 12 pockets, 900 doc/min)	No	Yes
A 9136 (8 or 12 pockets, 600 doc/min)	No	Yes

Slow-Speed Peripherals

Slow-speed peripherals for the B 700 include 80- and 96-column card readers, a 96-column card reader/punch, and line printers of various speeds. Punched paper tape reader and punch and MICR units (600 or 900 documents per minute) are also available.

High-Speed Peripherals

High-speed peripherals for the B 700 include magnetic tape units and discs. The magnetic tape drive is 9-track tape with 800 bits per inch; a maximum of four drives per system can be used. The magnetic tape cassette holds 96K bytes and operates at 30 inches per second; a maximum of four cassette drives per system are allowed.

Total disc capacity of the B 700 Series is 36.8K bytes. Dual disc drive A 9480-12 stores 4,667,120 bytes in 180 byte segments; up to four dual disc drives can be used on each system. A 9,354,240-byte drive (A 9481-12) is available for use on the B 711 and B 720; up to four drives can be used for a total of 36.8 million bytes of disc storage.

A new floppy mini-disc, the B 9489-15, which is industry compatible, has been announced by Burroughs for use with the B 700 models. It can only be used in addition to the freestanding disc drive — not in lieu of it.

Special-Purpose Peripherals

The AE 300 Audit Entry Series is composed of stand-alone units for off-line data entry preparation. It is packaged for use with the B 709, and can be used optionally with the other B 700 Systems. The AE 301 and AE 306 Audit Entry Systems furnish a journal that chronicles data input, audits it, and provides a magnetic tape cassette to record data. Programs are loaded into the AE 301 and AE 306 via the magnetic tape cassette.

The AE 501 Audit Entry Systems represent upgraded versions of the AE 300 systems. While the systems also use magnetic tape cassettes to capture clean data and provide for software loading, the AE 501 adds a 60 character-per-second line printer and asynchronous or synchronous communications.

DATA COMMUNICATIONS

Single-line communications are available with the B 702, B 703, B 704, B 709, and B 713 models. The single line uses two I/O ports and interfaces to the system via a B 351-1 Communications Interface. The single line allows for up to nine TD 700 or 800 terminals (all 9 terminals can be used for on-line inquiry; however only 4 of the 9 terminals can be used for updating), or local connection to a host mainframe. Burroughs is planning to offer a switching arrangement in the future, so that both the terminals and the communications capabilities can be used alternatively.

In a local connection environment, data transfer via single-line communications can be made from up to 1000 feet away in synchronous or asynchronous mode at rates up to 9600 bits per second. Also, a B 700 can use a modem to connect to another B 700 and transfer data at up to 4800 bits per second synchronously.

Data communication on the B 720 models is handled by an optional Communications Processor Subsystem. A

programmable communications processor, the B 352, can handle up to four concurrent communications lines for terminals (local or remote) or connection to the host mainframe. Transmission is in a synchronous or asynchronous mode at 75 to 9600 bits per second. Burroughs and IBM binary synchronous communications are slated for the near future.

Future plans for data communications on the B 700 include the implementation of the Burroughs B 771 system and communications processor on all the models of the series. Also, the B 771 interface will be used to provide IBM 3780 HASP-type remote job entry (RJE) communications for the B 700.

SOFTWARE

The B 700 operates under the control of the Supervisory Control Program (SCP), which is primarily a serial batch operating system (one job at a time). The data entry models (B702, 703, and 704), however, can handle up to four interactive jobs (terminals) through memory partitioning. This allows for simultaneous entry functions on these models. The B 700 Series SCP reads programs to the systems' disc before they are executed. The disc system on the B 700 allows for faster processing than is available with the magnetic tape system on the L 8000.

The SCP handles interrupts (I/O and operator), I/O transfer (including parallel I/O), and checkpoint/restart (which Burroughs calls "interrupt/resume"). The checkpoint/restart facility means that an executing program, including a utility or sort, can be temporarily suspended. Another program can then be invoked and executed. The first program can be resumed afterwards without omission or duplication of any function.

Available software functions on the B 700 Series include a sort program and various data conversion utilities. RPG and COBOL compilers on the B 700 are compatible with Burroughs L series and B 1700 systems. Burroughs' upward-compatible Network Definition Language (NDL) serves the B 720 systems as a conversion-interface between the user and the data communications environment.

There are 12 basic turnkey packages, written in RPG or COBOL, that are supported by Burroughs on a nationwide basis. They are:

- Business Management System (BMS)
- Commercial Business Management System (Keyboard Oriented)
- Hospital Business Management System
- Contractor Business Management System
- Credit Union Business Management System
- Manufacturing Business Management System (Job Cost Module)
- Bank Business Management System
- Thrift Business Management System (for Savings and Loan institutions)
- On-Line Order Entry System
- Production Control System (PCS I)
- Fuel Oil Package
- Automotive Modules (Tire, Battery and Auto Accessories)

A total collection of more than 350 software modules exists for use with the B 700 Series, each of which performs a single common business function. The main body of B 700 software is report oriented. Its data base is key oriented, which makes report production and cross-referencing simpler.

Software modules are interchangeable within a given system. For example, a hospital payroll subsystem may require the same deductions that a wholesaler's payroll subsystem requires. The same BMS module can satisfy the needs of both users. Therefore, either a complete package or parts of packages can be purchased and mixed. When the user buys part of a package, i.e., buys only the modules required, the rest of the software may be written using the RPG or COBOL compiler; or it may be obtained as a customized module from Burroughs or independent software houses. Also, over 70 different types of unsupported software packages are available from Burroughs district offices.

MAINTENANCE

Burroughs offers a basic maintenance contract for its hardware and software. This contract calls for maintenance during regular business hours 5 days a week. Contracts are also available for overtime hours and round-the-clock service. Unlimited usage of the Burroughs equipment is part of the service agreement.

There are more than 300 Burroughs field and engineering offices across the country.

PRICE DATA

Model Number	Description	Purchase Price $ (Maint. not incl)	Monthly Maint. $	Rental (1-yr) lease)* $
Packaged B 700 Systems				
The following systems include processor, system console/printer, 4.6MB dual-cartridge disc drive, and the required peripheral controllers.				
B 702-085	Data Entry System (processor with 32KB core memory, 145-msec disc drive, 85-lpm printer, and items noted above)	33,900	180	858
B 702-160	Data Entry System (same as B 702-085 but with 160-lpm printer)	37,800	211	1,053
B 703-085	Data Entry System (same as B 702-085 with the addition of one TD 700 Input & Display Unit)	39,300	228	1,084
B 704-085	Multistation Entry/Inquiry System (processor with 48KB core memory, 145-msec disc drive, 85-lpm printer, 2 TD 700s, and items noted above)	43,900	256	1,221
B 704-160	Multistation Entry/Inquiry System (same as B 704-085 but with 160-lpm printer)	46,600	271	1,289
B 709-085	Audit Entry System (processor with 32KB core memory, 145-msec disc drive, tape cassette drive, 85-lpm printer, AE 306 Audit Entry Computer System, and items noted above)	43,800	255	1,216
B 709-160	Audit Entry System (same as B 709-085 but with 160-lpm printer)	46,500	270	1,284

PRICE DATA (Contd.)

Model Number	Description	Purchase Price $ (Maint. not incl)	Monthly Maint. $	Rental (1-yr) lease)* $
B 713	Basic System (processor with 32KB core memory, 80-msec disc drive, 160-lpm printer, and items noted above)	54,900	318	1,515
Packaged B 720 Systems				
The following systems include MOS main memory, 11 I/O control attachments, 160-lpm printer, 80-msec disc drive and system console/printer.				
B 723-035	System (with 32K bytes of main memory and B 9136 600-dpm MICR Reader/Sorter)	105,000	NA	2,350
B 723-036	System (with 96K bytes of main memory and B 9135 900-dpm MICR Reader/Sorter)	132,580	NA	3,214
Basic Models (processors)				
B 705	Processor (with 16K bytes of core memory)	15,425	70	420
Memory Options for B 705 Processor				
B 11-32	32K Bytes Total Memory	5,300	16	122
B 11-40	40K Bytes Total Memory	9,000	24	180
—	Upgrade, B 705 to B 711	5,225	—	180
B 711	Processor (with 16K bytes of core memory)	20,650	80	600
Memory Options for B 711 Processor				
B 11-32	32K Bytes Total Memory	5,300	16	122
B 11-40	40K Bytes Total Memory	9,000	24	180
B 11-48	48K Bytes Total Memory	10,600	32	205
B 721	Processor (with 32K Bytes of MOS memory)	24,550	105	651
B 312	I/O Expansion Unit	1,500	8.40	40
Packaged B 770 Communications Systems				
B 771	Basic System (includes B 711 Processor, 16KB memory, I/O base, console printer/keyboard control, console table, single-line control)	19,255	85	550
B 772	Basic System (includes B 711 Processor, 16KB memory, I/O base, console printer/keyboard control, console table, single-line control, disc cartridge control)	22,865	104	654
Memory Options for B 770 Processors				
B 11-24	24,576 Bytes Total Memory	3,200	8	92
B 11-32	32,768 Bytes Total Memory	5,300	16	122
B 11-40	40,960 Bytes Total Memory	9,000	24	180
B 11-48	49,152 Bytes Total Memory	10,600	32	205
B 253	Single-line Control for TD 700 Inquiry Station	1,540	10	35
A 1306	I/O Expansion feature (for 8 devices total; for upgrading a package)	1,000	4	25
B 9343-1	15" Console Printer and Keyboard	5,500	21	143
B 9343-2	26" Console Printer and Keyboard	7,500	24	160
B 9344	Console Printer and Keyboard	2,640	16.20	55
Mass Storage				
A 9480-12	Dual Cartridge Drive (4.6MB)	15,450	53	365
A 9481-12	Dual Cartridge Drive (9.2MB)	21,600	72	480
B 489	Control for A 9480-12, B 9480-17	675	14	19
B 489-1	Control for A 9481-12	1,200	14	38
B 9480-17	Dual Cartridge Drive (2.3MB)	12,000	53	345
B 9489-15	Mini Disc	3,950	13	110
B 379	Control for B 9489-15	1,000	1	23
Magnetic Tape Equipment				
A 9490-25	Magnetic Tape Cassette (30 ips)	1,940	6.41	55
A 9491-2	Magnetic Tape Unit (9-track, 800 bpi, 10KB)	8,600	21	215
B 391	Control for A 9491-2	1,250	30	30
B 392	Control for A 9490-25	800	3	24
80-Column Card Equipment				
A 9114-1	Card Reader (200 cpm)	2,790	21.41	78
A 9115	Card Reader (300 cpm)	4,900	31	130
A 9116	Card Reader (600 cpm)	6,890	44	206
B 111	Control for A 9114-1	750	5	22
B 115	Control for B 9115, B 9116	880	7	22
B 9418-2	Reader/Punch/Recorder (200 cpm read, 45 cpm punch/print)	10,990	83	280
B 311	Control for B 9418-2	850	2	25
B 9918-5	Four Additional Program Levels for B 9418-2	500	1	10
96-Column Card Equipment				
A 9419-1	Card Reader (300 cpm)	3,500	25	85
A 9419-2	Card Reader/Punch/Data Recorder (300-cpm reader, 60-cpm punch/print)	9,490	71	240
A 9419-6	Card Reader/Punch/Data Recorder (300-cpm reader, 60-cpm punch/print, 6-pocket sorting)	11,390	85	285
B 311	Control for A 9418-2, B 9419-1, A 9419-2, or A 9419-6	850	2	25
PC 920	Printing Data Recorder (off-line keypunch)	8,050	45	163
Line Printers				
A 9249-1	Printer (85 lpm, 132 positions)	8,500	60	240
A 9249-2	Printer (160 lpm, 132 positions)	11,200	70	280
A 9247-2	Printer (400 lpm, 120 positions)	19,500	100	460
B 9247-3	Printer (750 lpm, 120 positions)	39,000	189	935
B 9247-12	Printer (400 lpm, 120 positions)	20,500	100	485
B 9249-3	Printer (250 lpm, 132 positions)	15,000	94	375
B 243	Control for A 9249-1	625	5	16
B 243-1	Control for A 9249-2, B 9249-3	1,600	5	36
B 244	Control for A 9247-2, B 9247-3, B 9247-12	2,000	5	45
B 9942-2	Additional 12 Print Positions for A 9247-2, B 9247-3, & B 9247-12	2,000	10.80	40
B 9942-9	Additional Print Train Module for A 9247-2, B 9247-3, & B 9247-12	3,500	18	65
B 9948-1	12-Channel Format Tape Option for B 9249-1 & B 9249-2	1,200	—	30
B 9949-2	12-Channel Format Tape for A 9247-2, B 9247-3 & B 9247-12 (required)	3,050	15	61
Paper Tape Equipment				
A 9122-1	Punched Paper Tape Reader (40 cps)	1,490	9.92	42
A 9222-1	Punched Paper Tape Punch (40 cps)	1,890	12.58	53
B 121-1	Control for A 9122-1	750	2	22
B 221	Control for A 9222-1	750	2	22
Data Entry Subsystem				
AE 301	Audit Entry Computer Basic System (off-line)	6,990	61	240
AE 306	Audit Entry Computer (off-line); includes 15-1/2 in. carriage and one A 9490-25 Cassette Tape Station	7,490	61	250
AE 501-100	Audit Entry Computer (off-line; 16KB of memory, 60 cps printer, 1 A 9490-25 Cassette Tape Station)	9,940	61	295
AE 501-200	Audit Entry Computer (includes all of the AE 501-100 items and asynchronous data communications processor)	10,980	61	305
AE 501-300	Audit Entry Computer (includes all of the AE 501-100 items and synchronous data communications processor)	11,480	65	315
Magnetic Ink Character Recognition (MICR) Units				
B 9135-2	Reader/Sorter (8 pockets)	45,500	431	1,000
B 9135-3	Reader/Sorter (12 pockets, 900 dpm)	55,900	467	1,300
B 9136-5	Reader/Sorter (8 pockets, 600 dpm)	34,000	225	700
B 9135-6	Reader/Sorter (12 pockets, 600 dpm)	39,000	270	850
Input and Display Terminals				
TD 701	SELF-SCAN Display & Control	2,840		71
TD 801	CRT Display/Control (960 char)	3,725		87
TD 802	CRT Display/Control (1,920 char)	4,465		112
TD 011	Typewriter-Style Keyboard	461		11
TD 011-1	Typewriter-Style Keyboard (same as TD 011 but used with TD 052)	461		11
TD 012	Keypunch-Style Keyboard	461		11
TD 012-1	Keypunch-Style Keyboard (same as TD 012 but used with TD 052)	461		11
TD 013	Numeric Keyboard	332		8
TD 021	Asynchronous Communications Interface (75/150/300/600/1,200/1,800 bps)	206		5
TD 022	Synchronous Communications Interface (2,400/4,800 bps)	206		5
TD 023	2-Wire, 9,600 bps Direct Connect	206		5
TD 031	Poll & Select Procedure	338		9
TD 032	Poll & Select w/Group Poll Procedure	410		10
TD 033	Point-to-Point Procedure	338		9
TD 034	IBM 2260 Procedure	500		13
—	Cables & Connectors (keyboard/display)	20-35		1
TD 052	Expanded (1,024-char) Memory for TD 700	500		13
TD 053	Asynchronous Data Rate Selection Dial	100		3
TD 054	"Y" Cable for Concatenation (per unit)	33		1
TD 070	Upper/Lowercase Char Set for TD 800	300		10
TD 071	Security Lock	125		4
TD 072	Field Upgrade, TD 801 to TD 802	1,000		25
TD 074	Interface for B 9354-6 Printer	180		5
B 9354-6	Printer	1,980		45

*Rental prices include equipment maintenance.

BURROUGHS CORP.

B 730 Series

The new B 730 Series is Burroughs' contribution to the growing number of workstation-based small business systems that are being spotlighted in the small systems marketplace. The B 730 Series, the successor to the long-standing B 700 Series of small business systems, is a disc-based system offering multiple-station direct data entry/inquiry — a feature that Burroughs never offered on the older B 700 models.

The B 730 Series is comprised of the following packaged models: B 731-102, B 731-104, B 731-304, B 731-404, and B 731-704. The standard B 730 processor, without any system devices, is referred to as the B 738; this model can be configured to fit the user's requirements. Effective immediately, the older B 700 models (B 702, B 703, B 704, B709, B713, and B 723) are subject to availability.

What's New?

In the area of basic system components, the B 730 offers the following enhancements:

- The console printer operates at 60 characters per second; the older models used a 20-character-per-second console printer.
- Metal Oxide Semiconductor (MOS) memory technology is offered for all models; among the older models, only the B 723 used MOS memory. Core was used for all other models.
- Maximum main memory capacity has been increased to 80KB; maximum memory on the B 702 to B 713 was 48KB. Maximum memory capacity on the B 723 was 96KB.
- Audit Entry Language (AEL) for data entry and editing has been introduced for the B 730 Series. COBOL and RPG II are available for programming on the B 730 Series.
- SCP II, a new version of the B 700 Series operating system

See Table 1 for system specifications.

Workstations are the Word

The B 730 places Burroughs one step ahead of its competitors. Rather than the usual "either/or" capability in terms of off-line or on-line data entry devices, the B 730 offers devices for both modes of data entry. This free choice of devices is important to the small business user who needs several data entry options to choose from when tailoring his DP system to his business structure.

For off-line data entry, the B 730 systems can accept magnetic tape cassettes from the Burroughs audit entry systems, the AE 300 and 500 Series, or from the Burroughs L Series. For on-line data entry, the B 730 systems can use the operator's keyboard on the B 730 console for up to nine TD 700s or 800s and up to four Direct Data Entry Stations (DDES).

The Burroughs folks say that the new DDES (B 9347-2), in conjunction with AEL, is just the thing for data entry. The DDES combines the famous Burroughs keyboard (similar to that of the L Series) and a 256-character SELF-SCAN® panel display. AEL, designed with the novice DP user in mind, is supposed to be easy enough to learn in several hours.

NEW COMPETITIVE CHALLENGES

The Burroughs B 700 family of small business systems has been a serious and aggressive competitor in the small systems market since 1973, and now with the introduction of the B 730 Series it is reinforcing its commitment to serve the market, while providing the B 700 with a mid-life kicker in price and performance.

The essence of the B 730's new capabilities lies in the Direct Data Entry Station (DDES). Following the lead of several other manufacturers that have introduced multiple-station data entry capabilities, Burroughs now offers the user a system that will allow up to four operators to key in data from DDES's. Burroughs points out that because the SCP II operating system and the DDES manager handle DDES functions, there is not the resource overhead usually associated with multiprogramming operating systems. Thus, there is little noticeable degradation when several operators are keying in data. It must be kept in mind, however, that the DDES's are designed for the purpose of entering data and inquiring into files, not for the purpose of interactive file updating. Burroughs believes that most businesses will be served by the transaction input capabilities of the B 730 and DDES.

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HEADQUARTERS

Burroughs Corporation
Burroughs Place
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Table 1. B 730 Series: System Specifications

CENTRAL PROCESSOR	
Cycle Speed (MHz)	1 (1 million cycles/sec)
Storage Technology	MOS
Main Memory Capacity (KB)	32-80
SYSTEM CONSOLE	
Keyboard	Alphanumeric and 10-key numeric
Special Function Keys	24
Matrix Printer (cps)	60
SOFTWARE	
Operating System	SCP II
Compiler	COBOL, RPG I, II
Data Entry Language	Audit Entry Language (AEL)
DATA COMMUNICATIONS	
Sync Single Line (bps) (B 351-1)	up to 9,600
Single Line (B 351-2)	3780 emulation

Even in the face of the introduction of Burroughs' newest small system, the B 80, the B 730s will undoubtedly remain an aggressive and strong product. While both products are in the same price range (the B 80 starts lower for a basic system, but full configurations of both products are in the same range), the B 730 offers the user a full range of peripheral products and proven application programs that the B 80 cannot offer at this point in time. For those users who want card and paper tape equipment, a variety of line printers, magnetic tape drives, the B 9347-2 DDES, or a wide range of application programs (banking, thrift, credit union, contractor, production control/manufacturing, manufacturing job cost, hospital, public utility, wholesale, commercial, and on-line order entry), the B 80 will not suffice. As the B 80 grows in capability, however, the B 700 systems will have to follow suit in order to keep from being swallowed.

The B 730 systems' primary competition will be the Basic/Four systems, the NCR 8200, IBM's System/3 Model 4, and Digital Equipment's Datasystem 350 Series. All of these systems offer the user the option of adding multiple data entry stations of varying capabilities. The choice between systems depends heavily on the user's requirements and language preference. Also, the user will want to take into consideration the growth potential of any system he chooses. Burroughs, NCR, and IBM systems offer clear and often compatible growth paths for the small system user.

CONFIGURATION GUIDE

The processor for the packaged and configurable B 730 systems includes:

- 1 MHz central processor.
- 32K bytes of MOS main memory.
- Six I/O ports.
- B9343-61 60-character-per-second console printer and keyboard.
- B346-3 console control.
- B489-5 disc drive control.

To this must be added at least one line printer and control and one dual disc drive (see PERIPHERALS for listings of printers and disc drives). And for the use of a B 9347-2 Direct Data Entry Station, at least 40KB of main memory is needed.

There are five standard packaged B 730 systems. They are the B 731-102, B 731-104, B 731-304, B 731-404, and the B 731-704. Refer to Table 2 for their configuration requirements. In addition to these five B 730 packages, there is also a B 738. The B 738 is configured by the user; it would include at least a B 730 processor, the required line printer and dual disc drive, and any other B 700 peripherals, up to the maximum number of I/O ports.

Central Processor

The B 730 CPU contains both high-speed MOS (Metal Oxide Semiconductor) memory and a microprogrammed interpreter for system functions. The interpreter is dynamic and its operation is transparent to the user. It reconfigures itself to include only the code needed to execute the application program at hand.

The central processor speed is one million cycles per second (1 MHz).

Main Memory

The B 730 systems are configured with 32KB to 80KB of MOS main memory, expanded in increments of 8K bytes.

For estimating main memory requirements, Burroughs offers the following guidelines:

- In DDES mode, approximately 16KB for System Control Program/Interpreter.
- 16KB for the B 9347-2 (DDES) manager.
- 16KB of memory for batch application programs.
- 1-2KB of memory for AEL programs implemented via DDES stations.

When DDES stations are not being used, the 16KB of memory for the 9347-2 manager can be implemented as user-program memory.

PERIPHERALS

All of the previously released peripherals for the B 700 Series are available for use with the B 730 Series. See Table 3 for a listing of these devices.

Data Entry Devices

The B 730 has the ability to accept data from both off-line and on-line devices.

System Console (B 9343-61). For on-line data entry. A B 730 system must be configured with a maximum of one console that includes an operator keyboard similar to that of the Burroughs L Series and the audit entry systems, and a 60-character-per-second matrix printer. The keyboard has buffered alphanumeric and numeric (10-key pad) keys,

Table 2. B 730 Series: Packaged Configurations

Description	B 731-102	B 731-104	B 731-304	B 731-404	B 731-704
STD PROCESSOR					
1 MHz Processor 6 I/O Ports	32K bytes of memory	32K bytes of memory	48K bytes of memory	48K bytes of memory	32K bytes of memory
B 9343-61 Console (keyboard + 60-cps printer)					
B 346-3 Console Control					
B 489-5 Disc Drive Control					
A 9480-22 Dual Disc Drive (4.6B, 145 msecs)	X	X	X	X	X
A 9249-1 Line Printer (85 lpm) and B 243 Printer Control	X				
A 9249-2 Line Printer (160 lpm) and B 243-1 Printer Control		X	X	X	X
B 351-1 Single-Line Control			X		
TD 701 Display + Control			X		
TD 011-1 Keyboard			X		
TD 023 Direct Connect			X		
TD 031 Poll/Select			X		
TD 052 Ext Memory			X		
B 9347-2 DDE Station				X	
B 354 DDE Control				X	
B 9490-25 Tape Cassette Drive + B 392 Control					X
AE 501-100 Audit Entry System					X

operator communications lights, and program keys. The printer has a 32-character buffer and 255 print positions, and can print an original and five copies. The console is equipped with a 26-inch forms handler.

Direct Data Entry Stations. The B 9347-2 Direct Data Entry Station (DDES) is a newcomer to the Burroughs product line. Up to four B 9347-2s may be interfaced to a B 730 for data input and inquiry. B 9347-2s cannot handle interactive file updating.

The B 9347-2 is equipped with a keyboard like that on the L Series, the audit entry systems, and the SELF-SCAN® display panel. Included on the keyboard are special function keys for program load, batch end, reset, error correct, delete (record), and insert new format. The SELF-SCAN® displays 256K characters and has a screen size of 9.2 by 3.4 inches.

The B 9347-2 uses the new "programmerless" Audit Entry Language (AEL) for data entry. Burroughs claims that AEL can be taught in a short amount of time to the novice DP user. It can be compiled on the B 730, and features strong editing capabilities.

TD Input and Display Systems. Up to nine Burroughs TD 700 and TD 800 displays may be connected to a single-line control for inquiry-only or inquiry and update.

Audit Entry Systems. The Burroughs AE 300 and AE 500 can be used for off-line data entry and data preparation. The AE 300s and AE 500s prepare magnetic tape cassettes for the B 730. Along with the magnetic tape cassette the AE systems prepare a printed audit journal of all data entered.

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L Series. Like the AE systems, the Burroughs L Series can prepare magnetic tape cassettes for the B 730. (See report 155.1885.080 in your service for a complete analysis of the L Series.)

Table 3. B 730 Series: Peripherals

AUXILIARY STORAGE		
A 9480-22	Dual Disc Cartridge Drive	4.6MB, 145 msecs
A 9480-12	Dual Disc Cartridge Drive	4.6MB, 80 msecs
A 9481-12	Dual Disc Cartridge Drive	9.2MB, 101 msecs
A 9490-25	Magnetic Tape Cassette Drive	
A 9491-2	Magnetic Tape Drive	10KB, 9-channel
A 9489-15	Mini-disc Drive	243KB
DISPLAYS		
TD 701	Terminal Display	256/1,024 char
TD 801	Terminal Display	960 char
TD 802	Terminal Display	1,920 char
PRINTERS		
A 9249-1	Line Printer	85 lpm
A 9249-2	Line Printer	160 lpm
A 9249-3	Line Printer	250 lpm
A 9247-12	Line Printer	400 lpm
CARD AND PAPER TAPE EQUIPMENT		
A 9114-1	80-column Card Reader	200 cpm
A 9115	80-column Card Reader	300 cpm
A 9116	80-column Card Reader	600 cpm
A 9418-2	80-column Card Reader /Punch/Recorder	
A 9119-1	96-column Card Reader	300 cpm
A 9419-2	96-column Card Reader /Punch/Recorder	
A 9419-6	96-column Card Reader /Punch/Recorder	
A 9122-1	Paper Tape Reader	40 cps
A 9222-1	Paper Tape Punch	40 cps

DATA COMMUNICATIONS

B 730 models can be equipped with two single-line controls (B 351-1 and B 351-2); only one line can operate at a time. The B 351-1 is for synchronous communications up to 9,600 bits per second between one B 700 system and another B 700 system, or for the direct connection (up to 1,000 feet) of nine TD terminals for inquiry or inquiry/update. The B 351-1 single-line control requires two I/O ports. When used for communications between two B 700s, one of the following data sets must be used: Burroughs TA 33, TA 34, Bell 201A, or 201B.

The B 351-2 is for bisync communications up to 9,600 bps between one B 700 system and another mainframe. Using the B 351-2, the B 730 operates in the 3780 look-alike mode.

SOFTWARE

The B 730 systems operate under the control of a new operating system, SCP II. SCP II permits the B 730 to handle one batch program and four data entry programs concurrently. Data entry programs initiated from DDES (B 9347-2) stations are monitored by the SCP II and the DDES manager. SCP II polls each workstation at the end of every 500 microseconds (or S-level instruction), checking for a character. If a character is found, the AEL program takes over. It then edits the data transmitted from the keyboard of the B 9347-2 to the B 730, and then transmits it back to the B 9347-2 stations to be displayed.

When a DDES initiates a file inquiry, the request is handled in a "breakout-resume" manner. Data entry from the DDES is suspended, and if a batch program is operating, the inquiry will cause the program to be interrupted and then resumed automatically after the inquiry is completed.

Languages

Like the other products in the "700 Systems Family," the B 730's programming languages are RPG I and II and COBOL. RPG and COBOL compilers on the B 730 are compatible with those for the Burroughs L Series and the B 1700 systems, thus ensuring the user a high degree of compatibility within the Burroughs small systems family. The B 730 systems also use an Audit Entry Language (AEL) language for data entry and editing.

AEL. AEL, Burroughs' language for the B 9347-2 stations, is used for data entry, editing, and interactive verification of account numbers with B 730 disc tag files. Editing features of AEL include:

- Check-digit verification.
- Alpha mode enforcement.
- Numeric mode enforcement.
- Field sizing.
- Parameter testing.
- Range testing.

AEL programs are not used for interactive inquires into disc files. These programs are written in COBOL.

Application Packages

Burroughs offers a library of nationally supported application packages. These include packages for the wholesale/distribution, banking, thrift, hospital, and governmental fields.

PRICE DATA

		Purchase Price (Maint. not Included) $	Monthly Lease 1 Yr	Monthly Lease 3-5 Yr	Monthly Maint. $
B 730	Processor with 32KB main memory B 9343-61 Console B 346-3 Console Control B 489-5 Disc Drive Control Wiring for 80KB memory 6 I/O Ports	19,900	569	541	168.85
B 31-8	8KB Memory Modules (8,192 bytes)	2,280	60	57	9.40
B 9347-2	Direct Data Entry Station	4,990	125	119	19.00
B 354	Control for 9347-2	1,050	26	25	3.65
B 312-3	I/O Expansion	1,990	57	54	13.00
B 489-5	Disc Drive Control	675	25	24	10.30
Packaged Systems					
B 731-102	B 730 Processor with 32KB main memory A 9480-22 Disc Drive A 9249-1 85-lpm Printer B 243 Printer Control	34,900	997	947	214.00
B 731-104	B 730 Processor with 32KB main memory A 9480-22 Disc Drive A 9249-2 160-lpm Printer B 243-1 Printer Control	37,900	1,083	1,028	239.00
B 731-304	B 730 Processor with 48KB main memory A 9480-22 Disc Drive A 9249-2 160-lpm Printer B 243-1 Printer Control B 351-1 Single-Line Control TD 701 Display/Control TD 011-1 Keyboard TD 023 Direct Connect TD 031 Poll/Select TD 052 Extended Memory	44,900	1,283	1,219	289.00
B 731-404	B 730 Processor with 48KB main memory A 9480-22 Disc Drive A 9249-2 160-lpm Printer B 243-1 Printer Control B 9347-2 DDE Station B 354 DDE Control	45,900	1,311	1,245	284.00
B 731-704	B 730 Processor with 32KB main memory B 9480-22 Disc Drive A 9249-2 160-lpm Printer B 243-1 Printer Control A 9490-25 Tape Cassette Drive B 392 Tape Cassette Control AE 501-100 Audit Entry System	48,900	1,397	1,327	299.00

OVERVIEW

Burroughs B 1700 Systems are a range of small business general-purpose computers aimed at both small businesses and larger firms that need satellite data processing installations.

Characterized as the 1710 Series and the 1720 Series, the individual models in the series are: B 1712, B 1714, B 1716, in the 1710 Series, and B 1718, B 1726 and B 1728 in the 1720 Series. Essential differences among the models are in processor cycle rate, size range of main memory, and available peripherals. The B 1720 Series models also have control memory that operates at four times the speed of main memory. (Control memory is used to store sequences of microinstructions which perform the macrooperations of high-level languages).

Peripheral equipment available includes 80- and 96-column card readers and punches, 96-column card sorters, and multifunction units, disc units, line printers, magnetic tape units, a data communications interface, and a console printer. Also available is a series of MICR document reader-sorters, which are of special interest for banking applications. All devices are buffered; up to 10 individual I/O controls are available on models in the 1710 Series and 14 on models in the 1720 Series.

Two versions of the Master Control Program (MCP) operating system exist for the 1700 Series, MCP I and MCP II. Designed for the entry level systems (B 1712, B 1714), MCP I is a serial batch programming system. MCP II provides a multiprogramming environment for any of the 1700 Series systems. As far as operating systems go, MCP II is better than any competing operating system for increased throughput without unnecessary overhead.

Burroughs supplies a comprehensive library of business management software (BMS) for customers who do not have or cannot afford to develop their own software. The BMS package is functionally general enough so that it can be tailored to almost any user environment. This generality, however, has resulted in some user complaints in relation to slow processing.

The programming languages available are COBOL, BASIC, FORTRAN, and RPG. The language compilers in each case generate "s-code," Burroughs' version of machine language. The s-code is then executed by interpreters for each language. RPG is handled somewhat differently; the RPG compiler generates COBOL s-code, which is then executed by the COBOL interpreter.

Variable word length, instruction length, and operand length are features at the s-code level, the Burroughs word (or "unit") can be defined as one to 65,535 bits (8,191 characters). This flexibility allows improved utilization of available space and faster execution. In regard to space savings, Burroughs claims a 20 to 40 percent reduction in the amount of memory needed to execute programs. Users of variable word length machines from other manufacturers report space savings of as much as 70 percent. Burroughs' 40 percent is probably a conservative estimate.

CONFIGURATION GUIDE

Tables 1 and 2 show the variations in processor speed, memory size, and supported peripherals of the six B 1700 series models. They also contain configuration information. A minimum entry configuration for the B 1700 series could include a B 1714 with 16,384 bytes of memory, an A 9350 console printer, an A 9419-2 96-column reader-punch (300/60 cards per minute), an A 9245-16 32-column line printer, and A 9480-2 dual disc cartridge file (4.6 million bytes). Every system must include a console printer and a disc subsystem.

Expansion within the series is eased by add-on memory modules and compatibility of peripherals. The 1720 series will not handle the 1710 series slow-speed printers. Head-per-track discs are not available on the 1712 and 1714 models. Nine-track tapes (1,600 bits per inch) are optional on the 1720 models.

Expansion to larger computers in the Burroughs 700 series (the B 2700, B 3700, and B 4700) is eased by the fact that the larger computers are designed to run in a similar multiprogramming environment. They also accept without modification the higher-level languages, especially FORTRAN and COBOL, that can be run on the B 1700s.

Upgrading from Burroughs' commercial minicomputers and the B 500 systems is eased by their high-level language programs that will run on the B 1700 and make full use of the B 1700 configurations. B 300 programs can run under an emulator.

PERFORMANCE AND COMPETITIVE POSITION

B 1700 is well suited for the typical scope of small business data processing needs. The provision of customer-oriented software packages, and the high-level language compatibility with the 700 series computers make the B 1700 an excellent entry system for a small business or for a large firm that requires satellite data processing installations. The interfaces possible between computers in the 700 series in a communications environment, and the compatibility of other peripherals establish the B 1700 as a growth system. The multiprogramming facilities, albeit limited, are an encouraging step in a small system.

Burroughs is marketing the B 1710 series as implicit competition for the IBM System/3. Similar to System/3, Burroughs offers both 80- and 96-column card peripherals and data preparation equipment. Both systems offer BASIC, RPG, FORTRAN, and COBOL. IBM also offers

ASSEMBLER and a desk calculator. Burroughs, however, is aiming at the COBOL market; this is indicated by the facts that RPG is interpreted by the COBOL interpreter for the B 1700, and that Burroughs offers COFIRS (COBOL from IBM RPG Specifications), which is designated to automatically convert IBM's RPG to Burroughs' COBOL.

Multiprogramming can be done in both series. Burroughs' operating environment is suitable for multiprogramming because of the larger available core capacity and better space allocation. On the System/3 Model 10, IBM realistically offers two levels of multiprogramming as an option. Both systems apply variations on the theme of virtual memory. The System/3 Model 6 employs disc storage, and swapping to handle Basic programs that would not normally fit into main storage. The B 1700 MCP II uses a paging technique of programmer-defined or compiler-defined segments to accomplish a similar end.

Both systems have communications capabilities. The configuration of Burroughs' communications system should be greatly facilitated by the use of the Network Definition Language (NDL), a high-level language originally designed for the medium systems in the 700 series.

A major difference, from the user's point of view, is that source code on the B 1700 is upward compatible with the rest of the 700 series. This is not the case with System/3 code or data files.

The B 1700 is currently the second smallest system in the 700 series of computers. The Burroughs chain now extends from the L Series terminal computers introduced in 1968 through the B 700 and B 1700 small business computers to the B 2700, 3700, 4700, 5700, 6700, and 7700 medium- and large-scale computers. All are programmable in COBOL; most of the computers operate in multiprogramming mode and share many of the same peripherals. This enables expansion within a computer line that ranges from the very small to the very large.

MAINFRAME

All systems in the B 1700 series use large-scale integrated (LSI) circuit main memory. This small-size, high-density circuitry is faster, more reliable, and more easily maintained than conventional magnetic core. Main memory operates with a 666-nanosecond cycle time; control memory (B 1726) cycles in 167 nanoseconds. These speeds are significantly faster than the speeds of most competitive systems.

PERIPHERALS

Tables 1 and 2 contain peripheral device characteristics and configuration information for the three B 1700 series models.

Slow-Speed Peripherals

The operator's console features a built-in magnetic cassette unit intended for the initial entry of systems software and, when needed, the entry of diagnostic software.

The card reader controls will allow a dynamically determinable card size; for example, the readers will handle only 36 columns of a card instead of the full 80 or 96.

A new series of MICR document reader-sorters provide eight to 12 distribution pockets and sorting speeds of 600 or 900 documents per minute, or four to 16 pockets at 1,000 or 1,625 documents per minute.

High-Speed Peripherals

Disc storage is available in three different forms; their respective capacities and access times appear in Table 1. Suitability for on-line random access is relative to access time, with the cartridge disc file least suited and the head-per-track disc best suited. The latter is available on the B 1716, B 1718, B 1726 and B 1728.

Magnetic tape equipment is a subset of the equipment that is offered for the larger 700 series computers. Both high-speed and slow-speed tape units and slow-speed tape clusters are available for B 1700.

DATA COMMUNICATIONS

For data communications, the B 1700 can interface with other models in the series and with larger Burroughs 700 systems, either as a "host" or a remote batch collection terminal system. The data communications single-line control option can handle up to two lines on the B 1714 and three lines on the B 1726. Synchronous or asynchronous lines, that operate at a maximum of 9,600 bits per second, can be controlled. The 1700 is best suited for remote terminal processing for a larger central computer. Presently the option is capable of operation with all Burroughs data communications terminals (namely, the TC, RT, and TU series). Burroughs states that the option later will be expanded to include standard synchronous and asynchronous communications conventions of other manufacturers' terminals.

The Network Definition Language (NDL) enables users to define and generate network control programs tailored to their particular requirements. Another communications-oriented program product is UPL (User Programming Language). UPL is intended for systems programmers and is a problem solving language for message handling. The B 1700 Series can support multiple-line communications networks.

Table 1. Burroughs B 1700: Series Comparison and Configuration Information

Characteristic or Device	B 1712	B 1714	B 1716	B 1718	B 1726	B 1728	Comments
Processor Speed (msec)	0.5	0.25	0.25	0.25	0.125	0.125	
Memory Size (bytes)	16-40K	16-65K	32-65K	32-65K	24-98K	65-262K	
Increment Sizes	8K	8K	8K	8K	8K to 65K; 16K to 98K	16K	On the 1726, main memory increments replace the basic configuration memory. MOS/LSI semiconductor.
Control Memory	—	—	—	—	X	X	2K or 4K available for 1726.
9340 Console Printer & Control	X	X	X	X	X	X	Required.
Maximum No. of I/O Channels	8	8	10	10	10	14	
HIGH-SPEED PERIPHERALS							
Direct Access Devices							At least 1 dual drive required. Max 2 for 1714, unless MICR reader/sorter is used, then max 1. Need I/O expansion feature when 2 disc subsystems or when 1 disc and 1 MICR are used.
9480 Single Disc Cartridge Drive (2.3 or 4.6 mb; 90 msec)	X	X	X	X	X	X	Data in cartridges is recorded in 180-byte segments; avg head positioning is 60 msec; rotational delay 20 msec; transfer rate is 193 kb/sec.
9481 Dual Disc Cartridge Drive (4.6 or 9.2 mb; 90 msec)	X	X	X	X	X	X	
9499-8 Dual Disc Pack Drive (87.2 mb; 30 msec)	—	—	X	X			Max 1/control.
9486-2 Dual Disc Pack Drive (95.5 mb; 42.5 msec)	—	—	—	—	X	X	Max 1/control.
9371 Head-per-Track Memory Bank (7 or 14 mb; up to 5 units; 20 and 40 msec, respectively)	—	—	X	X	X	X	Max 1 control/processor.
Magnetic Tape							
9491-2 9-Channel Magnetic Tape Unit (10 kb; NRZ; 80 bpi)	X	X	X	X	X	X	Max 4/control.
9381-12/13/14 9-Channel Magnetic Tape Cluster (18 kb; 2/3/4 stations)	—	X	X	X	X	X	
9381-22/23/24 9-Channel Magnetic Tape Cluster (36 kb; 2/3/4 stations)	—	X	X	X	X	X	
9390-3 7-Channel Magnetic Tape Unit (18/50 kb; NRZ; 200 or 556 bpi)	—	—	—	—	X	X	
9495-2 9 Channel Magnetic Tape Unit (1,600 bpi, 120 kb)	—	—	—	—	X	X	
9496-2/4 9 Channel Magnetic Tape Unit (1,600 bpi, 40 and 80 kb)	—	—	—	—	X	X	

SOFTWARE

Burroughs "soft" machines offer a sophisticated operating system and a very flexible set of applications packages.

OPERATING SYSTEM

Two versions of the Master Control Program operating system have been announced for the B 1700: MCP I and MCP II. The installed base is operating under MCP II, since MCP I is not available yet. MCP I is planned as an entry-level (minimum 16K main memory) batch serial operating system that handles all I/O scheduling, dynamic control of memory and resource assignments (including the addition of memory and peripherals), disc program library management, operator and system communication (via console or control cards), job status and logging, program compilation and loading, file management, and utilities. MCP I is expected to need a minimum of 4K for resident requirements.

MCP II, currently available, does all of the functions of MCP I, plus the system handles communications controllers, MICR reader-sorters, and scheduling and loading

Table 2. Burroughs B 1700: Configuration Information

Characteristic or Device	B 1712	B 1714	B 1716	B 1718	B 1726	B 1728	Comments
Card Equipment							Max 2 controls/processor. Max 3 readers on 1726.
9115 80-Col Card Reader (300 cpm)	X	X	X	X	X	X	
9116 80-Col Card Reader (600 cpm)	—	X	X	X	X	X	
9111/2 80-Col Card Readers (800, 1,400 cpm)	—	—	—	—	X	X	
9210 80-Col Card Punch (100 cpm)	X	X	X	X	X	X	
9213 80-Col Card Punch (300 cpm)	—	—	—	—	X	X	
9119-1 96-Col Card Reader (300 cpm)	X	X	X	X	X	X	Max four 96-col readers,
9319-2 96-Col Card Reader-Punch (300/600 cpm)	X	X	X	X	X	X	or if MICR used, probably 3.
9319-4 96-Col Reader-Punch (500/120 cpm)	—	X	X	X	X	X	
9419-2 96-Col Reader-Punch Data Recorder	X	X	X	X	X	X	
9419-6 96-Col Multifunction Card Unit (includes sorter)	X	X	X	X	X	X	
Line Printers							Max 1 control/processor.
132-Col Line Printers (90-300 lpm)	X	X	X	X	—	—	
132-Col Line Printer (400 lpm)	—	X	X	X	—	—	
132-Col Line Printers (475-750 lpm)	—	X	X	X	X	X	
132-Col Line Printer (1,040 lpm)	—	—	—	—	X	X	
Reader-Sorters							Max 1 control/processor. If used, requires I/O expansion feature. If used, only 1 disc subsystem can be used on 1714.
MICR Reader-Sorters (600 cpm; 8 or 12 pockets)	—	X	X	X	X	X	
MICR Reader-Sorters (900 cpm; 8 or 12 pockets)	—	X	X	X	X	X	
MICR Reader-Sorter (1,000 cpm; 13 pockets)	—	—	—	—	X	X	
MICR Reader-Sorter (1,625 cpm; 4-16 pockets)	—	—	—	—	X	X	
Data Communications Single Line Control	—	X	X	X	X	X	Max 2 controls/processor, controls need line adapters.
1352 Multiline Controller	—	—	—	—	X	X	Handles 8 communications lines.
1352 MLC Extension	—	—	—	—	—	X	Total of 16 lines.

of programs in a multiprogramming environment. It also provides spooling in the form of pseudo readers and disc backup for printers. The MCP II requires at least 8K bytes of main storage.

The MCP is a paging operating system; page sizes are controlled either by the MCP or by the programmer (the COBOL SEGMENT-LIMIT clause, for example). Paging is facilitated by code (not data) that is entirely reentrant; therefore, there is no need to write back to disc. Data, however, is always written to disc if space is required. Associated with the programs in core is a run status nucleus, tables/stacks, and a segment dictionary, which at any time indicates the pages resident in main storage. If space is needed, it is allocated dynamically in the following page order: available memory, not in use code, in use code, not in use data, and in use data. This is the optimum order with respect to minimized disc access.

Interrupts in the 1700 are soft interrupts; for example, there is a timer bit set every 100 milliseconds, and software must test the bit in order to realize a "timer" interrupt.

The 1700 interpreters reside in 4K or less of core and can be overlayed. On the 1712 and 1714, the MCP resides in whatever core is available. On the 1726, the interpreters reside in control memory, which is either 2K or 4K.

The MCP's paging technique will allow it to run faster as more core is made available. Therefore, we feel that in the 98K bytes (max) available for the 1726, three programs are a reasonable multiprogramming mix. Burroughs claims that the 1710 systems also can multiprogram effectively.

We were skeptical about the ability of the 1710 systems (1712, 1714) to multiprogram effectively. A meeting with

Burroughs was arranged to discuss the machines and watch a 1714 with 48K, running MCP II. We had three Burroughs-authored demonstration programs, subsets of BMS programs, that performed the following: card input; inventory totaling and printing; and file updating. The programs could be further characterized as heavy card input, light processing, light printing; light input, light processing, heavy printing; and light input, heavy processing, light printing. Each of the three programs was run serially; the timings were recorded. The programs were then multiprogrammed.

Their order of entry into the system was 2, 3, 1. In this order, the programs ran in 69 percent of the time required by the serial execution. We then requested that the programs be run in the order 1, 3, 2. In this order, the programs ran in 93 percent of the time required by serial execution. The pseudo-reader of MCP II was not used in either multiprogramming example. We feel that if this option had been used, more favorable timings would have resulted. Disc backup for the printers, however, was used.

Clearly, for the 1714 to multiprogram effectively, the order of job submission can be critical. This in itself requires knowledge of the job types in terms of resource utilization.

Applications Software

Burroughs offers a comprehensive library of business management software in wholesaling, distribution, and manufacturing, including reports; invoicing, accounts receivable, and inventory control; accounts payable; payroll; and general ledger. Other management systems exist for contractors, credit unions, automobile dealers, utilities, and government.

The firm also offers bank management software in proof and transit; demand deposit accounting; savings accounting; installment loan accounting; and general ledger accounting.

Hospital management software includes reports; patient accounting; medical records; payroll and personnel reporting; and general and responsibility accounting.

All of Burroughs' software is modular in design, which allows modification of packages to suit individual users' needs. This generality of design has aroused some user complaints of lengthy execution times.

Programming Languages

Users intending to write their own software can do so in BASIC, COBOL, FORTRAN, or RPG.

BASIC is batch only. COBOL is an extended ANS COBOL. FORTRAN is also an extended ANS. COBOL programs can run on a 16K entry level system. RPG is handled as if it were COBOL, below the compiler level.

The "variable micrologic" of the B 1700 series computers allows dynamic respecification of the micrologic to fit the particular parameters and requirements of a specific language. For example, COBOL and FORTRAN vary in their needs for transfers of large data areas. The COBOL compiler might invoke a specially designed move instruction that is not subject to the traditional limit of 256 characters; whereas the FORTRAN compiler could still use the traditional instruction. The sequence of (software) microinstructions is changed by the specific interpreter called by the control program.

The minimum number of interpreters per purchased machine is two: one for SDL (Systems Definition Language, Burroughs' high-level language version of ASSEMBLER), and one for the language that the user's applications programs employ (COBOL / RPG or FORTRAN).

Burroughs also offers COFIRS for users of IBM's RPG who may wish to convert their programs to Burroughs' COBOL. Input to COFIRS is an RPG source deck. Output is Burroughs' COBOL.

Users who plan on a communications environment will have their configuration definition (for Burroughs-supported terminals) eased by the use of the Network Definition Language (NDL). Parameter statements to the NDL compiler create instructions and tables for handling the Burroughs-supported terminals. NDL also handles respecification of the communications network as terminals are added or deleted.

MAINTENANCE

Maintenance for the B 1700 series is performed by Burroughs service personnel available on-call during mutually agreeable business hours and operating from over 200 branch locations throughout the country. First-year maintenance is included in the lease or provided by a separate contract.

PRICE DATA

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
	BURROUGHS B 1712/1714/1716/1718			
	CENTRAL PROCESSOR AND WORKING STORAGE			
B1712	Processor (includes I/O base; 16K bytes main memory; console; table; corner table)	560	24,503	95
B1714	Processor (includes I/O base; 16K bytes main memory; console; table; corner table)	780	30,803	100

PRICE DATA (Contd.)

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
B1718	Processor (includes I/O base; 32K bytes main memory; console; table; corner table)	1,695	63,165	NA
B1716	Processor (includes I/O base; 32K bytes main memory; console; console printer; table; corner table)	1,736	64,815	NA
	Processor Options			
A1305	I/O Expansion Feature For B 1712 Only	30	1,350	5
B1012-24	Total Memory (24K)	150	4,500	11
B1012-32	Total Memory (32K)	400	11,250	17
B1012-40	Total Memory (40K) For B 1714 Only	550	15,750	28
B1014-24	Total Memory (24K)	200	5,850	14
B1014-32	Total Memory (32K)	400	11,250	19
B1014-40	Total Memory (40K)	550	18,000	26
B1014-49	Total Memory (48K)	700	23,400	38
B1014-57	Total Memory (56K)	850	28,800	50
B1014-65	Total Memory (64K)	1,000	34,200	64
	MASS STORAGE			
	Discs			
	Disc Cartridge Drives (60-msec avg seek time; 20-msec avg latency; 80-msec avg data access time)			
A9480-2	Dual-Cartridge Drive (4.6-mb)	365	13,905	56
A9481-2	Dual-Cartridge Drive (9.3-mb)	480	19,440	76
A1480	Control (for A9480-1 and A9480-2 drives)	90	2,430	15
A1481	Control (for A9481-1 and A9481-2 drives)	100	3,150	16
A9985-3	Disc Cartridge (for A9481 drives)	—	125	—
	INPUT/OUTPUT			
	Punched Card			
A9115	Reader (80-col; 300-cpm)	110	4,050	26
A9116	Reader (80-col; 600-cpm)	195	5,850	37
A1115	Control (for A9115)	45	810	7
A1116	Control (for A9116)	55	1,080	8
A9119-1	Reader (96-col; 300-cpm)	85	3,150	26
A1119-1	Control for A9119-1	45	810	7
A9212	150 cpm 80-col Card	430	18,576	119
A1212	Control for A9212	90	3,888	15
A9991-1	Stand for A9115/A9116/ A9491-2		113	
A9319-2	Reader/Punch (reads 300 cpm; punches/prints 60 cpm; 96-col)	200	7,191	63
A9319-4	Reader/Punch (reads 500 cpm; punches/prints 120 cpm; 96-col)	310	10,071	96
A1319-2	Control (for A9319-2)	65	1,710	11
A1319-4	Control (for A9319-4)	70	2,070	12
	Recorders			
A9419-2	Reader/Punch Data Recorder (reads 300 cpm; punches/ prints 60 cpm; 96-col)	240	8,541	75
A9419-6	Reader/Punch Data Recorder (reads 300 cpm; punches/ prints 60 cpm; 6-pocket sorting at 300 cpm; 96-col)	285	10,251	89
A1419-2	Control for A9419-2	65	1,710	11
A1419-6	Control for A9419-6	70	1,890	12
	Printers			
A9247-12	400 lpm, 132 Print Positions with Format Rdr	586	22,995	132
A9247-3	Printer (750-lpm 132 PP)	710	34,245	172
A9249-1	Printer (90-lpm 132 PP)	240	7,650	63
A9249-2	Printer (180-lpm 132 PP)	280	10,080	74
A9249-3	250 lpm 132 Print Positions	375	13,500	99
A1247-3	Control (for A9247-3)	215	2,520	46
A1249-1	Control (for A9249-1)	35	900	5
A1249-2	Control (for A9249-2)	40	990	6
	MASS STORAGE			
	Discs			
	Disc Pack Drives (30-msec avg seek time; 12.5-msec avg latency; 42.5-msec avg data access time)			
B9486-2	Dual Drive (95.5-mb)	1,000	46,750	135
B1486-1	Control (for B9486-2)	255	11,200	37
B9974-1	Disc Pack (for B9486-2)		350	
B9974-4	Disc Pack, certified at 200 tpi for B9484-4, 9485-4, and 9486-4		485	
B1484-4	Disc Pack Control for B9484-4 Drive	950	45,600	108
B9484-4	Dual Drive (174.4M bytes)	1,550	74,400	201
B9486-45	Increment for B9484-4, 9485-4 (87.2M bytes, 30 ms aver access)	800	38,400	108
B9486-4	Increment for B9484-4, 9485-4 (174.4M bytes; limit 3 increments per 9484-4 and 9485-4)	1,400	67,200	177
B9499-1	1 x 4 Disc Pack Electronic Control	345	15,180	45
B9499-2	1 x 8 Disc Pack Electronic Control	400	17,600	50
	Head-per-Track Memory Banks (incl 1 EU)			
B9371-7	Storage (7-mb, 20-msec)	600	28,800	210
B9371-14	Storage (14-mb, 40-msec)	750	36,000	221
	Head-per-Track Memory Bank Add-On Units			
B9374-10	Storage (14-mb, 40-msec)	550	26,400	99
B9374-17	Storage (7-mb, 20-msec)	400	19,200	124
B1374	Control (for Head-per-Track Memory Banks)	200	9,600	13
B1674-1	1 x 2 Disc File Adapter	45	1,980	7
B1674-2	2 x 2 Disc File Exchange	40	1,760	5
	INPUT/OUTPUT			
	Punched Cards			
	Card Readers (80-col)			
B9111	800-cpm	350	17,550	94
B9112	1,400-cpm	485	23,325	143
B9115	300-cpm	110	4,500	26
B9116	600-cpm	195	6,500	37
	800-cpm	250	9,000	45
B1111	Card Reader Control (for B9111 and B9112)	48	2,332	7
B1115	Card Reader Control (for B9115 and B9116)	45	2,160	8
B9917	Card Counter (for B9111 and B9112)	5	240	NC
B9918	Postal Money Order Feature (for B9111/2)	30	1,440	6

PRICE DATA (Contd.)

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
B9919	40-Column Read Switch (for B9111 and B9112)	–	190	–
B9119-1	Card Readers (96-col; 300-cpm)	85	3,500	26
B1119	Control (for B9119-1)	48	2,332	7
B9213	Card Punch (300-cpm, 80-col)	530	25,440	152
B1212	Card Punch Control for B9212	90	4,320	15
B1213	Control (for B9213)	90	4,320	15
B9319-2	Card Reader/Punches (96-col) (Reads 300 cpm; punches/ prints 60 cpm)	200	7,990	63
B9319-4	(Reads 500 cpm; punches/ prints 120 cpm)	310	11,190	96
B1319	Control (for B9319)	75	3,628	12
	Printers			
A9942-9	Addl Train Module for A9247	65	3,150	19
A9944-2	64-char ASCII to Replace 48-char Set on A9249-1/2/3 (F.O. only) - No Charge	–	–	–
A9948-1	12-char Format Tape Rdr for a 9249-1/2/3	30	1,080	–
	Consoles			
A9340	Console Printer	55	2,376	17
A1340	Control (for A9340)	60	1,620	5
	Magnetic Tapes			
A9381-12	18-Kb Cluster (2-station; NRZ; 9-channel; 800-bpi)	525	22,680	118
A9381-13	18-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	570	24,264	210
A9381-14	18-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	680	28,944	253
A9381-22	36-Kb Cluster (2-station; NRZ; 9-channel; 800-bpi)	700	30,240	215
A9381-23	36-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	900	38,880	248
A9381-24	36-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	1,100	47,520	280
A9491-2	10-Kb Tape Unit (NRZ; 9-channel; 800-bpi)	215	7,740	22
A1381	Tape Cluster Control	250	5,400	120
A1491-2	Tape Control (10-Kb)	200	3,510	120
	Sorters			
A9135-2	8-Pocket (900 doc/min; E13-B; off-line sorting)	1,000	40,950	453
A9135-3	12-Pocket (900 doc/min; E13-B; off-line sorting)	1,300	50,310	490
A9136-5	8-Pocket (600 doc/min; E13-B; off-line sorting)	700	30,600	236
A9136-6	12-Pocket (600 doc/min; E13-B; off-line sorting)	850	33,100	284
A1135	Control (for A9135)	150	5,400	32
A1136	Control (for A9136)	150	5,400	32
	DATA COMMUNICATIONS			
A1351	Single-Line Control	50	1,800	8
	Line Adapters			
A1650-1	Async Data Set Connect (up to 1,200 bps)	50	1,350	8
A1650-2	Async Data Set Connect (up to 1,800 bps)	65	1,620	11
A1650-5	Async Direct Connect (up to 2,400 bps)	50	1,350	11
A1650-6	Async Direct Connect (up to 4,800 bps)	65	1,620	11
A1650-7	Async Direct Connect (up to 9,600 bps)	80	1,890	13
A1651-1	Sync Data Set Connect (up to 2,400 bps)	50	1,350	8
A1651-2	Sync Data Set Connect (up to 4,800 bps)	65	1,620	11
A1651-3	Sync Data Set Connect (up to 9,600 bps)	80	1,890	13
A1652-1	Async Data Set Connect (for TTY)	50	1,350	8
A1652-5	Async Direct Connect (for TTY)	50	1,350	8

Note:
Maintenance rates are higher outside metropolitan area.

	Sorters			
	Reader Sorters			
B9134-1	4-Pocket (1,625 doc/min; requires B9938-1)	1,025	49,200	369
B9135-2	8-Pocket (900 doc/min, E13B; off-line sorting)	1,000	45,500	453
B9135-3	12-Pocket (900 doc/min, E13B; off-line sorting)	1,300	55,900	490
B9136-5	8-Pocket (600 doc/min; E13-B; off-line sorting)	700	34,000	236
B9136-6	12-Pocket (600 doc/min; E13-B; off-line sorting)	850	39,000	284
	For 9131-1			
B1131	Control	150	6,480	24
B9930-1	Mobile Carrier and Tray	6	240	NC
B9930-2	Document Tray (purchase only)	–	15	–
B9931-1	Item Separation (B9131)	20	960	NC
B9932	Endorser (factory-installed)	200	9,000	57
B9934	Start/Stop Bar (B9131)	7	275	NC
B9935	Special Field Ending	10	450	NC
B9935-4	Canadian Check Feature (B9131)	–	180	NC
B9936	Override Code (specify type)	10	450	NC
B9937	Validity Checking-Sort Field	10	450	NC
B9938	Reverse Override (specify type)	10	450	NC
B9939-1	Resettable Counter	5	240	NC
B9939-2	Nonresettable Counter	5	240	NC
	For B9134-1			
B1134	Control	200	6,480	32
B9930-3	Mobile Carrier	NA	150	NC
B9930-4	One-Tray Document Rack	NA	60	NC
B9932-1	Endorser	200	9,000	57
B9932-4	Batch Ticket Detector	10	480	1
B9932-5	Short Document Read Feature (factory installation only)	10	480	2
B9932-6	Short Document Module Expander (factory installation only)	5	240	NC
B9933-1	Two-Field Basic Off-Line Sort	25	1,200	6
B9933-2	Two-Field 8-Pocket Off-Line Sort	30	1,440	6
B9933-3	One-Field Expanded Off-Line Sort (max 8)	5	240	NC
B9933-4	Extended Sort Control	50	2,400	17
B9933-5	Zero Kill	10	480	1
B9933-6	No Field – No Digit	10	480	1
B9933-7	Digit Override	10	480	1
B9933-8	Digit Edit	10	480	1
B9933-9	Field Override	10	480	1
B9933-10	Field Edit	10	480	1
B9935-2	Four-Pocket Module (up to 16 pockets)	300	14,400	40
B9936-1	Stacker Overflow	10	480	1
B9937-1	Valid Character Check	5	240	1
B9938-1	Multitrack E13-B Read	375	18,000	62

PRICE DATA (Contd.)

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
B9939-3	Resettable Item Counter	5	240	1
B9939-4	Nonresettable Item Counter	5	240	1
B9939-5	Running Time Meter	5	240	1
B1135	Control for B9135-2/3 For B9136-5/6	200	6,480	32
B1136	Control	150	6,480	24
	DATA COMMUNICATIONS			
B1351	Single Line Control	50	2,000	8
B1352	Multiline Controller (8 lines)	200	13,000	29
B1353	Multiline Controller Extension (8 lines; B1728-1 only)	150	6,750	22
	Line Adapters			
B9419-2	Card Reader/Punch/Data Recorder (reads 300 cpm; prints/punches 60 cpm; keyboard; 96-col)	240	9,490	75
B9419-6	Multipurpose Card Unit (reads 300 cpm; prints/punches 60 cpm; keyboard; 96-col)	285	11,390	89
B1419	Control (for B9419)	75	2,332	12
	Printers			
B9247-12	400-lpm (132 PP)	586	25,550	132
B9247-3	750-lpm (132 PP)	811	38,050	172
B1247	Control (for B9247 Printers)	90	4,320	15
B9942-9	Add'l Train Module for B9247-2/3	65	3,500	19
B1340	Control for B9340	60	2,230	5
B9340	Console Printer	55	2,640	17
	Magnetic Tapes			
B9381-12	18-Kb Cluster (2-station; NRZ; 9-channel; 800-bpi)	525	25,200	188
B9381-13	18-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	570	26,960	210
B9381-14	18-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	680	32,160	253
B9381-22	36-Kb Cluster (2-station; NRZ; 9-channel; 800 bpi)	700	33,600	215
B9381-23	36-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	900	43,200	248
B9381-24	36-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	1,100	52,800	280
B9390	18/50-Kc Mag Tape Unit (7-channel; 200/556-bpi)	330	15,860	156
B9391-2	18-50-72-Kc Mag Tape Unit (7-channel; 200/556/800 bpi)	375	18,000	177
B9394-2	96-Kb Mag Tape Unit (9-channel; 800-bpi)	425	20,400	183
B9496-2	40-Kb Mag Tape Unit (9-channel; 1,600 bpi)	270	12,800	68
B9496-4	80-Kb Mag Tape Unit (9-channel; 1,600-bpi)	320	15,300	73
B9495-2	120-Kb Mag Tape Unit (9-channel; 1,600-bpi)	400	16,650	78
B9491-2	10-Kb 9-Channel Tape Unit	215	8,600	22
B1381	Tape Cluster Control	250	6,960	40
B1390	18/50-Kc 7-Channel Tape Control	250	6,960	40
B1491	10-Kb Tape Control	216	10,368	32
B1394-2	9-Channel Tape Control	300	12,300	42
B1496-4	Single Control for B9496 Series	325	15,740	56
B1495-2	Single Control for B9495 Series	460	19,130	56
B9499-30	1 x 4 Master Electronics Exchange (for B9496 Series only)	125	5,500	21
B9499-32	2 x 8 Master Electronics Exchange (for B9496 Series only)	300	13,200	45
B9499-31	1 x 8 Master Electronics Exchange (for B9496 Series only)	200	8,800	21
B9499-10	1 x 4 Master Electronics Exchange (for B9495 Series only)	125	5,500	21
B9499-11	1 x 8 Master Electronics Exchange (for B9495 Series only)	200	8,800	21
	BURROUGHS B 1726 and B 1728 SYSTEMS CENTRAL PROCESSOR AND WORKING STORAGE			
B1726	Processor (includes I/O base, 24K bytes main memory, 2,048 bytes control memory, console, and table)	1,740	78,300	147
B1728	Processor (includes I/O base, 64K bytes of memory, 6,144 bytes control memory, console and table, console printer and control, disc file control, disc file electronics unit, 8.1 million bytes H-P-T 20 ms systems disc)	3,825	181,688	436
	Processor Options			
B1097-3	Corner Table	15	720	NC
B1305	I/O Expansion Feature (2 allowed)	30	1,500	5
B1098	Processor Extension Cabinet	225	9,900	16
	Control Memory Options			
B1026-2	Add'l 2,048 Bytes	400	9,600	32
B1028-2	Add'l 2,048 Bytes	400	9,600	32
	Main Memory Options for B1726			
B1026-32	32K Bytes	85	5,400	11
B1026-40	40K Bytes	205	10,800	17
B1026-49	48K Bytes	325	16,200	23
B1026-57	56K Bytes	460	21,600	29
B1026-65	64K Bytes	610	27,000	37
B1026-81	80K Bytes	810	35,800	49
B1026-98	96K Bytes	1,010	44,600	63
B1026-114	114,688 Bytes Total Memory	1,210	53,400	77
B1026-131	131,072 Bytes Total Memory	1,410	62,200	90
	Main Memory Options for B1728			
B1028-81	80K bytes	250	11,000	13
B1028-98	96K bytes	450	19,800	26
114	112K bytes	650	28,600	39
131	128K bytes	850	37,400	52
147	144K bytes	1,050	46,200	64
163	160K bytes	1,250	55,000	77
180	176K bytes	1,450	63,800	89
196	192K bytes	1,650	72,600	102
212	208K bytes	1,850	81,400	114

PRICE DATA (Contd.)

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
229	224K bytes	2,050	90,200	127
245	240K bytes	2,250	99,000	140
262	256K bytes	2,450	107,800	152
	MASS STORAGE			
	Discs			
	Disc Cartridge Drives (70-msec avg seek time; 20-msec avg latency; 90-msec avg data access time)			
B9480-2	Dual-Cartridge Drive (4.6-mb)	365	15,450	58
B9481-2	Dual-Cartridge Drive (9.2-mb)	480	21,600	79
B1480	Control (for B9480)	97	4,665	16
B1481	Control (for B9481)	97	4,665	16
B9985-3	Disc Cartridge (for B9481) (purchase only)		125	NA
B1650-1	Async Data Set Connect (up to 1,200 bps)	50	1,500	8
B1650-2	Async Data Set Connect (up to 1,800 bps)	65	1,800	11
B1650-5	Async Direct Connect (up to 2,400 bps)	50	1,500	8
B1650-6	Async Direct Connect (up to 4,800 bps)	65	1,800	11
B1650-7	Async Direct Connect (up to 9,600 bps)	80	2,100	13
B1651-1	Sync Data Set Connect (up to 2,400)	50	1,500	8
B1651-2	Sync Data Set Connect (up to 4,800)	65	1,800	11
B1651-3	Sync Data Set Connect (up to 9,600)	80	2,100	13
B1652-1	TTY Async Data Set Connect	50	1,500	8
B1652-5	TTY Async Direct Connect	50	1,500	8
B1653-1	Binary Sync Data Set Connect (up to 2,400 bps)	200	8,800	34
B1653-2	Binary Sync Data Set Connect (up to 4,800 bps)	225	9,900	36
B1653-3	Binary Sync Data Set Connect (up to 9,600 bps)	250	11,000	38

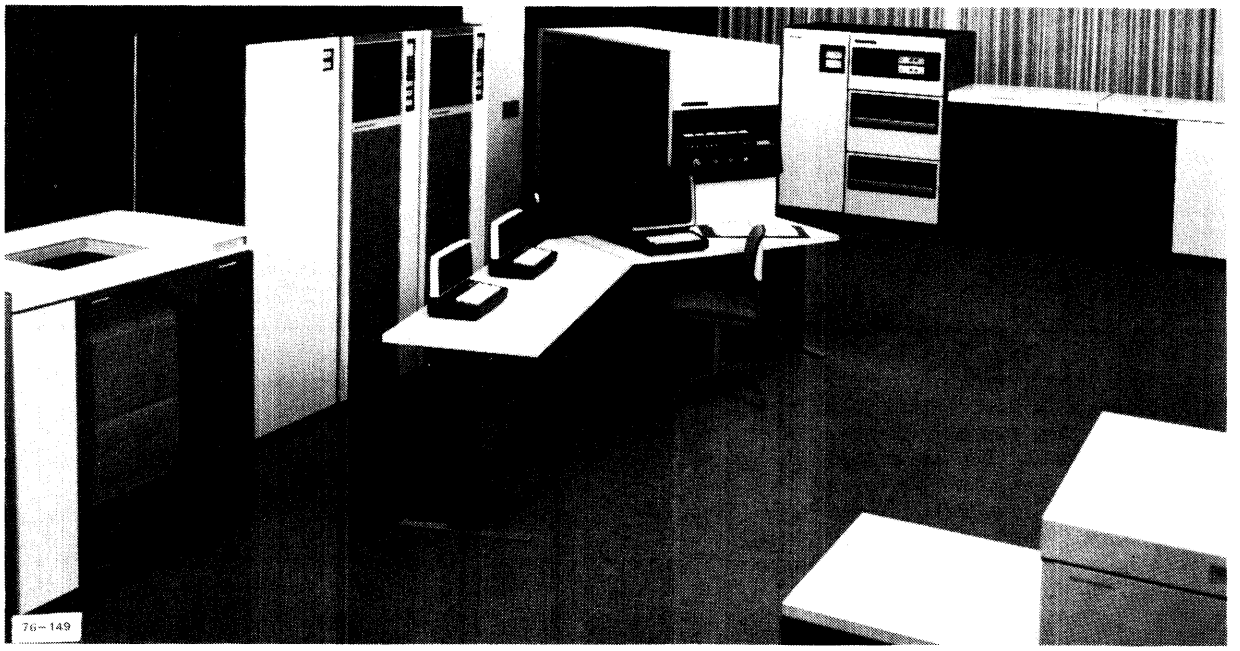
Notes:
– Not Applicable
NA Not Available
NC No Charge

HEADQUARTERS

Burroughs Corporation
6071 Second Avenue
Detroit MI 48202

BURROUGHS CORP.

B 1700 Systems Recent Announcements



NINE MODELS

Burroughs has completely revamped their B 1700 product line by introducing seven new models and enhancing two of its existing models. The B 1700 Systems now comprise the following models: B 1705, B 1707, B 1709, B 1713, B 1715, B 1717, B 1776, B 1726, and B 1728. Models B 1705 through B 1717 are characterized as the B 1710 Series; Models B 1776, B 1726 and B 1728 are characterized as the B 1720 Series.

As part of the remodeling work done on the B 1700 Systems, Burroughs has reworked its marketing and pricing policies. The B 1710 Series and the B 1720 Series are no longer being marketed by separate sales forces, and the pricing structure (particularly in the area of memory prices) has been lowered to bring the cost of the systems in line with the cost of competitive systems. Burroughs hopes that these moves will allow it to serve the B 1700 customer more effectively. The B 1700 salesman can offer the user a cardless, financial MICR, or a totally configurable B 1710 system, or a large (up to 393KB of main memory), powerful B 1720 system at a price that has been designed to be aggressively competitive with IBM System/3 and Univac Series 90 Model 90/30. Burroughs has declared war on the competitive replacement market.

B 1710 Series

Burroughs has announced new models for the B 1710 Series (the low end of the B 1700 product line). The new models, the B 1705, B 1707, B 1709, B 1713, B 1715, and B 1717, are intended to replace the older B 1710 models, the B 1712, B 1714, and B 1716. In addition to the new models, Burroughs has released two new software packages for cardless B 1710 models — a B 1700 Data Entry Program and a text editor. Table 1 lists the configurations for the new models.

Each of the B 1710 models is packaged to fit a particular application.

HEADQUARTERS

Burroughs Corporation
1 Burroughs Place
Detroit MI 48232
(313) 972-7000

Table 1. B 1710 Series: Basic Configurations

Description	B 1705[1]	B 1707[1]	B 1709[2]	B 1713	B 1715	B 1717[3]
Processor	4 MHz	4 MHz	4 MHz	4 MHz	4 MHz	4 MHz
Main Memory (K bytes)	24 (to 64)	24 (to 64)	48 (to 64)	48 (to 64)	32 (to 64)	32 (to 128)
Console & Control (A 9340 & A 1340)	—	Yes	Yes	Yes	—	—
Disc & Control (80 ms)	—	4.6MB	4.6MB	4.6MB	—	—
Printer & Control	—	160 lpm	160 lpm	250 lpm	—	—
Mag Tape Cassette & Control	—	10 ips	—	—	—	—
AE 306 Audit Entry Station	—	Yes	—	—	—	—
Single Line Communications (9,600 bps)	—	—	Yes	Yes	—	—
TD 701 Input/Display Stations & Keyboards	—	—	2	—	—	—
Card Reader & Control	—	—	—	300 cpm	—	—
MICR Reader/Sorter & Control (8-pocket)	—	—	—	Yes	—	—
Disc-Pack Control (A 1486-1)	—	—	—	—	Yes	—

Notes:
1. Except for the disc-pack and the MICR Reader/Sorter, these models can use any of the B 1710 Series peripherals.
2. The B 1709 can use all the B 1710 Series peripherals except the disc-pack and the MICR Reader/Sorter. This system must include the Data Entry Program and text editor. If text editor is not included, a card reader is necessary for program compilations.
3. An option for the B 1717 is the B 1020 I/O Expansion cabinet with 28 I/O slots.

- B 1705 is an entry level system that can be configured to meet the user's needs.
- B 1707 is a cardless system that accepts input from magnetic tape cassettes prepared offline by the Burroughs audit entry system, the AE 306. Source code can be compiled from cassette.
- B 1713 is a remote MICR system for the financial community. The system uses the Burroughs eight-pocket reader-sorter and communicates with host mainframes using HASP RJE.
- B 1715 is a configurable system for users with mass storage requirements. The B 1715 uses the 87.2MB dual disc pack (A 9499-8).
- B 1717 is a system for expanding the memory of the B 1710 systems to 131KB. As an option, the B 1717 can add an I/O expansion unit that will provide up to 28 I/O slots.

B 1720 Series

Burroughs has announced one new model and two enhanced models for the B 1720 Series (the high end of the B 1700 product line). The new model, the B 1776, is the usually-conservative-Burroughs concession to the Bicentennial spirit. Models B 1726 and B 1728 are enhanced versions of the older B 1726 and B 1728-1. Enhancements consist mainly of expanded control memory and main memory. Table 2 outlines B 1720 basic configurations.

Each of the B 1720 models is packaged to offer the user expanded memory potential and high speed control memory.

- B 1776, the Bicentennial special, is an entry-level system for the B 1720 Series. It uses the 167 nanosecond per 16 bit high-speed control memory.
- B 1726, the enhanced B 1726, offers the user up to 262KB of main memory and 6KB of control memory.
- B 1728, the enhanced B 1728, offers the user up to 393KB of main memory and 8KB of control memory.

Conversion Aids

In support of its efforts in the competitive replacement market, Burroughs offers the following conversion aids for the B 1700:

- Compilers
  - IBM-Compatible RPGI and RPGII Compilers.
  - ANSII COBOL Compiler.
  - Level F Fortran Compiler.
- Interpreters
  - B300/B500 Interpreter.
  - IBM 1400 Interpreter.
  - IBM 1130 Interpreter.
- Translators
  - Honeywell Easycoder to B 1700 COBOL.
  - NCR Century COBOL to B 1700 COBOL.
  - Autocoder to B 1700 COBOL.
  - NCR Neat 3 to B 1700 COBOL.
  - B500 Assembler to B 1700 COBOL.
  - Honeywell COBOL to B 1700 COBOL.
- COFIRS
  - IBM RPG to B 1700 COBOL.

Table 2. B 1720 Series: Basic Configurations

Description	B 1776	B 1726	B 1728
Processor	6 MHz	6 MHz	6 MHz
Main Memory (K bytes)	48–131	64–262	64–393
Control Memory (K bytes)	2–4	4–6	6–8
8.1MB HPT			
System Disc (B 9371-7)			Yes
HPT Control (B 1374)			Yes
Disc File Control			Yes
Disc File Control Unit			Yes

PRICE DATA

Model No.	Description	Monthly Rental (incl. maint.) $	Purchase Price $	Maintenance $
B 1710 Series				
B 1705	BASIC SYSTEM 4 MHz Processor 24 KB Processor Memory	720	32,225	119.40
B 1701	MAGNETIC ENTRY SYSTEM 4 MHz Processor 24 KB Processor Memory A 9340 Console A 1340 Console Control A 9480-12 4.6MB 80 ms Disc A 1480 Disc Control A 9249-2 160 lpm Printer A 1249-2 Printer Control A 9490-25 10 ips Cassette A 1490-25 Cassette Control AE 306 Audit Entry Station	1,900	72,900	404.90
B 1709	DIRECT DATA ENTRY SYSTEM 4 MHz Processor 48 KB Processor Memory A 9340 Console A 1340 Console Control A 9480-12 4.6MB 80 ms Disc A 1480 Disc Control A 9249-12 160 lpm Printer A 1249 Printer Control A 1351 Single Line Control A 1650-7 9600 Baud Adapter 2 TD 701 Input/Display Stations 2 TD 012-1 Keyboards 2 TD 023 Interfaces 2 TD 031 Poll & Select Options 2 TD 052 Expanded Memory Features 2 TD 056 Cables	2,211	77,900	355.50
B 1713	MICR ENTRY SYSTEM 4 MHz Processor 48 KB Processor Memory A 9340 Console A 1340 Console Control A 9115 300 cpm Card Reader A 1115 Card Reader Control A 9249-3 250 lpm Printer A 1249-3 Printer Control A 9480-12 4.6MB 80 ms Disc A 1480 Disc Control A 9135 8-Pocket Reader Sorter A 1135 Reader Sorter Control A 1351 Single Line Control	2,970	127,900	912.00
B 1715	MASS STORAGE SYSTEM 4 MHz Processor 32 KB Processor Memory A 1486-1 Disc-Pack Control	1,400	53,200	163.40
B 1717	EXTENDED MEMORY SYSTEM 4 MHz Processor 32 KB Processor Memory	1,600	57,900	124.80
B 1705 **B 1707**	MEMORY OPTIONS			
	B 1010-32 KB Total Memory	75	3,000	11.00
	B 1010-40 KB Total Memory	150	6,000	17.60
	B 1010-48 KB Total Memory	225	9,000	24.30
	B 1010-56 KB Total Memory	300	12,000	30.90
	B 1010-64 KB Total Memory	375	15,000	38.60
B 1709	MEMORY OPTIONS			
	B 1011-56 KB Total Memory	75	3,000	11.00
	B 1011-65 KB Total Memory	150	6,000	17.60
B 1713	MEMORY OPTIONS			
	B 1011-56 KB Total Memory	75	3,000	11.00
	B 1011-65 KB Total Memory	150	6,000	17.60

Model No.	Description	Monthly Rental (incl. maint.) $	Purchase Price $	Maintenance $
B 1715	MEMORY OPTIONS			
	B 1015-40 Total Memory	75	3,000	11.00
	B 1015-48 Total Memory	150	6,000	17.60
	B 1015-56 Total Memory	225	9,000	24.30
	B 1015-64 Total Memory	300	12,000	30.90
B 1717	MEMORY OPTIONS			
	B 1017-40 Total Memory	75	3,000	11.00
	B 1017-48 Total Memory	150	6,000	17.60
	B 1017-56 Total Memory	225	9,000	24.30
	B 1017-64 Total Memory	300	12,000	30.90
	B 1017-80 Total Memory	450	18,000	38.60
	B 1017-96 Total Memory	600	24,000	51.30
	B 1017-112 Total Memory	750	30,000	65.60
	B 1017-128 Total Memory	900	36,000	79.90
B 1717	I/O EXPAN[illegible]ION CABINET			
	B 1020 I/[illegible] ion Cabinet I/O Ca[illegible] Additional	300	12,000	60.00

UPGRADE PRICES

Model No.	Upgrade Monthly Lease $	Upgrade Purchase $
B 1705 to B 1715	700	22,000
B 1707 to B 1715	700	22,000
B 1709 to B 1715	440	19,000

APPLICATION PROGRAMS

Model No.	Description	Unlimited Time Plan 1-Time Payment $	Unlimited Time Plan Charge 12 Mo. Payment $	Unlimited Time Plan Annual Maint. Charge $	Limited Time Plan Mo. License Fee 3 Yr $	Limited Time Plan Mo. License Fee 5 Yr $
B 1710	1710 DE 1					
	1710 DE 1 B 1700 Data Entry	2,400	220	150	80	77
	1710 TE1 Text Editor	1,500	138	150	50	48

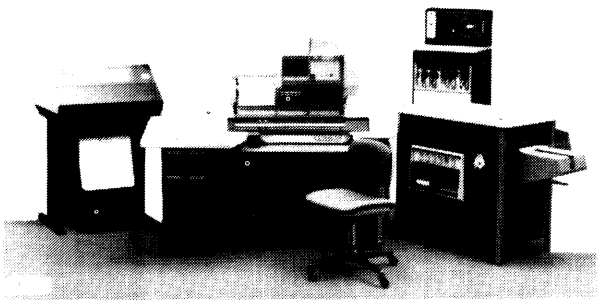
B 1720 Series

Model No.	Description	Monthly Rental (incl. maint.) $	Purchase Price $	Maintenance $
B 1776	6 MHz Processor 48KB Processor Memory 2KB Control Memory	2,200	90,000	192.00
B 1726	6 MHz Processor 64KB Processor Memory 4KB Control Memory	2,850	115,000	208.00
B 1728	6 MHz Central Processor 64KB Processor Memory Disc File Control Disc File Electronic Unit B 9371-7 8.1MB hpt System Disc B 1374 hpt Control	3,935	160,500	495.00
B 1720	MEMORY OPTIONS			
	16KB Memory Model	150	6,000	19.00
	2KB Control Memory	250	10,000	35.70
B 1726	OPTION			
B 1728	B 1352 Multiline Control	204	9,000	33.20
PERIPHERALS				
	DISC CARTRIDGE			
	A 9480-12 4.6MB 80 ms	330	11,900	58.50
	A 9481-12 9.2MB 100 ms	485	14,900	79.40
	LINE PRINTERS			
	A 9249-1 85 lpm Printer	243	8,500	66.20
	A 9249-2 160 lpm Printer	283	9,900	77.20
	A 9249-3 250 lpm Printer	379	13,400	104.00
	A 9247-2 400 lpm Printer	567	20,550	139.00
	A 9247-3 750 lpm Printer	820	34,050	189.00

PRICE DATA (Cont)

Model No.	Description	Monthly Rental (incl. maint.) $	Purchase Price $	Maintenance $
	DISC-PACK			
	A 9499-8 87MB Dual Disc-Pack 1 x 2 DPEC	900	38,000	269.00
	CARD EQUIPMENT			
	A 9117 800 cpm 80-Col Card Reader	265	9,540	54.20
	A 1115 Card Reader Control	55	1,200	8.80
	A 9119-2 1000 cpm 96-Col Card Reader	223	9,600	55.10
	A 1119-2 Card Reader Control	100	4,500	15.40
	LINE PRINTERS			
	A 9247-12 400 lpm Printer	592	21,550	139.00
	A 9247-13 750 lpm Printer	935	35,000	189.00
	MAGNETIC TAPE			
	A 9496-2 40KB PE MTU	273	11,500	71.70
	A 9496-4 80KB PE MTU	345	13,770	76.10
	A 1496-4 Control	325	13,500	58.50
	A 9499-30 1 x 4 Exchange	127	4,950	22.10
	A 9499-31 1 x 8 Exchange	202	8,000	22.10

BURROUGHS
L Series



OVERVIEW

The Burroughs L Series comprises a family of accounting and visible record computers intended for the small business user. Individual members of the series offer different capabilities determined by the type of processor, memory, and peripherals in the system. The design emphasis is on interactive processing and simple control by novice users responding to the step-by-step guidance of indicator lights on the console. Since all models support a COBOL compiler, any applications programs a user develops are highly "portable."

The history of Burroughs small business computers could be written as the story of one keyboard. First introduced in 1967 on the TC 500, the keyboard is utilized on all of the L Series computers, on the terminal computer (TC) models, and on the 700 Series. The L6000 took the formerly mechanical keyboard and made it electronic — but otherwise Burroughs has left it alone since much of the L Series marketing success hinges on it.

If the L6000 Series was a milestone in keyboard development, the L8000 Series was a high point in internal operating speeds. Burroughs brought the L Series circuit technology up to date with the L8000, which utilizes metal-oxide-semiconductor (MOS) and large-scale integration (LSI) circuitry to obtain an internal processing cycle time of 3 microseconds.

The older members of the L Series — L2000, L3000, L4000, and L5000 — are no longer in production although many remain in service. The L6000 Series offers improved throughput over early models and is now the entry-level series for the range. The L7000 Series is also no longer in production. When it was introduced, it utilized fast read only memory (ROM) instead of magnetic discs for firmware. The L8000 Series consolidated that advance and now forms the middle plank in Burroughs' marketing strategy for the L Series. The new L9000 models at the top of the range which were announced in June 1975 offer increased throughput over the L8000 Series.

Burroughs' intent is to offer customers different levels of throughput. Internal operating speeds to not mean a great deal when discussing a keyboard-oriented machine — a human operator can type only so fast. However, the new 60 characters-per-second keyboard printer and an optional magnetic record feeder/stacker will eliminate the kinds of bottlenecks that occur at month-end when many reports have to be produced quickly.

Burroughs is placing more emphasis on configured systems now than in the past. A glance at its price list reveals a new numbering scheme meant to encompass the typical configuration a user would need. All L Series computers are upward compatible. The L8000 Series provides models at each earlier L Series level. Features of the L8000 models are greater working storage capacity and a new cassette-based, software-controlled "dynamic memory overlay" technique. None of the 8000 Series use discs for firmware. Instead, MOS LSI random access memory stores the control firmware and operates as the user's working memory, while optional cassette tape drives provide auxiliary storage and support for the dynamic memory overlay feature at every level. Thus, for a modest increase in cost, an L2000 or L3000 system can be upgraded to an 8200 or 8300 without cassette, i.e., without the dynamic memory overlay feature.

Most L Series models can be easily converted to a corresponding TC model since the data communications memory and logic are housed in a separate unit. The TC 3500 Series, like the L8000, provides models at each earlier TC level. Certain TC 3500 models are direct upgrades for TC 500/1500/2500 models.

Table 1 shows basic configuration differences between the various styles of the L Series.

PERFORMANCE AND COMPETITIVE POSITION

The new L9000 Series with its faster keyboard printer keeps Burroughs competitive with some of the European accounting computers now being marketed worldwide. Philips and Nixdorf are both well established in the United States. Philips has a 60 character-per-second keyboard

HEADQUARTERS

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Detroit MI 48202

Table 1. Configuration Differences Among the L Series Models

MODEL	L2000/L3000 L4000	L5000	L6000	L7000	L8000	L9000
Memory						
Cycle Time (msec)	5,000	5,000	5,000	5,000	3.0	3.0
Firmware Location	Disc	Disc	Disc	MOS ROM	MOS ROM	MOS ROM
RAM (user memory)						
Type	Disc	Disc	Disc	Disc	MOS	MOS
Size (bytes)	512-6,144	512-6,144	1,280	512-6,144	4K - 44K	4K - 44K
Data Structure						
Bits/Word	64	64	64	64; 16	64	64
Bytes/Word	8	8	8	8; 2	8	8
Auxiliary Memory	—	—	Cassette	Disc	Cassette	Cassette
Keyboard Printer (cps)	20	20	20	20	30	60
Peripherals						
Punch Cards						
80-Col Reader	A595; A596	A595; A596	A595; A596	A9114	A9114-1	A9114-1
80-Col Punch	A149	A149	A149	A149	A9119-1	A9119-1
80-Col Rdr/Pch	—	—	—	—	A9418-2	A9418-2
96-Col Reader	—	—	—	—	A9119-2	A9119-2
96-Col Multifunction Unit	—	—	—	—	A9119-6	A9119-6
96-Col Rdr/Pch	—	—	—	—	A9419-2, -6	A9419-2, -6
PT/EP Card						
Reader	A581	A581	A9122	A9122	A9122-1	A9122-1
Punch	A562	A562	A9222	A9222	A9222-1	A9222-1
Computer Tape	A1495	A1495	A1495	A1495	A1495	A1495
Transport Magnetic Stripe						
1-trk	—	A4005	A4005	A9161	A9161-1	A9161-1
2-trk	—	—	—	A9162	A9162-1	A9162-1
Console Forms Handler	—	—	—	—	A9361/A9362	A9361/A9362
Auxiliary Printers	—	—	—	A9249	A9249-1, -2	A9249-1, -2
Magnetic Tape Cassette Transport	—	—	—	—	A9490-25	A9490-25

printer on the 300 Series, which is marketed in Europe by Unidata. Nixdorf has a full range of peripherals, including fast printers. **Kienzle** in Europe has a 120 character-per-second printer which can also print bidirectionally.

The L8000 Series has enabled Burroughs to remain competitive in a market generally experiencing price drops from the lower costs of LSI and MOS technology. In fact, the L Series was innovative for its time in that it used microprogramming to implement COBOL on a small system. Burroughs has been able to upgrade the series with faster, less expensive, higher performance models and still use the software developed for earlier systems.

Burroughs maintains a "Hall of Programs" library of successfully installed applications software. These tested, documented programs are available to users through Burroughs Sales Offices. Banking, government, manufacturing, construction, mining, and retail trade are some of the applications areas represented.

NCR recently introduced the NCR299 Accounting Computer, which can handle visible records (ledger cards). The NCR299 allows exceptionally easy and inexpensive program development through a mark-sense form which enters long macro instruction words that even novices can use. The NCR299 will be a formidable competitor for the L8000 Series, particularly when companies have novices in accounting machine use, but it suffers from a lack of peripheral offerings and limited-size programs. NCR's installed base in the worldwide accounting machine market numbers more than 375,000 machines; thus, it is one of Burroughs' major competitors.

IBM's System/32 represents a move downwards towards the accounting computer market. Though IBM seems committed to RPG 2, many users will prefer COBOL as their programming language. RPG is not well suited to the trend toward interactive, transaction-oriented computer systems.

Philips and Nixdorf, as well as Olivetti, Kienzle, and a number of other European-based manufacturers, provide the major competition for Burroughs in Europe. Although NCR is also a formidable competitor, its NCR299 needs further development before it can compete directly with the European accounting computers that offer the range and price/performance of the Burroughs L Series.

User Reactions

Interviews with several accounting and visible record users revealed that all had recently upgraded from an old L Series to an L8000 or L9000 model. The L9000 user had upgraded from an L5000. The firm reported that the speed of the new system was astounding — what had taken a full day at month-end was now done in 1 hour. A small manufacturer of replacement parts for appliances

exchanged an L5000 for an L8500; a line printer was added to support billing and inventory control applications. An accounting firm, which markets its own client billing package for CPAs, exchanged an L2000 for an L8300. A software/services house that developed a mortgage-loan documentation package for banks, savings institutions, and mortgage companies switched from an L3000 to an L8300. All three users cited both better performance at virtually no change in price (the CPA firm was actually paying a lower price when cassette tapes were substituted for paper tape I/O) and cassette tape storage as reasons for their switch.

All the firms interviewed chose the original Burroughs equipment after studying NCR and IBM; in one case, Litton and Philips systems were also considered. All checked the marketplace before converting and were satisfied with the reliability and maintenance support for the original system; all had some software investment. Thus, none really wanted to switch unless a significant price saving could be made. One user remarked that his market check showed the L8000 to be very price/performance competitive, and he thought it would be hard for other manufacturers to beat.

The upgrade from an old L Series model to the L8000 version can result in enormous performance benefits, at little change in cost. The software house with the mortgage loan documentation package wrote one subroutine that ran in 3 minutes 4 seconds on the L3000; it ran in 3 seconds on the L8300. The manufacturer of appliance parts upgraded because two shifts on the L5000 were needed to enter 1,000 to 1,200 line items daily. With the 8500, the first shift hardly ever required overtime to complete the day's entries; this performance was even better than the Burroughs specification of 800 to 900 line items daily.

For the manufacturer and the software house, the type of visible record produced was an important part of the reason for using the L Series. The manufacturer likes the visible record with the magnetic stripe ledger card because it does not require a separate report run. The software house requires the front feed because its system prints legal documents than cannot be pin-fed forms. The CPA, who markets software as a side business, also mentioned that it is easier to convert the L8000 to its corresponding TC 3500 communications version than to convert earlier models to their corresponding communications version.

CONFIGURATION GUIDE

All L Series accounting computers include keyboard, "golfball" printer, and processor in a single, large, desk-like unit. When magnetic stripe ledger handling equipment is included in the system, it is superimposed over the carriage. When up to four cassette drives are included, they are also integrated into the basic work station. The line printer, card reader and punch, paper tape and edge-punch card readers and punches, and the polling magnetic tape unit are all freestanding devices.

Burroughs no longer has the L2000, L3000, L4000, L5000, or L7000 models in production. L Series models being actively marketed are: L6000, L8000, and the new L9000.

Table 1 outlines the configuration differences among the models or lines.

The L2000, L3000, and L4000 are essentially similar as far as I/O capabilities are concerned; the L2000 has a rear feed, the L3000 has a front feed, and the L4000 has a front feed with a larger platen (26.0 inches). The L5000, however, can handle Magnetic Memory Records (MMR), Burroughs' name for magnetic stripe ledger cards. The L7000 expands this capability further; it can handle dual tracks on each ledger card.

As far as technology is concerned, the L Series group themselves into three divisions. The L2000, L3000, L4000, and L5000 use discs for both working storage and control memory microprogram storage. The L7000 stores control memory in a 32- to 256-word. LSI/MOS ROM module which is not accessible to the user; disc provides working storage, and can also be used for auxiliary storage. The L8000 does not use disc storage; LSI/MOS modules provide both working storage and control storage. Cassette tapes are used for auxiliary storage.

The L8000 Series provides far greater memory capacity than do the other L Series systems. Basic user memory (memory available for storage of user programs and data) is 4K bytes. Memory can be added in 2K-byte increments up to a maximum capacity of 20K bytes for firmware storage and 44K bytes for user memory. This change is equivalent to more than 10 times the capacity of the 416-word maximum for the previous models; each word is 8 bytes long.

The configured L8000 systems all have 10 kilobytes of user memory. There is a choice of line printers, either the 90 or 180 line-per-minute models, cassettes, either three or four stations, and either a terminal display unit or audit entry system.

The L9000 Series offers the new 60 character-per-second printer. The bidirectional print option is available on all 9000 models. Configured in with the main processor are a cassette subsystem and magnetic record feeder/stacker for fast non-manual record handling.

Common Characteristics

All L Series accounting computers use the same basic keyboards, platens, and printers. Moreover, all use a similar processor architecture (to maintain compatibility), although the basic architecture is implemented with a variety of technologies, as explained earlier. The L8000 uses more extensive buffering in keeping with its higher performance.

The accumulator, a fixed-storage, 16-digit field within normal memory, serves as a working register with 15 digit

positions allocated to data storage. The sixteenth digit is reserved for special indicators. Shift, compare, and arithmetic operations manipulate data in the accumulator.

The keyboard incorporates two separate groups of keys: one set of 53 keys is arranged in almost a regular typewriter format, and the other 21 keys incorporate a numeric 10-key set arranged like a calculator. Both groups contain control keys. Items entered via either key group are temporarily stored in a buffer. A typewriter instruction transfers nonnumeric characters from the keyboard buffer for printing, storage in memory, or both. Numeric characters from either group of keys are transferred from the buffer to the accumulator, where they can be manipulated under program control.

Program-select keys are positioned across the top of the keyboard, up to 16 on the L2000 and L3000 and 24 on all other models. They are used to select and execute instructions that have previously been stored in memory, such as the user's subroutines.

A 64-character removable type ball holds the character set for the printer. Peak printing speed is 20 characters per second; either red or black characters can be printed. Maximum line length is either 150 or 255 characters (15.5-or 26-inch platen) depending on the computer model. The friction-feed platen can be split to accommodate two independent forms. An optional continuous forms feed is available in three styles for flexible forms-feed arrangement.

The MMR available for the L5000, L6500, L7000, L8500, and L9500 systems enables the system to read single- or dual-track (depending on model) magnetic stripe ledger cards 6, 8, 10, 12, or 14.5 inches in width. The L8500 systems include an A9362 Magnetic Record Handler that automatically feeds and stacks the magnetic records from a 150-record hopper. Alignment is automatic and based on data stored on the track or in the controlling program. Single tracks hold 352 digits, dual tracks 704. The MMR forms handler can also handle normal (non-magnetic) forms and continuous forms.

L2000/L3000/L4000/L5000 Peripherals

The optional input and output peripherals available for the older models include an edge-punched-card perforator (A562) which punches 40 characters per second; a paper-tape, edge-punched-card reader (A581) which reads 40 characters per second; an 80-column card reader (A595) which reads 100 BCL- or EBCDIC-punched cards per minute; a card keypunch (A149) which punches 25 columns per second under control of one of the terminal computers or in response to the operation of its own character keys; and a computer-compatible magnetic tape unit (A1495). All speeds are rated; effective speeds often depend upon such items as the controlling program.

The tape and edge-card punches and readers can handle paper, mylar, or aluminized 11/16- or 1-inch wide tape and individual, fanfold, paper, or mylar-reinforced 3- to 5-inch wide cards. In addition, 5-, 6-, 7-, or 8-level codes can be used. The A595 card reader and A149 keypunch use a stored table to translate between their own operating codes and the ASCII code used by the computers. The A596 card reader performs code conversion in the reader itself.

The basic magnetic tape unit incorporates two ports; up to three, two-port expansions are permitted, so as many as eight TC units can share a single tape drive.

L6000/L7000/L8000/L9000 Peripherals

The L7000 and L8000 can attach the same types of peripherals as for previous models. Some have been upgraded, reflecting the more powerful performance of these systems, particularly the L8000 Series. The A9122-1 Paper Tape/Edge Punched Card Reader reads 40 characters per second, and the A9222-1 Paper Tape/Edge Punched Card Perforator punches 40 characters per second, like their predecessors. The A9114-1 80-column card reader, however, reads 200 cards per minute; it automatically translates EBCDIC- or BCD-coded cards into machine language for the TC 3500; and its hopper holds 350 cards. The A9419-2 Card Reader Punch offers 96-column card I/O capabilities; it reads 300 cards per minute and punches 60; it has two feed hoppers and can be furnished with six stacking hoppers to permit off-line sorting and merging. With the stacking hoppers, it is designated the A9419-6. The A9419-2 is also available in a read-only version, the A9419-1.

Two chain line printers are available, one rated at 90 lines per minute and the other at 180 lines per minute. Maximum line length is 132 characters.

Both a magnetic tape drive and a magnetic tape cassette are available. The tape drive records data at 800 bits per inch. The cassette unit records at 100 8-bit characters per inch. Read/write speed of the cassette is 10 inches per second; usable tape capacity is about 280 feet. The magnetic tape unit is the same one used on earlier series, allowing eight systems to be connected to a common polling tape subsystem.

COMPATIBILITY

The Burroughs L Series is upward compatible from the L2000 through the newer L8000 Series and between corresponding models of older and newer series, given the same peripheral complement. These relationships are best understood by examining Table 1. For compatibility purposes, the L2000 and L3000 can be grouped as a single system because the rear versus front feed does not affect the programming. Thus, a program written for the L4000, for instance, can run on an L5000, L7000, and on an

L8400 and up, but it cannot run on an L2000, L3000, L8200, or L8300 because of the longer print line. An L8400 program, on the other hand, cannot run on the L4000 because of the L4000's small memory size. Programs written for a system with tape cassettes and the dynamic memory overlay feature will not run on an L4000.

Members of the TC 3500 Series are upward compatible with the L Series in relationships paralleling those of the L8000 Series, as listed in Table 1.

SOFTWARE

The L Series is unusual in terms of programming flexibility because it continues to be the only accounting computer of its size that permits COBOL programming for small operator-attended systems. Such COBOL programs must be compiled on a Burroughs B 3500 computer. If the L Series system has data communications ability (i.e., if it is a TC 3500), the program can be transmitted to a remote B 3500 for compilation.

This series can also be programmed in Assembler language. The programs are assembled either on the L Series machines or on a B 3500 if desired. Without charge, the company provides both preprogrammed routines to assist in program debugging and several utility routines.

Hall of Programs

Burroughs offers the following wide range of standard application packages — accounts payable, general ledger and financial statements, payroll accounting with reports, public utility billing, hospital accounting, job costing, billing and account updating, cash receipts and posting, general ledger and month-end reports, payroll accounting, accounts receivable, age analysis, general billing, and many others. Currently, over 150 packages are on the Burroughs applications software list. System software is also supplied to all users. In addition, Burroughs will either modify these standard packages to meet the user's specialized needs or write appropriate customized programs.

One of the users interviewed felt that Burroughs was not as oriented toward customized programming as was, for instance, Nixdorf. Consequently, when he bought the L Series system for the hardware/software package, he would resell for a particular specialized application (the home mortgage documentation system mentioned earlier). This user was not concerned about competition from his own supplier. The extensive list of applications software, which does include programs related to home mortage documentation, seems to belie his remarks.

Dynamic Memory Overlay

The L8000 and its sister line, the TC 3500, make use of a software-controlled feature called dynamic memory overlay. When operating in this mode, programs are automatically loaded from cassette tape stations and executed in segments. Programs larger than available main memory can be executed without operator intervention. The concept is similar to virtual memory, but it uses cassettes (slower but cheaper) as the auxiliary or virtual memory storage medium.

MAINTENANCE

L Series maintenance is performed by Burroughs service personnel available for on-call emergency service during normal business hours. Preventive maintenance is performed at mutually agreeable hours. Microcoded diagnostic routines use test cards and a dictionary to isolate memory failures.

First-year maintenance is covered by a warranty. A separate contract covers subsequent service. Maintenance personnel are located in more than 200 branches across the United States and in most computer-using countries in the world.

PRICE DATA

Model Number	Description	Purchase Price $	Rental (Exc Maint) $
BURROUGHS L6000			
Accounting Computers			
L6336 Models			
15-1/2-inch front feed			
L6336-800	(128 words of user memory)	321	9,490
L6336-820	(256 words)	356	10,490
L6336-840	(384 words)	393	11,490
L6336-860	(512 words)	428	12,490
L6336-890	(640 words)	464	13,490
L6346 Models			
26-inch front feed			
L6436-800	(128 words of user memory)	357	10,490
L6436-820	(256 words)	393	11,490
L6436-840	(384 words)	428	12,490
L6436-860	(512 words)	464	13,490
L6436-890	(640 words)	500	14,490
MMR Computers			
L6501-869	(no I/O potential)	567	19,690*
L6511-869	(paper tape or edge-punched cards)	629	20,690*
BURROUGHS L8000			
Accounting Computers			
(all models include dual pin-feed device and a cassette subsystem with 1 station)			
L8200-700	15-1/2-inch rear-feed forms handler (4KB)	446	12,990*
L8300-700	15-1/2-inch front-feed forms handler (4KB)	482	13,990*
L8400-700	26-inch front-feed forms handler (4KB)	518	14,990*
L8700-700	15-1/2-inch front-feed forms handler (4KB)	535	15,490*
L8800-700	26-inch front-feed forms handler (4KB)	571	16,490*

Model Number	Description	Purchase Price $	Monthly Rental (Exc Maint) $
MMR Computers			
L8541-709	26-inch MMR forms handler (6KB; 352-digit data track)	718	23,490*
L8542-709	26-inch MMR forms handler (6KB; 704-digit data track)	750	24,490*
L8941-709	26-inch MMR forms handler (6KB; 352-digit data track)	767	24,990*
L8942-709	26-inch MMR forms handler (6KB; 704-digit data track)	800	25,990*
Configured MMR Systems			
Subscript indicates type of peripherals, i.e. L8700-xyz where x = no of cassette stations; y = 0; no line printer; y = 1; 90-lpm printer; y = 2; 180-lpm printer; z = 1; terminal display unit; z = 3; audit entry system			
All models have 10KB user memory			
L8300-310		835	28,000*
L8300-313		1,060	35,390*
L8300-411		970	32,400*
L8541-300		795	27,400*
L8541-310		970	32,400*
L8541-313		1,215	40,390*
L8541-411		1,165	37,400*
L8700-310		835	29,500*
L8700-313		1,060	36,890*
L8700-411		970	33,900*
L8941-300		795	28,870*
L8941-310		970	33,900*
L8941-313		1,215	41,890*
L8941-411		1,165	38,900*
BURROUGHS L9000			
Accounting Computers			
L9300-200	15-1/2-inch dual pin-feed forms handler, cassette subsystem with 1 station, 60-cps keyboard printer	607	16,990*
L9400-200	26-inch dual pin-feed forms handler, cassette subsystem with 1 station, 60-cps keyboard printer	643	17,990*
L9541-209	single stripe, 6KB cassette subsystem with 1 station plus feeder/stacker, 60-cps keyboard printer	830	25,990*
L9542-209	dual stripe, 64KB, cassette subsystem with 1 station plus feeder/stacker, 60-cps keyboard printer	862	26,990*
	Options and Peripherals		
	Processor Options		
A4011	2KB Memory Module (up to 16KB total)	29	800
A4011-1	2KB Memory Module (over 16KB)	21	810
A2011	24KB Extended Memory Pot	21	750
A2012	32KB Extended Memory Pot	22	800
A7262	Bidirectional Print Option	35	1,000
A7341	Upgrade Kit (to upgrade an L8000 MMR console to 704-digit MMR capacity)		1,500
A7351	Upgrade Kit (to convert any Series L8000 to the corresponding single data comm TC 3500 style)		1,500
	INPUT/OUTPUT		
	Punched Card		
A9114-1	Reader (200-cpm; 80-col)	78	2,790
A9119-1	Reader (300-cpm; 96-col)	85	3,500
A9419-2	Reader/Punch Data Recorder (300/60; 96-col)	240	9,490
A9419-6	Multipurpose Card Unit (300/60; 96-col)	285	11,390
A2331-1	Control (for A9119-1)	25	900
A2331-2	Control (for A9419-2)	53	1,900
A2331-3	Control (for A9419-6)	59	2,100
	Card Tape		
A9222-1	PPT/EPC Punch (40-cps)	53	1,990
A9122-1	PPT/EPC Reader (40-cps)	42	1,590
A2322	PPT/EPC Control	28	1,000
	Printers		
A9249-1	Line Printer (90-lpm)	240	8,500
A9249-2	Line Printer (180-lpm)	280	11,200
A2361-1	Controller	39	1,400
A2361-2	Controller	42	1,500
A2362-6	Controller	21	490
	Magnetic Tapes		
A9490-25	Cassette Tape Subsystem (1st station includes controller)	59	1,649
A1495-1	MTU (2-port)	365	11,500
A1495-2	MTU (4-port)	373	11,750
A1495-3	MTU (6-port)	381	12,000
A1495-4	MTU (8-port)	389	12,250
A2392	Data Collection MTU Controller	28	1,000
	Magnetic Record Reader		
A9161-1	352-Digit Data Track	148	4,790
A9162-1	704-Digit Data Track	161	4,990
A7141	Upgrade Kit (to upgrade A9161 magnetic record reader to 704-digit data track)		500
	Consoles		
A9361	Magnetic Record Handler (stacker w/hold; includes PF29)	42	1,500
A9362	Magnetic Record Handler (feeder/stacker/hold; includes PF29)	78	2,790
PF 21	RF, Single Sync (15-1/2 inches)	7	250
PF 22	RF, Single Async (15-1/2 inches)	7	250
PF 23	RF, Dual (15-1/2 inches)	14	500
PF 24	FF, Single Sync (15-1/2 inches)	7	250
PF 25	FF, Single Async (15-1/2 inches)	7	250
PF 26	FF, Dual (15-1/2 inches)	14	500
PF 27	FF, Single Sync (26 inches)	7	250
PF 28	FF, Single Async (26 inches)	7	250
PF 29	FF, Dual (26 inches)	14	500

Notes:

Prices given are for 3-month warranty. Same styles can be purchased with 1-year warranty for $7,350 and $8,350.
*Omit Options
On any 8500 or 8900 model, the feeder/stacker device can be omitted.
On any 8000 level model, the cassette subsystem can be omitted.
If omitting A9362/2 feeder/stacker, deduct $2,000 from purchase price.
If omitting A9490-25 cassette subsystem, deduct $1,000 from purchase price.

COMPUTER AUTOMATION INC.
SyFA

OVERVIEW

SyFA (System For Access) is Computer Automation's (CAI) entry into the small business, commercial end-user market. A disc-based interactive system capable of supporting up to 24 on-line users, SyFA offers a demand-paging operating system and a comprehensive data base management system.

SyFA is based on CAI's LSI-2/60 MEGABYTER minicomputer, which has been enhanced with special hardware features (such as character movement and decimal arithmetic) to improve commercial functioning. It supports from 10 to 452MB of on-line storage and up to 24 local or remote display terminals. SyFA can act as a remote job entry (RJE) terminal to a mainframe computer.

SyFA comes with a special-purpose operating system, support language, and utilities bundled as part of the basic system price. The operating system, SyFA Concurrent Logic Operating System (SyCLOPS), is designed to control all terminals attached to the system and any application programs running on the terminals. The system programming language is SyBOL, a language designed by CAI to handle the requirements of an interactive commercial and data base environment.

CAI, founded in 1967 as a minicomputer manufacturer, has sold over 10,000 machines, primarily to the OEM market. SyFA was announced in March 1976 and first deliveries began in the same month. Table 1 lists SyFA system specifications.

COMPATIBILITY

SyFA is constructed of components currently marketed by CAI as part of its OEM product line. In particular, memory boards, disc drives and controllers, and terminals are all compatible with the components of the CAI LSI-2 minicomputer series. The LSI-2 does, however, offer a number of peripherals that are not currently supported by SyFA, such as magnetic tapes, card readers, and paper tape equipment.

A variety of terminal emulators are available for the SyFA system, including the Univac DCT 2000, CDC 200 VT, and IBM 2780, 3780, and HASP interleaving workstation. SyFA also supports any EIA-compatible device including teletypes, printers, and local or remote SyFA processors.

PERFORMANCE AND COMPETITIVE POSITION

CAI, after many years of selling only in the OEM marketplace, has followed the tracks of many other mini manufacturers and entered the commercial data processing market with a product aimed at large companies that are moving away from concentrating all of their processing at large, centralized DP sites. Like Hewlett-Packard with its 3000 Series II, Microdata with its REALITY, Data General with its Eclipse C/300, and Digital Equipment Corporation with its Datasystem 500 Series, CAI is offering an interactive, multistation system for business users. In most cases, the system is installed to handle data entry, processing, and files at the local site, and then communicate as an RJE terminal to a host site. Also marketing systems to handle similar functions are several of the terminal vendors — Four-Phase with its System IV/70, Raytheon with its PTS/1200, and Datapoint with its 5500.

HEADQUARTERS

Computer Automation Inc.
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Irvine CA 92664
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Table 1. SyFA: System Specifications

PROCESSOR	
Type	CAI LSI-2/60 MEGABYTER
Main Memory (bytes)	64K to 1,024K
Main Memory Type	Core
Cycle Time (μsec)	1.2
Character Size (bits)	8
Word Size (bits)	16
AUXILIARY DISC STORAGE	
Number of Drives	1 to 8
Drive Capacity (MB)	10 or 80
Seek Time (avg)	35 ms (10MB); 30 ms (80MB)
Transfer Rate	300KB (10MB); 1,200KB (80MB)
DISPLAY	
Number of displays	1 to 24
Screen size	13" diagonal
Lines	24
Characters per Line	80
Character Set	ASCII, upper & lower case
PRINTERS	
Number of Printers	Up to 2
Columns	80 & 132
Speed	100 cps, 165 cps, 300 lpm, 600 lpm
COMMUNICATIONS	
Line Facility	Dial or leased
Line Speed (sync)	2,000 to 4,800 baud
Line Speed (async)	110 to 1,200 baud
Transmission Mode	ASCII or bisync
Emulation	IBM 2780, 3780, HASP workstation; CDC 200 UT; Univac DCT 2000
COMPATIBILITY	
Computer System	CAI minicomputers
SOFTWARE	
Operating System	SyCLOPS
Languages	SyBOL std; FORTRAN, BASIC opt

With the exception of the REALITY system, which is often sold to the novice user as a turnkey system for standalone processing, all of the preceding systems (as well as SyFA itself) are designed for a sophisticated user who, at the very least, has some DP expertise, and in best cases some resident programmers who can deal with specialized languages, interactive environments, and managing a data base.

CAI's SyBOL is offered as a language designed specifically for an interactive environment; in this respect, it is similar to Microdata's ENGLISH, Digital Equipment's DIBOL, and Raytheon's MACROL. SyBOL features easy character string movement (as a single instruction), decimal arithmetic on fields with varying sizes and decimal locations, and a repertoire of data management services, including multiple index file access similar to that of Data General's INFOS.

Standard features of the system are two print spooling tasks and a single remote job entry task, all of which operate concurrently with terminal application programs. A full complement of system utilities is also provided.

In terms of price, the basic SyFA system at $45,000 is perhaps somewhat less expensive than many of its competitors. Since it makes use of the new, large 80MB discs, its price for systems that require larger data bases is considerably more attractive than those of competitors who do not yet offer this technology.

USER REACTIONS

The SyFA users interviewed had their equipment for only a few months; some had purchased their systems prior to formal product announcement. All were quite satisfied with their initial experiences on the system, and some had impressive plans for eventual SyFA usage based on their expectations of system performance.

Government Agency. A federal government agency has acquired a SyFA system configured with one 10MB disc, a printer, and six terminals. It will be used for data entry processing currently performed by Sycor data entry equipment. The SyFA system was chosen because the agency hopes to link its regional field offices into a distributed network with processing shared by a large mainframe (CDC Cyber system) and the distributed processors (SyFA). Although only data entry processing is currently being converted to SyFA, the user is planning to implement a number of other distributed applications. This user is quite pleased with the software facilities and system reliability.

Service Bureau. Another SyFA user is a small data processing service bureau. This organization performs full accounting functions for a number of clients, and parts inventory for 13 auto dealers. Originally, the service bureau performed all processing in a batch mode on an IBM System/370. As an intermediate step, Datapoint data entry terminals were installed at client sites for transaction capture. With SyFA, the user is planning on putting his processing programs directly on the system, and replacing the customer data entry terminals with SyFA Information Stations connected by modems. He had considered upgrading to a Datapoint 5500 controlling a network of terminals, but chose the CAI system because of its higher performance capability and the greater number of terminals that could be attached to the processor. He was planning a system with 16 terminal ports, and expected that additional terminals would be installed as the business grew.

Hospital. A hospital has acquired a SyFA system with two discs and four terminals to replace Datapoint data entry stations. The SyFA system was selected because of the superior response times it offered for on-line terminal stations. Also, this user found SyBOL to be relatively similar to Datapoint's Datashare language, which was already familiar to and liked by members of his programming staff.

Initially the SyFA system will be performing data entry for a batch-oriented Univac mainframe; the user plans to implement a full patient admission/discharge system on SyFA and spoke of eventual terminal populations in the neighborhood of 60. This user examined DEC, Data

General, and Four-Phase equipment prior to purchasing SyFA, and discovered that the SyFA system had the ability to connect terminals via telephone lines (at 1,200 baud) without direct and expensive cable connections throughout the building.

CONFIGURATION GUIDE

The basic SyFA system consists of a CAI LSI-2/60 minicomputer with 64K bytes of core memory, an asynchronous multiplexor terminal control unit with eight lines, a Direct Memory Access (DMA) controller, and a single 10MB disc drive. To this basic system may be added:

- Memory to 1,024K bytes in increments of 16K bytes.
- Up to eight disc drives. The P10 drive has one fixed and one removable drive, each with a nominal storage capacity of 10MB. Usable storage on the P10 drive is 8.1MB. The C56 drive is a removable pack with a nominal storage capacity of 80MB. Usable storage on the C56 is 56.5MB. Maximum on-line storage for the SyFA system is therefore 452MB.
- Up to 24 local or remote terminals (SyFA Information Systems). SyFA can support up to three asynchronous multiplexor units (for a total of 24 lines). A local terminal is hardwired to the multiplexor; a remote terminal uses a modem.
- Up to two printers with associated controllers, can be attached directly to the CPU. In addition, any terminal port can attach a printer. Available printers have speeds of: 100 cps, 165 cps, 300 lpm, and 600 lpm.

Mainframe

The SyFA central processor is the CAI LSI-2/60, the latest and most powerful member of the CAI minicomputer family. It has 224 instructions, including character string manipulation, stack instructions, bit-level addressing, decimal arithmetic, vectored priority interrupts, and a real-time clock. SyFA comes with core memory and a power-failure-detection interrupt to protect current memory contents during a power outage. I/O is handled by means of a high-speed asynchronous bus, with disc data transfer controlled by means of a cycle stealing direct memory access channel.

Under SyCLOPS, the SyFA operating system, main memory is partitioned into 32K bytes for the operating system, 16K bytes shared among I/O buffers and demand paging program requests, and 16K bytes (or more) for blocks of task data memory, one block per active terminal or background task. Concurrent handling of terminal or other asynchronous events is completely under the control of the operating system.

PERIPHERALS

Peripheral devices available on SyFA include moving-head discs, terminal stations, printers, and communications interface devices.

Display Terminal. The basic SyFA configuration includes an asynchronous multiplexor unit with eight lines or ports. Up to two additional multiplexor units (24 asynchronous ports) may be attached. Each port accepts any EIA or CCITT device, with local terminals directly wired to the multiplexor and remote terminals attached via a modem connection. Remote and local terminals may be mixed as desired.

A SyFA Information Station consists of a video screen and a detachable keyboard. The screen holds 24 lines, each with 80 columns; the full ASCII character set is available, including upper- and lower-case. The keyboard uses a standard typewriter section with numeric pad and a number of special function keys.

Disc. Up to eight disc drives may be attached to SyFA. Two different drive models are available; they may not be mixed on a single system. The smaller drive consists of two plotters, one fixed and one removable, with a total storage capacity of 10MB. The larger unit consists of a single removable pack, with a capacity of 80MB. With allowances for disc formatting, the maximum total system disc capacity is over 452MB.

All data on disc is formatted into 256 byte sectors, and all data transfers make use of cycle stealing and direct memory access. Head positioning of multiple drives is overlapped. Record and file manipulations of disc data are all handled by means of SyBOL verbs, including indexed file access.

Printers. One or two printers may be attached directly to the central processor and are supported by the operating system spooling facilities. In addition, any terminal port may accept a printer instead of a keyboard/display unit. Two matrix character printers are available, operating at 100 and 165 cps. Two medium-speed line printers are also offered operating at 300 and 600 lpm.

DATA COMMUNICATIONS

Asynchronous communications is supported for any system terminal through the standard asynchronous multiplexor unit. Directly connected local terminals operate at 9,600 baud. Remote terminals using modems operate at 100 to 1,200 baud.

A single synchronous communications controller may be attached to the central processor and can operate over leased or switched lines. Speeds from 1,200 to 9,600 baud are supported. A Remote Job Entry (RJE) task operates

under control of the operating system, and is capable of emulation of a number of RJE terminal protocols, including the IBM 2780, 3780, or HASP workstation; CDC 200 UT; and Univac DCT 2000.

A special feature also permits a number of individual SyFA Information Stations to emulate the IBM 3270 display station. Under program control, operators can switch between 3270 communications and normal system operation. If the switching mode is used, then a 16KB memory area must be dedicated to each port to assure rapid switching. If sufficient memory is not available, then mode switching may be delayed until system memory is freed from other activities.

SOFTWARE

SyFA runs under control of the SyFA Concurrent Logic Operating System (SyCLOPS), an interactive demand-paging operating system. CAI also makes available certain software from its LSI minicomputer line at an additional cost, including both FORTRAN and BASIC.

SyCLOPS

SyCLOPS is designed for multitasking; that is, it will support the simultaneous execution of 24 application programs (one per multiplexor port), one concurrent background utility program, one concurrent RJE communications emulator task, and two print spoolers.

System memory management is handled by the operating system; its operation is transparent to the user. The time allocated to each task is a function of recent processor usage, I/O request, and real-time waiting history. A computer bound program can never seize the system; an I/O bound program can never be frozen out. Separate address spaces are provided for variables and constants (data divisions), executable code (procedure divisions), and disc I/O. Data divisions are resident throughout a program execution, with no roll-out. Procedure divisions are compiled as reentrant code and are fetched from disc on a demand basis. Several ports may make use of the same segment of reentrant program in main memory.

Disc File Access. SyFA's data base access facilities represent one of the system's strong points. File creation and retrieval are done using symbolic names, and files can be expanded automatically in segments that need not be contiguous. Groups of records are blocked in memory buffers; buffer transfers can be of variable lengths so that wasted disc space is minimized. Space compression can be requested under program control at record write time; decompression of the record at read time is performed automatically.

Disc records can be stored and accessed in the following modes: sequential, relative random, and indexed. An arbitrary mixture of these methods can be used with any data file. A data file can have an unlimited number of associated indexes, with each one created, expanded, and deleted as required. Data files may be accessed either exclusively or in shared mode; for shared files record lockout facilities are provided.

SyBOL

User applications are written in the SyFA Business Oriented Language (SyBOL), which is a high-level procedural language, resembling COBOL in its structure and appearance.

SyBOL provides a series of specialized verbs for character movement and comparison, decimal arithmetic on varying sized fields with decimal points, and operations on the data base. Special features of the language include program chaining, checkpointing for invocation of system utilities or another program, and automatic invocation of a command procedure library.

CAI does not provide a particular set of system security features; it recommends that security and other port startup controls be implemented by the user writing his own protection features into SyBOL terminal control programs.

Utilities

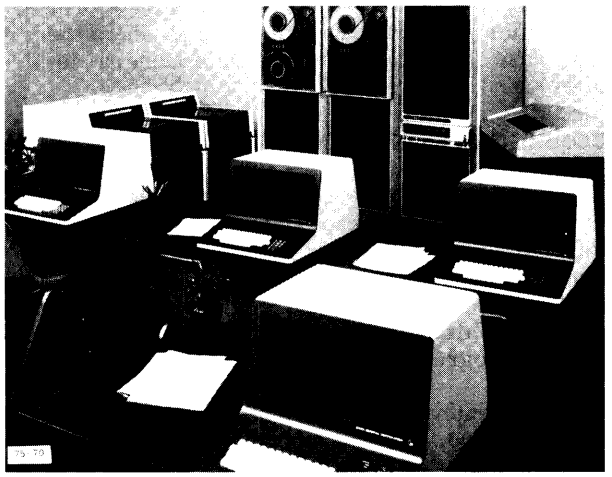
A host of system utilities are provided with the SyFA system. Many of them are offered in versions that run either under operating system control or in standalone mode. There is a SyBOL compiler, as well as standard utilities such as edit, sort, file copy, file search, disc reorganization, and copy and format functions.

MAINTENANCE

Maintenance is provided for SyFA through a nationwide contract with Sorbus, which has over 100 service centers in the U.S. Service representatives usually restore operation within 3 hours after placement of a service call.

PRICE DATA

Component	Purchase Price $ (Maint. not Incl)	Monthly Maint. $
SyFA system with 10MB disc, central processor, 64K bytes core memory, disc controller, async multiplexor	45,000	325
Additional 10MB disc	10,500	85
SyFA System with 80MB disc	56,000	400
Additional 80MB disc	17,500	115
Additional 16K Bytes Memory	2,500	25
SyFA Information Station	2,750	30
Sync Communications Facility	4,000	30
IBM 2780 Emulator	1,500	35
IBM 3780 Emulator	2,000	40
HASP Workstation Emulator (IBM 360/20)	2,500	50
CDC 200 UT Emulator	2,000	40
Univac DCT 2000 Emulator	2,000	60
80-col 100-cps Printer	4,950	45
132-col 165-cps Printer	8,500	55
132-col 300 lpm Printer	16,000	100
132-col 600-lpm Printer	19,500	125
FORTRAN Compiler	3,000	30
BASIC Compiler	2,000	20



OVERVIEW

On Tuesday, March 4, at simultaneous announcements in Boston, London, and Munich, Data General introduced the first in what will be a series of commercially oriented data-base management systems. Called the Eclipse C/300, the system is being marketed to "medium-to-large Fortune 500 companies" who already have sizable centralized computer installations and substantial EDP experience.

The Eclipse C/300 has all the earmarks of a minicomputer-turned-small-business machine. Based on Data General's Eclipse minicomputer, the C/300 can handle a large data base and support a number of terminals (32). It offers a standard programming language to generate periodic, exception, and demand reports (RPG II). Besides interfacing with IBM's medium-to-large-scale equipment, it has a reasonable operating system.

The C/300 is different, however. Even though it is bundled, it is not a small, prepackaged system — it is a larger system which Data General feels is competitive with the IBM S/370 Model 155 in computational power. It is not just a small, stand-alone business computer — it will not even be used for conventional batch activity. With the C/300, Data General has also chosen to ignore an industry constraint followed by other manufacturers' commercial products; specifically, COBOL is not offered. Moreover, the C/300 is being directed at a specific market segment — the sophisticated user.

WHAT THE C/300 IS

At AUERBACH, we have been talking for quite some time about the need for a sophisticated real-time system that would distribute some of the power and relieve the load on large, shared, centralized computers performing traditional batch activities. In addition, this hypothetical system would operate with reasonable economy of time and money. Data General has been talking to representatives of 35 to 40 major corporations who have expressed the same need. The result is the C/300.

Basically, the C/300 presupposes a dedicated on-line, real-time environment. It is directed toward networking and value-added network applications, thereby solving the problem of an overburdened central processor where the only previous alternative was to upgrade.

The C/300 or multiple C/300s would be physically located in particular departments or divisions of a company where they could perform such functions as inventory control, manufacturing, distribution, sales, and purchasing. Further, they could be connected locally or remotely to a full-scale central processor.

The C/300 provides RPG II, primarily for producing reports. It offers FORTRAN IV and 5 with instructions for handling commercial needs; a processor based on the Eclipse minicomputer but enhanced to include an instruction set designed for commercial data base activities; sort/merge utility programs; and a sophisticated data base management structure which is hardware-independent and also easy to use. Called Infos, the package creates and maintains data bases. It is an extension of Data General's Mapped Real-time Disc Operating System (MRDOS), used on the Eclipse minicomputer.

WHAT THE C/300 IS NOT

The C/300 is not oriented towards selling applications, nor is it really oriented towards commercial shops since there is no COBOL at this time. Its operating system does not emphasize scheduling since it is supposed to be a dedicated appendage of a larger network. Also, for the same reason, the C/300 is not intended to displace current systems but, rather, add to them.

Most important, it will not emphasize security/privacy. Any such provision is up to the user,

who must control access to his terminals. (Some record lock-out is provided, but passwords and/or user profiles are not.)

The C/300 is not in the small-business-computer competitive market; specifically, it does not compete with IBM's System/3 or System/32. Data General feels that it cannot offer the extensive support required by novice computer users. Although the C/300 competes with other minicomputer-oriented data base systems, it is not competing head-for-head since it is aiming at a specialized market of sophisticated users.

WHAT WE THINK

Data General's representatives were quietly confident at the announcement; from our perspective the feeling is justified. There is a market such as the one Data General is describing; now there is a product for that market. The product is reasonably priced, and the product works.

What is not clear is how certain other considerations will affect the product. The C/300 does not approach a COBOL-type data base management standard. Therefore, it cannot expect much government support, if any.

The C/300 is not answering the need for additional security/privacy precautions. It is leaving them entirely up to the user. We understand why, of course; they are too expensive in terms of software overhead and thus system resources. Although promising work is being done in this area, no system is really secure yet. Something should be offered beyond the announced capabilities, however, since representatives mentioned only that the user must control access to his terminals.

The state of the economy may curiously affect the product. On one hand, the C/300 offers a less expensive alternative to upgrading a central processor. However, it is currently a purchase-only system living in a mixed purchase/rental world. Data General may want to offer rental/lease plans eventually.

Finally, the C/300 offers distributed processing and distributed budgeting to situations where many corporate EDP budgets are centralized. This factor may introduce some confusion into the corporate paperwork necessary to acquire the systems.

USER REACTIONS

So far, there are no users, but we spoke to a few corporations who seemed to be potential users. Most were interested. As expected, they agreed that an important aspect of the system was its data base management facilities. Their plans were to examine the system's ease of use, particularly the effort involved to produce the data base from the tools that Data General is offering.

CONFIGURATION GUIDE

The Eclipse C/300 systems comprise a central processor, the Infos software package, the MRDOS operating system, a series of high-level language processors (RPG II, FORTRAN IV, FORTRAN 5, Extended BASIC, and ALGOL), plus certain utilities (sort/merge and multiterminal control program).

Data General lists three general configurations for the C/300:

- A small system including a processor with 96K bytes of interleaved core memory, 10 million bytes of disc storage, a keyboard console and one visual display terminal, a 9-track 60,000 character-per-second magnetic tape drive, a 60 line-per-minute printer, and a four-line asynchronous multiplexor.
- A medium system including a processor with 128K to 160K bytes of interleaved core memory, 90 million bytes of disc storage, a keyboard console with two or three visual display units, a 9-track 60,000 character-per-second magnetic tape drive, a 300 line-per-minute printer, and an eight-line asynchronous multiplexor.
- A large dual-programming system with a processor and 160K bytes of interleaved core memory, 90 to 180 million bytes of disc storage, a keyboard console and two to seven visual displays, a 9-track 60,000 character-per-second magnetic tape drive, a 300 line-per-minute printer, and a 16-line asynchronous multiplexor.

Commercial instructions added to the Eclipse Processor are microprogrammed; such instructions include character string moves and translates. The standard Eclipse processor handles extended arithmetic operations on packed and unpacked decimal data up to 32 digits long. Editing instructions allow for decimal conversion, zero suppression, leading/trailing signs, floating fill characters, and punctuation control.

The processors feature single-bit error correction and multiple-bit error detection. A byte moves through memory in 800 nanoseconds. Memory is 16-way interleaved and there is an optional cache memory.

Technically, 32 terminals can be configured on a C/300. Data General advises that the number really depends on what each user deems an acceptable response time for his individual applications. At present, no response times are available for prototype applications. C/300 allows hardwired, twisted-pair and modem terminal hookups.

SOFTWARE

C/300 offers an operating system, compiler languages, utilities, and a data base management system. MRDOS is a multitasking, dual-programming operating system currently used on the Eclipse minicomputers. FORTRAN IV and 5, ALGOL, and BASIC were also previously available on the Eclipse minicomputer. The RPG II compiler, which is compatible with IBM's DOS RPG II, is new for Eclipse C/300. It supports ISAM files. Moreover, the user can implement an RPG multiterminal facility which allows one terminal to talk to a second. There is a HASP emulator and a 2780 emulator, plus a disc sort/merge utility which operates in either interactive or batch mode.

Infos Explained

Data General's new data-base-oriented file management system is called Infos. Although Infos is acutally an extension of MRDOS, Data General claims it was designed with logical rather than physical orientation. The user can spread his data base across several storage media without having to modify the data.

Infos handles multivolume file structures; fixed and variable, blocked and unblocked records; file sharing; and buffer management. It also provides a record lock-out facility.

Infos supports the sequential access method (SAM), which in turn supports IBM and ANSI standard magnetic tape labels (for communication between the C/300 and other manufacturers' computers). In addition, it supports a Random Access Method (RAM) and an Indexed Sequential Access Method (ISAM). Most interesting, however, is Data General's Data Base Access Method (DBAM), which is truly a sophisticated means of accessing and maintaining data bases.

Basically, DBAM is a hierarchical key system. With DBAM, indexes and keys can be created without altering the data base. A variety of keys can access the same data base; and when records are deleted, keys and space are automatically compressed. An "index" to Data General is actually a single unit in an index file; this index can contain part of a record (which is good, since tests have shown that 2 percent of the data base is accessed 90 percent of the time). The index can be variable in length, with a pointer to another multilevel index.

The index file must always be on-line; but because it is implemented in a tree structure, the file can be spread across data storage media (top levels in core and lower levels on direct access, for example). A key can be generic or approximate (for example, "G+" will yield the first record beginning with G). Infos organizes data into records, records into blocks, blocks into volumes, and volumes into files.

Infos Analyzed

C/300's Infos has several characteristics that are usually found only in much larger, sophisticated data base management systems. First, it can optimize storage economy by filling "holes" and deleting keys left when records are deleted. Second, it uses an inverted file structure, which is best for heavy retrieval demands and ideal for applications requiring quick response, such as on-line systems. When a query is entered, for example, only the index need be searched to determine those records which satisfy the search parameters. There is no running through chains or lists as is the case with most other small DBMS systems.

The main drawback is that the inverted index can become quite large, thus eating up main storage and making the cost of maintenance and updating quite high. However, Data General has allowed for a hierarchy of data files, and the ability to put certain levels of the index on main storage and the rest in secondary storage. The drawback is that it is usually feasible to maintain only one data base. To maintain more than one causes headaches and overhead in searching media and moving indexes. Since Data General is targeting Infos as support for dedicated on-line environments, it should perform there admirably.

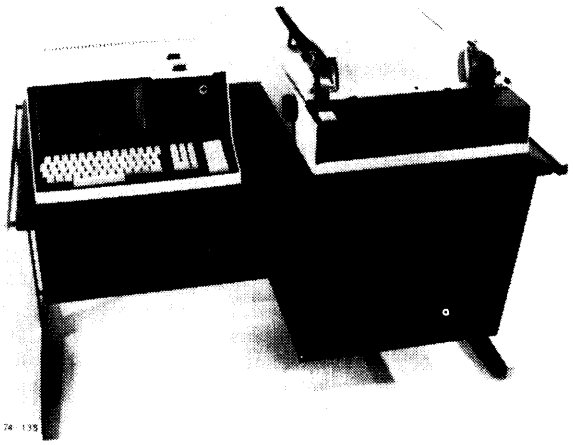
There are several things Infos does not do and other data base systems do. It does not offer a data descriptor language, nor does it offer a query language. The user, therefore, is on his own; this factor could cause headaches, even for sophisticated users.

PRICING AND AVAILABILITY

An average small configuration is priced at $77,400; an average medium system, at $113,950; and an average large configuration, at $159,650. Shipments will start in the summer of 1975.

SALES AND SUPPORT

Data General has a sales force of 150 people marketing the C/300 domestically. Sales offices are located throughout North America, Europe, and Australia.



Datapoint Corporation has added the Diablo 30 character-per-second impact data processing printer to the line of peripheral attachments available with the Datapoint 2200 business computer system. The Diablo printer, pictured adjacent to a 2200, offers a print quality that equals or surpasses that of most office typewriters.

OVERVIEW

The Datapoint 2200 is a communications-oriented small business computer designed to operate either as a small stand-alone system or as a local terminal-processor in a distributed processing network. It evolved from the 2200 intelligent terminal, which developed two versions early in its history: Version I remained a terminal; the higher-speed Version II expanded into the present small business system. Although Version I is still supported, the new Datapoint 1100 system is a higher-speed, lower-cost, more competitive system and is being actively marketed in its place. This report describes Version II, now marketed as the 2200 small business system proper.

The heart of the 2200 system is a byte-oriented processor with 4K to 16K bytes of MOS main memory, 1.6-microsecond cycle time. Standard processor features include 14 registers, a 16-deep push-pop stack, a 1-millisecond hardware interrupt facility and I/O facilities for up to 16 peripherals. The processor is housed in a single desktop unit that includes a 960-character CRT with keyboard and dual magnetic tape cassette drives. This basic system can be expanded by 256K-byte diskettes, 25M-byte disc pack drives, 2.4M-byte cartridge discs magnetic tape drives, printers, card readers, up to eight slave CRTs that can access memory independently via a multiport adapter, and a variety of communication adapters.

One strong point of the 2200 system is the extensive body of system software that the company has developed over the years: three operating systems (COS, TOS, and DOS), several assemblers, six versions of a special high-level language called Databus, Basic and RPG compilers, and a variety of utility routines (including sortmerge). A package called "Dataform" provides data entry capabilities; one called "Scribe" allows the 2200 to function as a powerful automatic typewriter/word processing system. A program called "Datashare," now in its third revision, permits the simultaneous execution of Databus programs on up to eight slave CRTs. Software packages provide compatibility with IBM 2780, IBM 2741, IBM 2265, IBM 360/20 HASP, CDC 200, Univac DCT-2000, and Teletype (RS232C). Datapoint has no standard business application packages, but the company does offer system engineering support for user programming efforts. Datapoint will also supply the names of all software houses they know of who supply packages and customized programming services.

Until 1973, Datapoint specialized in two basic product lines: the 3000/3300 Series interactive computer display terminals and the Datapoint 2200 systems. The 2200 was introduced in 1971 as an intelligent terminal, but soon a Version II was announced that was supported as a small business and "dispersed data processing" computer. By mid-1973, the company had delivered more than 4,300 of the 3000/3300 systems and 2,500 of the 2200 systems—it was a profitable operation. In November 1973 the company announced the new Datapoint 1100 and 5500 Series. The 1100 Series is designed specifically as an intelligent terminal for the source data entry market. The 5500 Series is a larger, faster distributed processing/small business computer system than the 2200; it gives 2200 users an upgrade system to expand their processing capabilities. The 1100, 2200, and 5500 Series are all upward compatible systems. The 1100 was delivered in February, 1974 and, by the end of fiscal 1974, the company had delivered more than 5,000 1100 and 2200 systems combined. The 5500 is due for delivery in the second quarter of 1975. In spite of the unfavorable economic climate, the company has maintained an impressive growth rate and a strong financial position.

Datapoint markets its systems through 30 direct sales offices in the United States. TRW Datacom International, Inc. in Los Angeles is the exclusive international distributor of the Datapoint system: it provides maintenance, service, and support ouside the United States through an international network of representatives. TRW Communications and its subsidiaries directly market the systems in Canada, Brazil and Switzerland. Scandinavian sales offices include Regnecentralen (Denmark and Holland), Oy Nokia Ab Electronik (Finland and Sweden), and Scanips (Norway and Austria). Ventek, Ltd., handles sales in the British Isles. Western Europe sales offices include Matra S.A. (France), Gier Electronics (Germany), Sair Electronics (Belgium), and Encodex S.p.A. (Italy). In addition to the aforementioned companies in Switzerland and Holland, CJK Company, Ltd., handles marketing in Japan, Control Y Proceso Electronico SA in Mexico, Sigma Data in Australia, Information Systems Ltd. in Israel, Computer Advances in South Africa, and Sistemas De Control C.A. in Equador. Applied Systems markets the system in the Philippines, Singapore and Malaysia.

Roughly 50 percent of Datapoint systems have been sold internationally. The U.S. installed base is divided into about 30 percent end-users and 20 percent OEM, with proportions shifting in favor of end-users.

PERFORMANCE AND COMPETITIVE POSITION

The Datapoint 2200 competes in a rapidly growing market for small business computers; this market has already begun to segment itself into sectors. One large sector is "distributed processing." Large businesses with many small branches allow as much local processing as possible (together with related record maintenance); only important summary records are transmitted to a large central mainframe for further processing. The second sector is that of a small stand-alone system for a small business, as an alternative to time sharing or a service bureau. The small business may want communications capability for certain jobs it cannot handle itself. Also, the size of the branch office as well as the small business determines the computer size and speed needed. Thus, there is considerable overlap between markets. A third sector markets to large businesses that dedicate computers to different departments instead of having a single central facility (Banks frequently fall into this category).

Two clear areas of differences arise among these three sectors:

- The small businessman is more interested in turnkey systems, standard software or systems that can be easily programmed to cut costs of in-house program development or of service bureaus. Branches in a distributed processing network or departments in a large business, on the other hand, frequently rely on in-house software development at a central facility.
- The small businessman or a department in a large business may or may not opt for communications, whereas this is an essential element of a distributed processing network.

Small business systems can also be subdivided into systems that provide interactive processing and those that do batch processing. Interactive processing is ideal for extensive key entry (keypunch-replacement) functions and word-processing. It appeals to the small user who needs a system that can do many things in order to be cost justified. It also appeals to large users for specific applications. The large batch-oriented systems appeal to the more experienced growing small business, to larger branches of a distributed processing network and to specific applications within a business. Frequently, these batch-type systems function like remote batch terminals. The two system types are not predetermined by processor hardware, as shown in the ubiquitous IBM System/3, with the interactive Model 6 and the batch-oriented Models 10 and 15;-all essentially the same processor.

The 2200 competes in all small business markets. Because of its strong communications capabilities and experience, however, it is particularly competitive in the distributed processing market. In this market it competes vigorously with the Four Phase IV/40 (the Datapoint's new 5500 is more competitive with the IV/70), Singer System Ten, and NCR 399.

Until recently, the main contender for the small businessman's computing dollar was IBM's System/3. Larger 2200 configurations competed with the smallest of the System/3 models, the interactive Model/6. Like the Model 6, Datapoint 2200 systems provide support for high-level languages (BASIC, RPG II). The 2200 disc storage is optional. The tape or cassette systems can provide cost advantages to small users who have less on-line storage and throughput requirements. Other larger manufacturers like Burroughs (1700), DEC (300 and 500), and NCR (50, 100) compete with System/3 across the board; small configurations or submodels compete with Models 6 and 8 and larger configurations or submodels compete with Models 10 and 15. The new upward-compatible 5500 allows Datapoint to compete with System/3 Model 10 and up. Although Datapoint does not provide the software support the larger manufacturers offer, the popularity of the 2200 has stimulated independent software houses to supplement Datapoints's own software offerings.

The recent announcement of the IBM System/32 has changed the competitive picture somewhat. System/32 is a disc-based turnkey system roughly comparable to the smaller Datapoint 2200, with more restricted I/O. System/32 is a move downward to capture the entry level. The industry giant anticipates selling as many System/32s as it has System/3s, which should alarm manufacturers in the same class of system, such as the Datapoint 3200 and 5500. Although IBM has not yet come out with a system with as inexpensive hardware as the smallest 1100 configurations and its competitors, or for that matter as the Wang 2200 and Hewlett Packard 9830 calculator/computers, the turnkey nature of System/32 will partly offset this apparent price discrepancy.

User Reactions

Users of the 2200 fit into all categories of applications. The following descriptions of 2200 systems now in use are only a sampling of Datapoint customers.

Although the system is very flexible and can be used for a variety of purposes, our contacts with users also point up the constant danger of over- or underestimation of the 2200's capability and of putting the unit in wrong applications. A New York bank, for instance, used five 2200s for more than a year, and then replaced them with IBM 2260s. The 2200s were used as data entry terminals for an on-line corporate trust system and for remote printing of stock certificates. It appears that the company overestimated the capabilities of the units. Later experience proved that certain applications originally planned were impractical because the total cost per terminal was too high and throughput was not as high as originally expected.

In most cases, however, careful analysis of requirements and the machine's capabilities has led to satisfactory installations. The following applications using 2200 systems are grouped according to type of processing.

Distributed Processing. A leading men's clothing manufacturer uses 2200s to move data quickly between central offices, field facilities, and their central warehouse in another state. Incoming sales orders pass through the central computer facility and are transmitted to the warehouse via two 2200s. The orders are filled, verification is transmitted to the central computer, and invoices are generated and mailed in the same day. The company also uses other 2200 systems in their accounts receivable and payroll offices as data entry devices. The intelligent terminals not only saved the company money over competing methods for performing the same functions, but they also added three years to the life of the mainframe because of the reduced central processing load.

A Midwest food producer is using 12 Datapoint 2200 Version I's as minicomputers, time-sharing terminals, and remote batch terminals. Installed at scattered plant locations, the units process inventory and accounts receivable data as a small computer and communicate with the main computer at the company headquarters in straight conversational mode. Production and management data is generated at each plant location and recorded on Datapoint 2200 cassettes; the data periodically is transmitted in batch mode to the main computer. This user was impressed by the combination of keyboard entry, communication, and computing capabilities in the Datapoint 2200.

A service bureau that supplies health care data processing to more than 100 institutions uses 2200s in a variety of ways. Most frequently, the 2200 is a data entry terminal that can adapt to the institutions's peculiarities in format yet submit data in a suitable form for central programs at the service bureau. The service bureau finds the terminals are more and more for on-site processing as users become more sophisticated.

Small Business. A California winery uses two 2200s to maintain their customer mailing list. This is extremely valuable, because marketing is done mostly by direct mail. The 2200s average 1,000 changes per day to their data base, and they incorporate the changes quickly and accurately. The 2200s are also used to print the personalized labels affixed to outgoing shipments.

Departmental Processing/Data Entry. A prestigious scientific publication uses 2200s to update its master international circulation list. The 2200s quickly pre-process renewals, gifts, new subscriptions, address changes, and other alterations. In most cases, they incorporate the changes into the data base the same day they are received.

Another user of the Datapoint 2200, a West Coast retailer, replaced a number of popular stand-alone key-to-tape units with the 2200 to enter accounts payable and payroll data directly onto cassette tape at the source. One of the seven 2200s used is equipped with a standard tape drive to convert data recorded on cassette tapes onto standard half-inch tape. Compared to the stand-alone key-to-tape units, reported a company spokesman, the 2200 is simpler to operate and doesn't require a specially trained operator. The regular payroll clerk operates the 2200. In addition, the 2200 prevents most data entry errors from getting through to tape, keeping a good portion of the pre-processing chores off the shoulders of the host computer.

CONFIGURATION GUIDE

A basic Datapoint 2200 includes an alphanumeric keyboard (both upper and lowercase letters) plus an 11-key numeric pad for data entry, a 960-character CRT screen to display data entered and error messages, a general-purpose minicomputer, two magnetic tape cassette drives (one for program storage and one for data storage), and a built-in power pack, all housed in a typewriter-like desktop unit weighing 48 pounds. Table 1 lists the system characteristics.

Peripheral devices include a 132-column, 30 character-per-second impact printer, a thermal printer, a 135 line-per-minute line printer, 300 and 600 card-per-minute card readers, a standard tape drives (seven- or nine-track), up to four single or dual cartridge disc drives with control, up to four diskette drives per controller, one or two 2314-type disc drives, and a number of communication adapters with modems.

The input lines transfer either status information or data from any of the system components to the central processor. Output lines transfer status information or data, as well as device addresses, to select the device that will transfer information. Devices integral to the 2200—the CRT, keyboard, and cassette tape transport—connect directly to the I/O bus, which originally flowed into a common buffer known as the A-register.

Thus, all information (both status and data exchanged between the processor and peripheral or integral devices) had to pass through a single point. This was no problem on the older Version I because of the long memory access (500 microseconds) time. With the greatly increased memory access speed of Version II, a single A-register was too slow, so the Datapoint 2200 Version II has seven additional I/O registers to alleviate this difficulty. The real-time clock and hardware interrupt facility also ease the handling of I/O operations.

A single address is utilized by both the keyboard and CRT because the keyboard performs only input; the CRT only output.

Minicomputer

The 2200 minicomputer provides all control functions for the system. The central processor includes the following components: 50 different instruction types (including push and pop instructions for stack manipulation), 14 addressable registers, 16-deep pushdown stack, 8-bit memory word length, up to 16K words of memory, complete parallel I/O system, 1-millisecond hardware interrupt, and automatic power-up restart.

Discs

From one to four cartridge disc drives can be added to the 2200 for a maximum of 9.6 million bytes of on-line random access storage (2.4M bytes per cartridge). Both single and dual drives are available. Average seek time is 70 milliseconds. The controller buffer (1,024 bytes) is divided into four 256-character buffers that correspond to sectors on the disc.

With the 2314-type, 20-million character disc, a Datapoint 2200 system has a storage capacity equal to that of a medium to large business system. In many business applications, the user does not need the computing power of a large mainframe computer, but needs large mass storage for files which are used occasionally.

The architecture of the new disc is similar to the diskette and employs 16 sector buffers. Each sector is randomly accessible. The storage capacity is 20 million bytes (characters) per drive, and each 2200 processor can handle two drives for a maximum storage capacity of 40 million bytes. Maximum data transfer rate is 2.5 million bits per second. Average access time is 35 milliseconds. The disc is fully buffered and the buffer is totally addressable. Data need not be transferred into the processor memory, most disc operations can be carried out in the disc buffer.

Diskette

The diskette unit is housed in a freestanding cabinet or in a console cabinet; the controller can handle up to four diskette drives. Each diskette can store over 256,000 characters; average latency time is 83 milliseconds. The diskette architecture is similar to that of the larger Datapoint disc. Four 256-character buffers, which together form a 1,024-character addressable buffer, correspond to sectors on the disc. Thus, software formatted for the larger disc can be used on the smaller diskette with only minor modifications. Software is available to format the diskettes so they are interchangeable with IBM's 3741 diskette.

Magnetic Tape

Datapoint offers three magnetic tape drives: Model 9550/9551 is a 9-track 800 bpi NRZI unit; Models 9552/9553 are 7-track, 556 or 800 bpi NRZI units; and Model 9580/9581 is a 9-track 1,600 bpi Phase-Encoded unit. Tape units include 1,057-word buffers that delimit maximum record size. The integral controllers generate and check vertical parity, longitudinal parity and cyclic redundancy check characters. Models 9550, 9552, and 9554 are console-mounted, while models 9551, 9553 and 9555 are freestanding.

Table 1. Datapoint 2200: Mainframe Specifications

SYSTEM	
MICROPROCESSOR	
Memory Size (bytes)	4-16K
Word Size (bits)	8
Cycle Speed (μsec)	1.6
Transmission Code	Any 7-11 bit code
Maximum I/O Devices	16
DISPLAY UNIT	
Screen Size (char)	960
Characters/Line	80
Lines/Display	12
Character Set	Full 94-char ASCII, upper/lower
Character Generation	5 x 7 dot matrix
PERIPHERALS	
Cassette	Dual drive std; 120Kb/cassette
Magnetic Tape	IBM cmptble 7- or 9-track
Printers	30-cps std; 165 cps, 330 cps, 300 lpm opt
Punch Card (cpm)	300
Disc	2.4 Mb; 1-4 drives/controller; 25Mb; 1-8 drives/controller
Diskette	256Kb; 1-4 drives/controller
COMMUNICATIONS	
Line interface	Sync or async
Control Procedures	IBM BSC
Standard Features	Autodial; auto answer
Optional Features	Programmable to accomplish most features
DATA TRANSMISSION	
Network	Leased; switched
Line Speed (bps)	Async: 37.5-9,600 sync: up to 9,600
Error Control	CRC; LRC; VRC
COMPATIBILITY	
Computer System	IBM 360; 370
Terminals	IBM 2265; 2741; 2780 Mdl 4; 360/20 HASP; 33 ASR ASR; Univac DCT 2000; CDC 200
Bell Data Set	103; 201; 202
SOFTWARE	Cassette, tape diskette and disc operating systems, word processing pkg, emulators (above), data entry pkg, forms generator, control pkg for 1-8 slave terminals
FIRST DELIVERY	April 1971

Keyboard/CRT

The integral keyboard provides a basic 41-key alphanumeric key group, an 11-key numeric pad,plus five system control keys. A multikey roll-over feature assures maximum ease for typing. Transfer of keyboard characters is under control of the 2200 processor, which makes an audible feedback signal to the typist each time a character is recorded. The CRT screen has a 7-inch by 2.5-inch viewing area, which can display 960 characters (12 lines of 80 characters each). All 94 characters of the ASCII character set can be displayed. The CRT also features a refresh rate of 60 frames per second, 5 x 7 matrix for character generation, a blinking cursor, single control line erasure, frame erasure, and page rollup.

Cassette Decks

The two read-write cassette tape decks accept ECMA standard Philips-type cassette tapes and provide: 100 character-per-inch density, dual-capstan forward-reverse operation, processor-controlled data transfer, direction control, head engagement, and high-speed rewind. Approximately 120,000 bytes can be recorded in each cassette.

Communications

The optional communication adapters are available in seven versions, as shown in Table 2. The adapters permit program selection of the desired bit rate, character length, and character set to offer versatile communications capability. The Multiple Port Adapter is a particularly important option; coupled with the Datashare package it permits up to eight "slave" Datapoint CRT terminals to operate simultaneously using different programs.

CRT Terminals

Datapoint supplies three different slave terminal models, the 3000, 3300, and 3600. The 3000 displays 25 lines of 72 characters each for a total of 1,800 characters, and transmits data at speeds up to 300 bits per second. The 3300 displays the same amount of data, but can transmit at up to 2,400 bits per second. The 3600 displays 24-lines of 80 characters for a total of 1,920 characters that can be transmitted at rates up to 4,800 bits per second. A special version of the 3600, a 3360, with 80 characters per line (2,000 total), has been particularly designated as the terminal to be used with the Datashare package.

Card Reader

A new Datapoint card reader is available for use in remote batch or job entry applications. The card reader is fully buffered and reads at 300 cards a minute. It is tolerant of cards that are bent or damaged and of cards that are out-of-punch registration. The unit leases for $154 a month including maintenance on a 2-year basis.

Printers

The 9250 console printer is an impact printer, 30 characters per second with 132 print positions per line; it prints 10 characters per inch. It handles either 14.875-inch wide tractor forms or ordinary typewriter paper. The character font can be Courier 10, Pica or Elite. The servo driven, rosette-shaped typewheel is made of plastic. One or more printers can attach directly to the I/O bus; Model 9251 is the free standing add-on version.

Table 2. Datapoint 2200: Data Communications Capability

Model No.	Name	Interface	Model	Transmission Rate (bps)	Duplex
9400	Serial Data Adaptor	EIA RS232C-level signal	Async	37.5-9,600	Full; half
9401	Communications Adaptor with Modem	Bell 103 equivalent	Async	300	Full
9402	Communications Adaptor with Modem	Bell 202 equivalent	Async	1,200	Half
9403	High-Level Keyer	Telegraph lines	Async	37.5	—
9404	Synchronous Communications Adaptor	Bell 201 or equivalent	Sync	Up to 9,600	Half
9420	Parallel Data Interface	Other mfrs peripherals		Parallel	—
9460, 9462	Multiport Adaptors	EIA RS232C, for attachment of 8 interactive peripherals	Async	100, 300 or 1,200 baud	Full
9410	CCITT Interface, Asynchronous Adapter	For European and other communication networks, CCITT Recommendation V.24	Async	NA	NA

The 9244 and 9245 are serial dot matrix printers that print 9 x 7 dot matrix characters from a 64 USASCII character set. Model 9244 prints 165 characters per second (60 lines per minute) while Model 9245 doubles the speed through bidirectional printing using two print heads (each traveling over only half of the paper). Standard line width is 132 characters. The printer handles 4.0 by 14.875-inch sprocket fed forms. The character set can be up to 128 characters, with a variety of fonts available.

The 9280 series of drum printers, 300 lines per minute, like the two serial printers, print a 132-character line in a 64-character set. Line spacing is switch selectable at six or eight lines per inch, printed on pin-fed forms, with up to six parts. Models 9280 and 9282 use 64-character fonts, while 9281 and 9283 use 96 character fonts. Models 9280 and 9281 include a single channel vertical forms control, set for 11-inch paper, while Models 9282 and 9283 include 12-channel vertical forms control for other paper sizes, including odd sizes like tags or checks. All line printers are fully buffered and attach directly to the Datapoint processor.

COMPATIBILITY

Compatibility on the Datapoint 2200 is provided by both hardware and software. The seven- and nine-track tape drives are industry compatible. A variety of communications adapters may be plussed into the parallel data I/O bus. One is Datapoint's own parallel data communications adapter, which can connect to many peripheral devices available from other manufacturers.

The programmable nature of the 2200 theoretically enables it to simulate any terminal. As a practical matter, terminal simulation is limited to the manufacturer's prewritten packages: IBM 2265, IBM 2741, IBM 2780 Model 4, Univac DCT 2000, CDC 200, Teletype 33 ASR, and Bell System 202 compatible modems. The Datapoint 1100, 2200, and 5500 Series systems software packages are upward compatible; all 1100 software can run on the 2200 and 5500, and all 2200 software can run on the 5500. The 2200 Version I has some compatibility problems with time-dependent programs to be run on Version II because Version I software used programmed loops for lack of a clock. The new 1100 and 5500 systems both have clocks.

SOFTWARE

Datapoint 2200 offers three operating systems (disc/diskette, tape, cassette); an assembly language; terminal emulators for IBM 2265, 2741, and 2780 terminals, and for CDC 200 and Univac DCT 2000 terminals; a Datashare multiple terminal control package; "Databus," Basic and RPG II compilers; a text processing package and many useful utilities as well as diagnostic programs. These programs are maintained and fully supported by the company.

Operations on Datapoint 2200 are usually under control of the operating system. A source code editor is available for program preparation. Programs can then be assembled and cataloged in the library. A number of programs for debugging and device control are also supplied by Datapoint.

Operating Systems

The Datapoint 2200 operating systems (COS, TOS, and DOS) enable the user to catalog, load, debug, and run programs. In addition, other programs, such as Editor and Assembler, can be cataloged into an operating system tape or disc file for use when needed. This arrangement is necessary because the Master segment is a relatively large program, and it is normally overlayed when user programs are loaded. It should be noted that most intelligent terminal operating systems work this way. User programs are entered through a loader that lets other programs load files from tapes even when the tape is not at the beginning of the file. COS/TOS operating systems require at least 8K words of memory, while DOS requires 16K.

The Disc Operating System (DOS) used for the diskette (as well as larger discs) is a full blown disc operating system with file manipulation capabilities. Disc files can be accessed via standard Indexed Sequential Access Method (ISAM) procedures. A "Data Sort" program organizes files on the diskette or disc alphabetically or numerically by field (key) within the record. A "Data Copy" program allows conversions from one media or format to another, including cassette to tape and disc to tape. An integral part of the package enables conversion from Datapoint to IBM diskette formats. A "chain" program, like a job control language, automatically executes other programs.

Datashare Package

The Datashare interpreter, which runs under DOS, uses virtual memory techniques to allow simultaneous execution of up to eight Databus programs. Each program deals with a slave Datapoint 3000 series terminal. All program execution is under control of the Databus language.

The Datashare III version requires a 2200 with 16K words of memory and at least 2.4 million characters of disc storage. A multiport communications adapter enables eight video display terminals, usually Datapoint 3360s, to be connected either locally or remotely over standard telephone channels. A printer, usually a Datapoint 300 line-per-minute drum printer, can be attached to any terminal.

Each terminal user can call up both public files and his own protected files from disc. Public files can be locked to certain terminals. With virtual memory resources, 128K words of memory are available for user programs.

The new Datashare III requires a 2200 with 16K words of memory and at least 2.4 million characters of disc storage. A multiport communications adapter enables eight video display terminals, usually Datapoint 3360s, to be connected either locally or remotely over standard telephone channels. A servo printer, usually a Datapoint 300 line-per-minute drum printer, can be attached to any terminal.

Dataform

The Dataform interpreter allows the user to generate and use more than 100 forms to control the entry process. After data has been processed, checked, and formatted by Dataform, it can be further processed using the assembly language, SCRIBE, or Databus, or the cassette can be directly converted to a disc file.

Dataform operates on two levels; on one level, it operates as a form generator; on the other level, it operates as a high-level programming language. It can be used to program editing, arithmetic, checking, or comparison routines.

Datapoint also has a disc-based version of Dataform which reduces program development time for new intelligent data entry application software. Datapoint states that the time required for program development is cut by at least 60 percent. Time required for testing new applications is reduced. Forms developed on the disc can be used on cassette-based machines without any changes.

High-Level Languages

The Datapoint BASIC language is patterned after Dartmouth BASIC; it runs under COS with 16K bytes of memory. Datapoint RPG II is a disc-based system, with source programs and data written in Databus 6 or Dataform, described below. BASIC is available on special request. RPG II is a standard offering.

RPG II. RPG II runs under DOS; it requires 16K words of memory. Application programs written in RPG II can access data files by using ISAM (Indexed Sequential Access Method). ISAM allows extended record lengths, up to 9,999 characters. RPG II also expands disc handling facilities for fixed and variable length blocks. RPG II files are compatible with other Datapoint programs for the 2200.

To aid the user in creating RPG II programs, Datapoint offers RPG PREP, which allows program preparation directly from the keyboard. Newly typed material is checked for correct structure and syntax displayed; on the screen, errors can be corrected line by line. Thus, the step of punching cards is bypassed completely. RPG PREP requires a 2200 with 16K words of memory and 2.4 million bytes of disc storage.

Assembly Language

The 2200 Assembler has gone through a number of revisions as the 2200 terminal/business system has developed. In addition to the versions now used under COS and TOS 3, other versions are in current use to operate under DOS:

Version 5. Features conditional assembly, list control directives, and expanded arithmetic; internal loader, allows programmer to perform entry point/external linking with address register relocation for a form of relocatable object code.

Version 6. Adds directives for user-defined macros to Version 5.

Version 7. Adds completely relocatable object capability to Version 6, together with a linking loader; program relocation makes overlay generation much easier.

Databus

Databus, a high-level, string-oriented language especially designed for the 200, currently has six versions.

- Databus 1—Requires 8K bytes of memory; it is the simplest form for stand-alone processing and data capture applications; includes keyboard, display, tape cassette, printer I/O, and string arithmetic capability.
- Databus 2—The same as Databus 1, plus string handling and indexing facilities; possible program size is slightly reduced.
- Databus 3—Requires 8K bytes of memory; simple instructions are used for complex functions like originating and answering automatically dialed data calls, automatic polling of multipoint networks, and transferring data between 2200s with error control; includes keyboard, display, printer, tape cassette, nine-track magnetic tape, and Bell 202 compatible communications.
- Databus 4—A simplified version of Databus 2; it restricts the arithmetic and printer capabilities so that it can operate with only 4K bytes of memory; principal application is low-cost, key-to-tape data capture.
- Databus 5—Companion to Databus 4, but does not have the extensive string-handling instructions; principal application is low-cost communication and printing of tapes under Databus 4.
- Databus 6—Designed to be programmed by the operator; features buffered keypunch and automatic batch communication, facilities for program "cards," insertion and deletion of cards, verifying previously input data, and send and receive tape cassette files with full error control; requires 2K bytes of memory, divided into six callable overlays; tapes are fully compatible with other Databus tapes.

Communications

Databus Communication Converters provide simple means for the 2200 user to transmit data between a Datapoint 2200 and a larger computer by telecommunications. A communications converter is a manufacturer-supplied Databus program called in subroutine form. The user can also program macroinstructions, if he prefers to write his own subroutines.

Terminal emulators are available for IBM's 360/20 HASP, 2780, 2265, and 2741, as well as for CDC 200, Univac DCT 2000, and teletypewriters. The emulators permit the 2200 to act as a plug-to-plug replacement for the appropriate terminal, because line disciplines are identical. Datapoint states that no hardware or software changes are required for any of its emulators, providing the Datapoint system has the same peripherals as the emulated system.

The IBM 2265 program operates at a maximum of 1,200 bits per second with an internal modem and 2,400 bits per second with an external modem. It requires an operating system and a 6K- or 8K-word memory. The EM2741 requires only 2K bytes of memory. It transmits EBCDIC over an external modem. Another emulator, DB 2780, transmits and receives 80-column card images using IBM's Binary Synchronous Communications (BSC) techniques. At the same time, it can simulate the IBM 2780 Model 4 terminal. The package requires 4K bytes of memory, the Synchronous Communication Adapter (2200-404), and a Bell 201 compatible modem.

Datapoint has introduced a batch processing systems line, built around the Datapoint 2200. The IBM 360/20 HASP Workstation Emulator handles all the usual IBM data and communication functions. The 2200 is used on-line; its synchronous communications adapter follows the line discipline of the IBM 360/370 computers.

Datapoint's CDC 200 Emulator performs all tasks that the CDC 200 does. In addition, it performs such tasks as code conversion of IBM 026 or 029 card decks (normally done on a CDC 6000), and data entry by means of cassettes.

The standard Univac DCT 2000 emulator includes many of Univac's extra-cost options as standard features, such as unattended answering, off-line listing, etc. Like the CDC 200, the DCT 2000 is card-oriented; Datapoint's system, however, provides the additional convenience of cassettes.

Other emulator programs are for Teletype Model 33 ASR and a Bell System 202 modem interface.

Scribe

Scribe is a text processing and printing utility for use with the general-purpose text editor called GEDIT, to provide a complete automatic typing/word processing system. The typist can either format the text on the screen as it is to be printed, or type free form, imbedding printing control symbols. In either case, data on the screen can be checked and corrected before the final copy is printed.

Utilities

Utilities include floating-point transcendental routines, floating-point/string conversion, tape lister, string print subroutines, 9-track tape drive subroutines, 9-track tape dump, and others. A new sort/merge package, important to business users, enables sorting and/or merging of disc files up to 2,000,000 bytes long.

Diagnostics

Diagnostics programs include testers for combined memory and tape endurance, printer, parallel interface, display, 2200/disc, disc controller buffer memory, keyboard, processor, and others.

Software Available From Other Vendors

Standardized packages and software services for the 2200 are available from a number of independent software houses. Among these are Bristol Information Systems (Fall River MA), Computerm (Bellevue WA), Dialogue Systems (Richardson TX), Diana M. Engel (Washington DC), F & S Systems (Framingham MA), Goal Systems Corp (Westport, CT), Jammar (San Bruno CA) and PBS Systems (Bellevue WA). Packages currently offered include accounts receivable, perpetual inventory, sales analysis, payroll, accounts payable, general ledger, mailing list maintenance, medical billing, and a variety of utility routines (sort, etc) extending Datapoint's own offerings. Datapoint has nothing to do with these packages, except that the company will provide a list of the independent packages it knows about. As the number of terminals and small business systems increases, the number of independent software offerings is also bound to increase.

MAINTENANCE

In the United States, Datapoint provides maintenance support through a staff of service engineers in 50 service centers located throughout the country. The company plans to double the size of its maintenance staff in 1975. In addition, the company has a 24-hour toll-free WATS line to a control center in Texas that promises a firm time commitment for Customer Service assistance within 1 hour. Replacement parts are also stocked at all major cities. Datapoint quotes from 4 to 6 hours average response time for user maintenance calls. The lease price does not include maintenance service, and each user must negotiate a maintenance contract with Datapoint. These contracts can be on an 8-hour, 24-hour, or per-call basis (price quoted in price data chart is four 8-hour contract); they generally cover units located within 15 miles of a Datapoint maintenance service area. Emergency maintenance service can be prearranged.

Installation of new systems takes an average of 2 hours per system. The installation charge is in addition to purchase or lease price. New systems carry a 90-day warranty.

Datapoint also maintains a Datapoint training center at its manufacturing facilities in San Antonio, Texas, where

a series of comprehensive courses acquaints potential customers and new customers with the product line. Some customers with purchased systems have been trained to do their own maintenance work.

Outside of the United States. Matra Engins. Regnecentralen and the other companies mentioned earlier are responsible for maintenance in their territories. Companies marketing the Datapoint system were chosen partly because they have marketed other peripheral systems and thus have already established service networks. Regnecentralen, for instance, has a particularly dense network of sales and service centers in Denmark and West Germany, from which it has serviced RC 3600 peripheral processing systems. Matra is also well-represented in France and Belgium. All distributors outside the United States are appointed by TRW, Inc., in Los Angeles, under the master distributorship agreement, as mentioned previously.

HEADQUARTERS

Datapoint Corporation
9725 Datapoint Drive
San Antonio TX 78284
(512) 690-7000

PRICE DATA

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint $
	CENTRAL PROCESSORS			
2201	Datapoint 2200, Version I, 2K Memory, 115 vac, 50-60 Hz	159	6,040	33
2202	Datapoint 2200, Version I, 2K Memory, 230 vac, 50-60 Hz	159	6,040	33
2210	2K Memory Expansion for 2201, 2202	14	590	4
2221	Datapoint 2200, Version II, 4K Memory, 115 VAC, 50-60 Hz	216	8,571	44
2222	Datapoint 2200, Version II, 4K Memory, 230 vac, 50-60 Hz	216	8,571	44
2230	4K Memory Expansion for 2221, 2222	36	1,600	8
	MASS STORAGE			
	DISCS			
9350	Cartridge Disc Controller/Drive Console, 115 VAC	268	9,800	60
9351	Cartridge Disc Controller/Drive Freestanding, 115 VAC	268	9,800	60
9352	Cartridge Disc Controller/Dual Drive Console, 115 VAC	372	13,600	60
9353	Cartridge Disc Controller/Dual Drive Freestanding, 115 vac	372	13,600	70
9354	Cartridge Single Disc Drive Extension Unit, 115 vac	—	NA	—
9355	Cartridge Dual Disc Drive Extension Unit, 115 vac	354	12,900	52
9356	Cartridge Disc Controller/Drive Console, 230 vac	268	9,800	60
9357	Cartridge Disc Controller/Drive Freestanding, 230 vac	268	9,800	60
9358	Cartridge Disc Controller/Dual Drive Console, 230 vac	372	13,600	60
9359	Cartridge Disc Controller/Dual Drive Freestanding, 230 vac	372	13,600	70
9360	Cartridge Single Disc Drive Extension Unit, 230 vac	NA	NA	NA
9361	Cartridge Dual Disc Drive Extension Unit, 230 vac	354	12,900	52
9362	Cable, Disc Interconnection, 5 ft	NA	150	—
9363	Cable, Disc Interconnection, 9 ft	NA	150	—
9370	Mass Storage Controller and Drive, 60 Hz	652	19,872	120
9371	Mass Storage Drive Extension for 9370, 60 Hz	232	8,352	85
9381/5	Diskette Controller, with one drive, Console Freestanding	85	3,800	25
9386	Diskette Extension Unit	25	600	15
9390	Mass Storage Controller and Drive, 50 Hz	552	19,872	120
9391	Mass Storage Drive Extension for 9370, 50 Hz	232	8,352	85
	INPUT/OUTPUT			
9504/24	Card Reader, 80 col, 300 cpm, 115/230 vac	119	5,000	35
9001	Special Display Option (Factory installed only)	10	375	—
9002	Special Display Option (Field Installed only)	24	950	—
9003	Special Keyboard Option (Factory installed only)	NA	NA	NA
9004	Special Keyboard Option (Field installed only)	—	—	—
9007	Number Pad Control Code Option	—	11[1]	—
9006	Number Pad Shift Option	—	11[1]	—
9009	Cancel Key Coding Option	—	11[1]	—
9010	Cable, 8 ft. I/O bus	—	228	—
9011	Cable, 18 in., I/O bus	—	180	—
9012	Cable, 5 ft, I/O Bus	—	228	—
9050/1	Equipment Rack, Console/Freestanding	—	850	—
9052	Shelf Attachment	—	—	—
9053	Table	—	84	—
9054	Paper Holder	20	700	—
9200/1/2/3	Printer, Console/Freestanding, 30 cps, 132 col impact, 115/230 vac	—	4,480	—
9240	IBM Selectric Interface	19	750	10
9241	Cable, IBM Selectric Interface	—	80	—
9242	Centronics Printer Interface	—	1,088	—
9244	Centronics Model 101A Including Interface and Cable	220	6,958	50
9245	Centronics Model 102A Including Interface and Cable	245	8,708	50
9246	Table for Centronics Printer	11	210	
9247	Cable Assy. Centronics Interface	—	80	—
9250/1	Servo Printer Console/Freestanding, 115 VAC	149	6,300	35
9253	12 In. Form Option for 9250, 1, 4, 5			
9254/5	Servo Printer, Console/Freestanding, 230 vac	149	6,300	35
9280	300 lpm Printer - 64 char/single chan Vertical Form Control	332	12,600	120
9281	300 lpm Printer - 96 char/single chan Vertical Form Control	389	14,475	135
9282	300 lpm Printer - 64 char/12 chan Vertical Form Control	354	13,320	130
9283	300 lpm Printer - 96 char/12 chan Vertical Form Control	411	15,195	145
9284	Paper Receptical for 300 lpm Printer	3	115	NA
9550/1/2/3	Tape Transport, 9-/7-track, Console/Freestanding, 115 VAC	214	8,500	40
9557	Conversion to 800 bpi, from 556 bpi unit	N/C	N/C	N/C
9570/1/2/3	Tape Transport, 9-/7-track, Console/Freestanding, 230 vac	214	8,500	40
9580/1/90/91	Tape Transport, 9-track, 1,600 bpi, Console/Freestanding, 115/230 vac	294	12,200	50
	DATA COMMUNICATIONS			
9400	Async Communications Adaptor, EIA Interface	26	910	11
9401/2	Async Communications Adaptor, 103/202 Compatible Modem	42	1,500	15
9403	Async Communications Adaptor, Telegraph High Level Keyer Interface	42	1,500	15
9404	Sync Communications Adaptor, EIA Interface, Without Internal Clock	26	910	11
9405	Sync Communications Adaptor, EIA Interface, with Internal Clock	32	1,160	11
9420	Parallel Communications Adaptor, Logic Interface	22	750	11
9450	Multiple Communications Adaptor Card Tray, 115 vac	N/A	3,600	—
9451	Async Communications Adaptor, EIA Interface for Use with 9450 and 9455	25	710	15
9452/3	Async Communications Adaptor, 103/202 Modem Compatible for Use with 9450 and 9455	42	1,300	15
9454	Async Communications Adaptor, Telegraph High Level Keyer Interface for Use with 9450	59	1,023[1]	—
9455	Multiple Communications Adaptor Housing	24	2,300	30
9456	Sync Communications Adaptor, EIA Interface for Use with 9450 and 9455	—	790	15
9457	IBM Selectric Interface for Use in 9450 and 9455	—	400[1]	—
9459	Parallel Communications Adaptor, Logic Interface for Use with 9450	38	567[1]	—
9460	Multiple-port Async Communications Adaptor	—	1,250	—

PRICE DATA (Contd.)

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	DATA COMMUNICATIONS (Contd.)			
9461	Connector Kit for 9460	38	22	30
9462	Multiple-Port Communications Adaptor (with Dataset ready Signal Provided)	—	1,250	30
9490	Multiple Communications Adaptor Card Tray, 230 vac	—	3,600(1)	—

* 2-yr lease plan. 1-yr and 3-yr plans available, as well as a short term rental plan
NA — Not available at this time
NC - No charge
(1) - Preliminary prices only


75-65

OVERVIEW

The Datapoint 5500 is a dispersed data processing/small business computer system with an 8-bit processor design that provides more capabilities and higher performance than the company's popular 2200 Series, while remaining upward compatible. The 5500 is due to be delivered in the second quarter of 1975.

The 5500 resembles the 2200 in external appearance, with a keyboard/CRT display and dual cassette drives housed in a single unit with processor and memory. Peripheral expansion at present is restricted to 2200-type peripherals, but higher-speed devices will be added in the future.

The basic differences between the 5500 and the 2200 are in the handling of memory, the expansion of the instruction set with the attendant possibilities in software development, and the greater variety of error checking facilities. Up to 64K bytes of ROM and RAM memory can be included in the system; memory mapping, memory protection, and virtual memory techniques all can be implemented using page- and sector-storage and addressing methods. The instruction set provides for multibyte (field) operations and address manipulation to support the memory scheme, as well as the 2200's stack manipulation instructions for efficient context switching. Optional parity checking is supported by an expansion of the interrupt system to include I/O parity as well as memory parity faults. Memory protect and privileged instruction violations have also been added.

Peripherals originally used on the 2200 provide an extensive base on which the 5500 can build. The 2200 peripheral line includes cartridge discs, industry standard magnetic tape drives, printers, card readers, a variety of communications adapters, and "slave" CRTs (up to eight on the 2200) that can access memory independently via a multiport adapter. The 5500 I/O throughput will be over twice that of the 2200. In addition, it will allow optional parity checking for new devices that can be mixed with the nonparity 2200 peripherals on a system. Some of the 2200 peripherals will require minor modifications to operate at the higher speed, but these will be handled through the factory.

Until 1973, Datapoint specialized in two basic product lines: the 3000/3300 Series interactive computer display terminals and the Datapoint 2200 systems. The 2200 was introduced in 1971 as an intelligent terminal, but soon a Version II was announced that was supported as a small business and "dispersed data processing" computer. By mid-1973, the company had delivered more than 4,300 of the 3000/3300 systems and 2,500 of the 2200 systems—it was a profitable operation. In November 1973 the company announced the new Datapoint 1100 and 5500 Series.

The 1100 Series is designed specifically as an intelligent terminal for the source data entry market. The 5500 Series is a larger, faster distributed processing/small business computer system than the 2200; it gives 2200 users an upgrade system to expand their processing capabilities. The 1100, 2200, and 5500 Series are all upward compatible systems. The 1100 was delivered in February 1974. By the end of fiscal 1974, the company had delivered more than 5,000 1100 and 2200 systems combined. The 5500 is due for delivery in the second quarter of 1975. In spite of the unfavorable economic climate, the company has maintained an impressive growth rate and a strong financial position.

Datapoint markets its systems through 30 direct sales offices in the United States. TRW Datacom International, Inc., in Los Angeles is the exclusive international distributor of the Datapoint system: it provides maintenance, service, and support outside the United States through an international network of representatives. TRW Communications and its subsidiaries directly market the systems in Canada, Brazil and Switzerland. Scandinavian sales offices include Regnecentralen (Denmark and Holland), Oy Nokia Ab Electronik (Finland and Sweden), and Scanips (Norway and Austria). Ventek, Ltd., handles sales in the British Isles. Western Europe sales offices include Matra S.A. (France), Gier Electronics (Germany), Sair Electronics (Belgium) and Encodex S.p.A. (Italy). In addition to the aforementioned companies in Switzerland and Holland, CJK Company, Ltd., handles marketing in Japan, Control Y Proceso Electronico SA in Mexico, Sigma Data in Australia, Information Systems Ltd in Israel, Computer Advances in South Africa, and Sistemas De Control C.A. in Equador. Applied Systems markets the system in the Philippines, Singapore and Malaysia.

Roughly 50 percent of Datapoint's systems have been sold internationally. The U.S. installed base is divided into about 30 percent end-users and 20 percent OEM, with proportions shifting in favor of end-users.

PERFORMANCE AND COMPETITIVE POSITION

While it is premature to make an extensive analysis of the 5500's position in the small business market without more details on any new software developments and especially pricing, certain elements of the 5500 system design indicate it will strengthen Datapoint's entire product line. The greater sophistication and speed of the processor, and the larger memory capacity with support

for development of a multiprogramming operating system provide a new upward mobility for 2200 users. Not only can they increase the processing volume, but the system is large enough to enable a shift from primarily preprocessing data that is communicated to a larger processor to primarily in-house processing for total applications, including processing input from intelligent terminals. Transmissions can be mostly summary data to a larger central computer. For certain businesses, the 5500 could handle preprocessed input from a number of other Datapoint 1100, 2200, or similar terminals, perhaps transmitting data to a larger computer only for certain infrequent large jobs. For other businesses, the 5500 could function as a front-end communications processor with added processing capabilities.

The 5500, together with the 1100 and 2200, make Datapoint able to set up a large dispersed data processing network with a wide variety of terminal capabilities. Each terminal can be geared to the load volume at a particular branch, and each is capable of relatively easy expansion if business should grow. In this respect, the 5500 occupies an important position in Datapoint's product line. Evaluation of the system against small business systems — such as those of IBM, Basic Four, Burroughs, Qantel, Cascade Data, Four-Phase, Singer, NCR, and Univac — cannot be made at this time.

Several small-computer manufacturers have product lines similar to Datapoint's in providing a range of processors and terminals for dispersed data processing. Four-Phase Systems recently added a processor at the top of its intelligent terminal line to provide breadth in the same way the 5500 does; the Four-Phase line has a large body of well developed software, but does not have an intelligent terminal comparable to the 1100. The Singer line goes one step further — the 4300 is an inexpensive "dumb" terminal, the 1500 (the old Cogar System 4) is like the 2200, and System Ten can be compared to the 5500. The elements of the Singer line, however, are not compatible with each other and the 1500 software is not as well developed as the 2200 software. The Mohawk 2400 system, especially when combined with communicating Data Recorders, can also be configured to provide a wide range in price and processing capability.

The recent announcement of the IBM System/32 has changed the competitive picture somewhat. System/32 is a disc-based turnkey system roughly comparable to the smaller Datapoint 2200 Models with more restricted I/O. System/32 is a move downward to capture the entry level market. The industry giant anticipates selling as many System/32s as they have System/3s, which should alarm manufacturers of systems such as the Datapoint 3300 and 5500. Although IBM has not yet come out with a system with as inexpensive hardware as the smallest 1100 configurations and its competitors, or for that matter as the Wang 2200 and the Hewlett-Packard 9830 calculator/computers, the turnkey nature of System/32 will partly offset this apparent price discrepancy.

CONFIGURATION GUIDE

The basic Datapoint 5500 processor is housed in a typewriter-like desktop unit together with 12K bytes of user program memory, 16K bytes of ROM/RAM control memory, a keyboard, printer, 960-character CRT, two magnetic tape cassette drives and a built-in power pack. This basic processor can attach all 2200 peripherals with the 5500 high-speed option added. In addition, user program memory can be expanded up to 48K bytes in 12K increments. All memory modules are MOS semiconductor memory with parity a standard feature.

Peripheral devices include: 132-column, 30 character-per-second impact printer, 165 and 330 character-per-second dot matrix printers, 300 line-per-minute line printer, a 300 card-per-minute card reader, standard tape drives (seven- or nine-track), diskette, cartridge disc and disc pack drives with control, and a number of communications adapters with modems.

Printers, tape drives, and card readers include integral controllers. Discs can be configured into subsystems: one to four diskette drives per controller, one to four cartridge discs per controller, and one to eight disc pack drives per controller. A multiport adapter also allows a CRT terminal subsystem of up to eight stations.

Processing Unit

The 5500 processing unit differs in architecture from the 2200 and 1100. It uses an 8-bit word and a push down stack like the 2200 and 1100 processors, but the 5500 has additional base registers and it uses paging registers and a memory sector table to divide logical memory into 16 4K-byte sectors. Each sector can be mapped into any physical 4K-byte memory section, which can be designated as access-protected or write-protected. The system features allow reentrant coding, memory swapping for implementing virtual storage, and locking out faulty memory sections so the system can operate as long as enough memory for a job is functional.

Physical RAM memory is on four 12K-byte boards, with a fifth 16K-byte board of combined ROM and RAM for "System Memory." The ROM contains loader, debug, memory test, and fixed operating system facilities, while the RAM portion of System Memory is reserved for the operating system.

The processor can operate in either the "system" or "user" mode. The system mode permits all instructions to be executed, while the user mode restricts the execution of certain privileged instructions. All interrupts except Power Up turn off the user mode, push the contents of the program counter on the stack, and continue program execution at the interrupt vector location. Interrupts are generated for Memory Parity Fault, Input Parity Fault, Output Parity Fault, Write Protect Violation, Access Protect Violation, Privileged Instruction Violation, Clock, User System Call Restart, and Power-Up.

The 2200 has 50 instructions in 28 basic instruction types. The 5500 includes all these instructions plus 41 instructions of five different kinds.

- Additional register referencing capability.
- Multibyte operations—block transfers, both binary and decimal field arithmetic compare and shift, and multiple I/O.
- Context switching—stack and register save and restore.
- Address manipulation including double and paged load and store.
- Operating system control—system call, user return, etc.

System specifications are listed in Table 1.

Power

The power supply of the 5500 has been completely redesigned to meet all known safety requirements of different countries, enabling Datapoint to obtain UL, CSA, and VDE approval.

PERIPHERALS

Discs

From one to four cartridge disc drives can be added to the 2200 for a maximum of 9.6 million bytes of on-line random access storage (2.4M bytes per cartridge). Drives are either single or dual drives, and average seek time is 70 msec. The controller buffer (1,024 bytes) is divided into four 256-character buffers that correspond to sectors on the disc.

With the 2314-type, 20-million-character disc, a Datapoint 2200 system has a storage capacity equal to that of a medium to large business system. In many business applications, the user does not need the computing power of a large mainframe computer, but needs large mass storage for files which are used occasionally.

The architecture of the new disc is similar to the diskette and employs 16 sector buffers. Each sector is randomly accessible. The storage capacity is 20 million bytes (characters) per drive, and each 2200 processor can handle two drives for a maximum storage capacity of 40 million bytes. Maximum data transfer rate is 2.5 million bits per second. Average access time is 35 milliseconds. The disc is fully buffered and the buffer is totally addressable. Data need not be transferred into the processor memory, most disc operations can be carried out in the disc buffer.

Diskette

The diskette unit is housed in a freestanding cabinet or in a console cabinet; the controller can handle up to four diskette drives. Each diskette can store over 256,000 characters; average latency time is 83 milliseconds. The diskette architecture is similar to that of the larger Datapoint disc. Four 256-character buffers, which together form a 1,024-character addressable buffer, correspond to sectors on the disc. Thus, software formatted for the larger disc can be used on the smaller diskette with only minor modifications. Software is available to format the diskettes so they are interchangeable with IBM's 3741 diskette.

Table 1. Datapoint 5500: Specifications

PROCESSOR	
No. of Registers	20 + implicit register
Memory	
Size (wds)	To 64K (48K available to user)
Bits/Word	8
Parity/Protect	Both
Cycle Time (μsec)	1.6
Paging	Yes
ROM	Control memory
Instructions	
Number	91
Double Precision	Yes
(Hardware) Multiply/ Divide	NA
Floating Point	NA
Stack Manipulation	Yes
Priority Interrupt	10 levels
DISPLAY UNIT	
Screen Size (char)	960
Characters/Line	80
Lines/Display	12
Character Set	94-char ASCII
Character Generation	5 x 7 dot matrix
PERIPHERALS	
Cassette	Dual drive std; 120 Kb/cassette
Magnetic Tape	7- or 9-track
Printers	30-cps; 165 cps, 330 cps and 300 lpm
Punch Card	300-cpm reader
Disc	2.4 Mb, 1-4 drives/controller; 25 Mb, 1-8 drives/controller
Diskette	256 Kb, 1-4 drives/controller
COMMUNICATIONS	
Line Interface	Sync or async
Control Procedures	IBM BSC
Standard Features	Autodial; auto answer
Optional Features	Programmable for most features
DATA TRANSMISSION	
Network	Leased; switched
Line Speed (bps)	Async; 37.5-9,600 sync: up to 9,600
Error Control	CRC; LRC; VRC
COMPATIBILITY	
Computer System	IBM 360; 370
Terminals Emulated	IBM 2265, 2741, 2780, Mdl 4; Univac DCT 2000; CDC 200; TTY 33 ASR
Bell Data Set	103; 201; 202
SOFTWARE	Cassette, tape, diskette and disc operating systems, emulators (above) DATAFORM editor, forms generator, data entry pkg
FIRST DELIVERY	2nd quarter 1975

Magnetic Tape

Datapoint offers three magnetic tape drives: Models 9550/9551 are 9-track 800 bpi NRZI units; Models

9552/9553 are 7-track, 556 or 800 bpi NRZI units; Models 9580/9581 are 9-track 1600 bpi Phase-Encoded units. Tape units have 1057-word buffers that delimit maximum record size. The integral controllers generate and check vertical parity, longitudinal parity and cyclic redundancy check characters. Models 9550, 9552, and 9554 are console-mounted, while models 9551, 9553 and 9555 are free standing.

Keyboard/CRT

The integral keyboard provides a basic 41-key alphanumeric key group, an 11-key numeric pad plus five system control keys. A multikey roll-over feature assures maximum ease for typing. Transfer of keyboard characters is under control of the 2200 processor, which makes an audible feedback signal to the typist each time a character is recorded. The CRT screen has a 7-inch by 2.5-inch viewing area, which can display 960 characters (12 lines of 80 characters each). All 94 characters of the ASCII character set can be displayed. The CRT also features a refresh rate of 60 frames per second, 5 x 7 matrix for character generation, a blinking cursor, single control line erasure, frame erasure, and page rollup.

Cassette Decks

The two read-write cassette tape decks accept ECMA standard Philips-type cassette tapes and provide: 100 character-per-inch density, dual-capstan forward-reverse operation, processor-controlled data transfer, direction control, head engagement, and high-speed rewind. Each cassette can store about 120 kilobytes.

Communications

The optional communication adapters are available in seven versions, as shown in Table 2. The adapters permit program selection of the desired bit rate, character length, and character set to offer versatile communications capability. The Multiple Port Adapter is a particularly important option; coupled with the Datashare package it permits up to eight "slave" Datapoint CRT terminals to operate simultaneously using different programs.

CRT Terminals

Datapoint supplies three different slave terminal models, the 3000, 3300, and 3600. The 3000 displays 25 lines of 72 characters each for a total of 1,800 characters, and transmits data at speeds up to 300 bits per second. The 3300 displays the same amount of data, but can transmit at up to 2,400 bits per second. The 3600 displays 24 lines of 80 characters for a total of 1,920 characters that can be transmitted at rates up to 4,800 bits per second. A special version of the 3600, a 3360, with 80 characters per line (2,000 total), has been particularly designated as the terminal to be used with the Datashare package.

Card Reader

A new Datapoint card reader is available for use in remote batch or job entry applications. The card reader is fully buffered and reads at 300 cards a minute. It is tolerant of cards that are bent or damaged and of cards that are out-of-punch registration.

Printers

The 9250 console printer is an impact printer, 30 characters per second, with 132 print positions per line, and 10 characters per inch. It handles either 14.875-inch wide tractor fed forms or ordinary typewriter paper. The character font can be Courier 10, Pica or Elite. The servo driven, rosette-shaped typewheel is made of plastic. One or more printers can attach directly to the I/O bus; Model 9251 is the free standing add-on version.

The 9244 and 9245 are serial dot matrix printers that can print 9 by 7 dot matrix characters from a 64 USASCII character set. Model 9244 prints 165 characters per second (60 lines per minute), while Model 9245 doubles the speed through bidirectional printing using two print heads (each traveling over only half of the paper). Standard line width is 132 characters. The printer handles 4.0 to 14.875-inch sprocket fed forms. The character set can be up to 128 characters, with a variety of fonts available.

The 9280 Series of drum printers, 300 lines per minute, like the two serial printers, prints a 132-character line from a 64-character set. Line spacing is switch selectable at six or eight lines per inch, printed on pin-fed forms with up to six parts. Models 9280 and 9282 have 64-character fonts, while 9281 and 9283 have 96-character fonts. Models 9280 and 9281 include a single channel vertical forms control set for 11-inch paper, while Models 9282 and 9283 include 12-channel vertical forms control for other sizes, including odd sizes like tags or checks. All line printers are fully buffered and attach directly to the Datapoint processor.

COMPATIBILITY

Datapoint 2200 Version II programs should run without modification on the 5500. Programs sensitive to instruction timing and programs generated on compilers or assemblers other than those supplied by Datapoint may not be compatible with the 5500. The Datapoint 1100, 2200, and 5500 Series systems software packages are upward compatible; 1100 software can run on the 2200 and 5500, and 2200 software can run on the 5500.

The programmable nature of the 5500 theoretically enables it to simulate any terminal. As a practical matter, terminal simulation is currently limited to the manufacturer's prewritten 2200 packages: IBM 2265, IBM 2741, IBM 2780 Models 1 through 4, Univac DCT 2000, CDC 200, Teletype 33 ASR, and Bell System 202-compatible modems.

Table 2. Datapoint 5500: Data Communications Capability

Model No.	Name	Interface	Mode	Transmission Rate (bps)	Duplex
9400	Serial Data Adaptor	EIA RS232C-level signal	Async	37.5-9,600	Full; half
9401	Communications Adaptor with Modem	Bell 103 equivalent	Async	300	Full
9402	Communications Adaptor with Modem	Bell 202 equivalent	Async	1,200	Half
9403	High-Level Keyer	Telegraph lines	Async	37.5	—
9404	Synchronous Communications Adapter	Bell 201 or equivalent	Sync	Up to 9,600	Half
9420	Parallel Data Interface	Other mfrs' peripherals		Parallel	—
9460, 9462	Multiport Adaptors	EIA RS232C, for attachment of 8 interactive peripherals	Async	100, 300 or 1,200 baud	Full
9410	CCITT Interface, Asynchronous Adaptor	For European and other communication networks, CCITT Recommendation V24	Async	NA	NA

SOFTWARE

As yet, no software has been released specifically for the 5500; only the 2200 software is available. The 2200 software is quite extensive: three operating systems (disc, tape, and cassette); an assembly language; terminal emulators for IBM 2265, 2741, 2780 and 360/20 HASP terminals, and for CDC 200 and Univac DCT 2000 terminals; DATASHARE multiple terminal control package, "DATABUS," Basic, and RPG II compilers; a text processing package; and many useful utilities as well as diagnostic programs. These programs are maintained and fully supported by the company.

Operating Systems

The Datapoint 5500 operating systems (COS, TOS, and DOS) enable the user to catalog, load, debug, and run programs. In addition, other programs, such as Editor and Assembler, can be cataloged into an operating system tape or disc file for use when needed. This arrangement is necessary because the Master segment is a relatively large program, and it is normally overlayed when user programs are loaded. It should be noted that most intelligent terminal operating systems work this way. User programs are entered through a loader that lets other programs load files from tapes even when the tape is not at the beginning of the file. COS/TOS operating systems require at least 8K words of memory, while DOS requires 16K.

The Disc Operating System (DOS) used for the diskette (as well as larger discs) is a full-blown disc operating system with file manipulation capabilities. Disc files can be accessed via standard Indexed Sequential Access Method (ISAM) procedures. A "Data Sort" program organizes files on the diskette or disc alphabetically or numerically by field (key) within the record. A "Data Copy" program allows conversions from one media or format to another, including cassette to tape and disc to tape. An integral part of the package enables conversion from Datapoint to IBM diskette formats. A "chain" program, like a job control language, automatically executes other programs.

Datashare Package

The Datashare interpreter, which runs under DOS, uses virtual memory techniques to allow simultaneous execution of up to eight Databus programs. Each program deals with a slave Datapoint 3000 series terminal. All program execution is under control of the Databus language.

The new Datashare III version requires a 2200 with 16K words of memory and at least 2.4 million characters of disc storage. A multiport communications adapter enables eight video display terminals, usually Datapoint 3360s, to be connected either locally or remotely over standard telephone channels. A printer, usually a Datapoint 300 line-per-minute drum printer, can be attached to any terminal.

Each terminal user can call up both public files and his own protected files from disc. Public files can be locked to certain terminals. With virtual memory resources, 128K words of memory are available for user programs.

Datashare III uses ISAM to open, combine, delete, and sort files. ISAM links sectors, creates disc space tables, and handles file lengths so these functions are transparent to the user. This new version also provides variable partitioning of user space and includes a new arithmetic package.

Dataform

The Dataform interpreter allows the user to generate and use more than 100 forms to control the entry process. After data has been processed, checked, and formatted by Dataform, it can be further processed using the assembly language, SCRIBE, or Databus, or the cassette can be directly converted to a disc file.

Dataform operates on two levels: on one level, it operates as a form generator; on the other level, it operates as a high-level programming language. It can be used to program editing, arithmetic, checking, or comparison routines.

Datapoint also has a disc-based version of Dataform which reduces program development time for new in-

telligent data entry application software. Datapoint states that the time required for program development is cut by at least 60 percent. Time required for testing new applications is reduced. Forms developed on the disc can be used on cassette-based machines without any changes.

High-Level Languages

The Datapoint BASIC language is patterned after Dartmouth BASIC; it runs under COS with 16K bytes of memory. Datapoint RPG II is a disc-based system, with source programs and data written in Databus 6 or Dataform, described below. BASIC is available on special request RPG II is a standard offering.

RPG II. RPG II runs under DOS; it requires 16K words of memory. Application programs written in RPG II can access data files by using ISAM (Indexed Sequential Access Method). ISAM allows extended record lengths, up to 9,999 characters. RPG II also expands disc handling facilities for fixed and variable length blocks. RPG II files are compatible with other Datapoint programs for the 2200.

To aid the user in creating RPG II programs, Datapoint offers RPG PREP, which allows program preparation directly from the keyboard. Newly typed material is checked for correct structure and syntax displayed; on the screen, errors can be corrected line by line. Thus, the step of punching cards is bypassed completely. RPG PREP requires a 2200 with 16K words of memory and 2.4 million bytes of disc storage.

Databus

Six versions of Databus are available:

- Databus 1 — The simplest form for stand-alone processing and data capture applications; includes keyboard, display, tape cassette, printer I/O, and string arithmetic capability; requires 8K bytes of memory.
- Databus 2 — Has all the features of Databus 1, plus string handling and indexing facilities; as a result, user program size is reduced.
- Databus 3 — Requires 8K bytes of memory. Simple instructions can call complex functions: originate and answer automatically dialed data calls, automatically poll multipoint networks, and transfer data between 1100s with error control; includes keyboard, display, printer, tape cassette, 9-track magnetic tape, and Bell 202-compatible communications.
- Databus 4 — A simplified version of Databus 2 with restricted arithmetic and printer capabilities; operates in only 4K bytes of memory; principal application is low-cost, key-to-tape data entry.
- Databus 5 — Companion to Databus 4 but without the extensive string-handling instructions; principal application is low-cost communication and printing of tapes under Databus 4.
- Databus 6 — Simplest form of Databus, designed to be programmed by the operator; provides the feature of buffered keypunch and automatic batch communication, facilities for program "cards," insertion and deletion of cards, verifying previously input data, and send and receive tape cassette files with full error control; requires 2K bytes of memory, divided into six callable overlays; tapes are fully compatible with other Databus tapes.

Assembly Language

The 2200 Assembler has gone through a number of revisions as the 2200 terminal/business system has developed. In addition to the versions now used under COS and TOS 3, other versions are in current use to operate under DOS:

Version 5. Features conditional assembly, list control directives, and expanded arithmetic; internal loader, allows programmer to perform entry point/external linking with address register relocation for a form of relocatable object code.

Version 6. Adds directives for user-defined macros to Version 5.

Version 7. Adds completely relocatable object capability to Version 6, together with a linking loader; program relocation makes overlay generation much easier.

Communications

Databus Communication Converters provide simple means for the 2200 user to transmit data between a Datapoint 2200 and a larger computer by telecommunications. A communications converter is a manufacturer-supplied Databus program called in subroutine form. The user can also program macroinstructions, if he prefers to write his own subroutines.

Terminal emulators are available for IBM's 360/20 HASP, 2780, 2265, and 2741, as well as the CDC 200, Univac DCT 2000, and teletypewriters. The emulators permit the 2200 to act as a plug-to-plug replacement for the appropriate terminal, because line disciplines are identical. Datapoint states that no hardware or software changes are required for any of its emulators, providing the Datapoint system has the same peripherals as the emulated system.

The IBM 2265 program operates at a maximum of 1,200 bits per second with an internal modem and 2,400 bits per second with an external modem. It requires an operating system and a 6K- or 8K-word memory. The EM2741 requires only 2K bytes of memory. It transmits EBCDIC over an external modem. Another emulator, DB 2780, transmits and receives 80-column card images using IBM's Binary Synchronous Communications (BSC) techniques. At the same time, it can simulate the IBM 2780 Model 4 terminal. The package requires 4K bytes of memory, the Synchronous Communication Adapter (2200-404), and a Bell 201 compatible modem.

Datapoint has introduced a batch processing systems line, built around the Datapoint 2200. The IBM 360/20 HASP Workstation Emulator handles all the usual IBM data and communication functions. The 2200 is used online; its synchronous communications adapter follows the line discipline of the IBM 360/370 computers.

Datapoint's CDC 200 Emulator performs all tasks that the CDC 200 does. In addition, it performs such tasks as code conversion of IBM 026 or 029 card decks (normally done on a CDC 6000), and data entry by means of cassettes.

The standard Univac DCT 2000 emulator includes many of Univac's extra-cost options as standard features, such as unattended answering, off-line listing, etc. Like the CDC 200, the DCT 2000 is card-oriented; Datapoint's system, however, provides the additional convenience of cassettes.

Other emulator programs are for Teletype Model 33 ASR and a Bell System 202 modem interface.

Scribe

Scribe is a text processing and printing utility for use with the general-purpose text editor called GEDIT, to provide a complete automatic typing/word processing system. The typist can either format the text on the screen as it is to be printed, or type free form, imbedding printing control symbols. In either case, data on the screen can be checked and corrected before the final copy is printed.

Utilities

Utilities include floating-point transcendental routines, floating-point/string conversion, tape lister, string print subroutines, 9-track tape drive subroutines, 9-track tape dump, and others. A new sort/merge package, important to business users, enables sorting and/or merging of disc files up to 2,000,000 bytes long.

Diagnostics

Diagnostics programs include testers for combined memory and tape endurance, printer, parallel interface, display, 2200/disc, disc controller buffer memory, keyboard, processor, and others.

Software Available From Other Vendors

Standardized packages and software services for the 2200 are available from a number of independent software houses. Among these are Bristol Information Systems (Fall River MA), Computerm (Bellevue WA), Dialogue Systems (Richardson TX), Diana M. Engel (Washington DC), F & S Systems (Framingham MA), Goal Systems Corp (Westport CT), Jammar (San Bruno CA) and PBS Systems (Bellevue WA). Packages currently offered include accounts receivable, perpetual inventory, sales analysis, payroll, accounts payable, general ledger, mailing list maintenance, medical billing, and a variety of utility routines (sort, etc) extending Datapoint's own offerings. Datapoint has nothing to do with these packages, except that the company will provide a list of the independent packages it knows about. As the number of terminals and small business systems increases, the number of independent software offerings is also bound to increase.

MAINTENANCE

In the United States, Datapoint provides maintenance support through a staff of service engineers in 50 service centers located throughout the country. The company plans to double the size of its maintenance staff in 1975. In addition, the company has 24-hour toll-free WATS lines to a control center in Texas that promises a firm time commitment for customer service assistance within 1 hour. Replacement parts are also stocked at all major cities. Datapoint quotes from 4 to 6 hours average response time for user maintenance calls. The lease price does not include maintenance service and each user must negotiate a maintenance contract with Datapoint. These contracts can be on an 8-hour, 24-hour, or per-call basis (price quoted in price data chart is for 8-hour contract); they generally cover units located within 15 miles of a Datapoint maintenance service area. Emergency maintenance service can be prearranged.

Installation of new systems takes an average of 2 hours per system. The installation charge is in addition to purchase or lease price. New systems carry a 90-day warranty.

Datapoint also maintains a Datapoint training center at its manufacturing facilities in San Antonio, Texas, where a series of comprehensive courses acquaints potential customers and new customers with the product line. Some customers with purchased systems have been trained to do their own maintenance work.

Outside of the United States, Matra Engins, Regnecentralen and the other companies mentioned earlier are responsible for maintenance in their territories. Companies marketing the Datapoint system were chosen partly because they have marketed other peripheral systems and thus have already established service networks. Regnecentralen, for instance, has a particularly dense network of sales and service centers in Denmark and West Germany, from which it has serviced RC 3600 peripheral processing systems. Matra is also well-represented in France and Belgium. All distributors outside the United States are appointed by TRW, Inc., in Los Angeles, under the master distributorship agreement, as mentioned previously.

HEADQUARTERS

Datapoint Corporation
9725 Datapoint Drive
San Antonio TX 78284

PRICE DATA

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	CENTRAL PROCESSORS AND WORKING STORAGE			
5500-124	Datapoint 5500 with cassette (24K user memory, 115 vac, 50-60 Hz)	587	22,500	80
5500-124/163	Same as 5500-124 except 230VAC, 50-60 Hz	587	22,500	80
5500-136	Datapoint 5500 with cassette (36K user memory, 230 vac, 50-60 Hz)	744	28,500	90
5500-148	Datapoint 5500 with cassette (48K user memory, 115 vac, 50-60 Hz)	901	34,500	100
	MASS STORAGE			
	DISCS			
9350/1	Cartridge Disc Controller/Drive Console/Freestanding, 115 VAC	268	9,800	60
9352/3	Cartridge Disc Controller/Dual Drive Console, Freestanding, 115 vac	372	13,600	60
9354	Cartridge Single Disc Drive Extension Unit, 115 vac	—	—	—
9355/6	Cartridge Dual Disc Drive Extension Unit, 115/230 vac	354	12,900	52
9357/8	Cartridge Disc Controller/Drive Freestanding/Console, 230 vac	268	9,800	60
9359	Cartridge Disc Controller/Dual Drive Freestanding, 230 vac	372	13,600	60
9360	Cartridge Single Disc Drive Extension Unit, 230 vac	N/A	—	—
9361	Cartridge Dual Disc Drive Extension Unit, 230 vac	354	12,900	52
9370	Mass Storage Controller and Drive, 60 Hz	652	19,872	120
9371	Mass Storage Drive Extension for 9370, 60 Hz	232	8,352	85
9381/5	Diskette Controller, with one drive, Console/Freestanding	85	3,800	25
9386	Diskette Extension Unit	25	600	15
9390	Mass Storage Controller and Drive, 50 Hz	552	19,872	120
9391	Mass Storage Drive Extension for 9370, 50 Hz	232	8,352	85
	INPUT/OUTPUT			
9504/24	Card Reader, 80 Column, 300 CPM, 115/230 VAC	119	5,000	35
9001	Special Display Option (factory installed only)	—		
9002	Special Display Option (field installed only)	10	375	—
9003	Special Keyboard Option (factory installed only)	24	950	—
9004	Special Keyboard Option (field installed only)	—	—[1]	—
9007	Number Pad Control Code Option	—	11[1]	—
9008	Number Pad Shift Option	—	11[1]	—
9009	Cancel Key Coding Option	—	11[1]	—
9010	Cable, 8 ft, I/O Bus	—	228	—
9011	Cable, 18 In., I/O Bus	—	180	—
9012	Cable, 5 Ft, I/O Bus	—	228	—
9050	Equipment Rack, Console	—	850	—
9051	Equipment Rack, Freestanding	—	850	—
9052	Shelf Attachment	—	84	—
9053	Table	20	700	—
9054	Paper Holder	—	17	—
9200/1	Printer, Console/Freestanding, 30 cps, 132 col Impact, 115 vac	—	4,480	—
9202/3	Printer, Console/Freestanding, 30-cps, 132 col Impact, 230 vac	—	4,480	—
9240	IBM Selectric Interface	19	750	10
9241	Cable, IBM Selectric Interface	—	80	—
9242	Centronics Printer Interface	—	1,088	—
9244	Centronics Model 101A Including Interface and Cable	220	6,958	50
9245	Centronics Model 102A Including Interface and Cable	245	8,708	50
9246	Table for Centronics Printer	11	216	
9247	Cable Assy Centronics Interface		80	
9250/1	Servo Printer, Console/Freestanding, 115 vac	149	6,300	35
9254/5	Servo Printer, Console/Freestanding, 230 vac	149	6,300	35
9280	300 lpm Printer — 64-char/single chan Vertical Form Control	332	12,600	120
9281	300 lpm Printer — 96 char/single chan Vertical Form Control	389	14,475	135
9282	300 lpm Printer — 64 char/12 chan Vertical Form Control	354	13,320	130
9283	300 lpm Printer — 96 char/12 chan Vertical Form Control	411	15,195	145
9284	Paper Receptical for 300 lpm Printer	3	115	—

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
9550/1	Tape Transport, 9-Track, Console/Freestanding, 115 vac	214	8,500	40
9552/3	Tape Transport, 7-track, Console/Freestanding, 115 vac	214	8,500	40
9557	Conversion to 800 bpi, from 556 bpi Unit		N/C	
9570/1	Tape Transport, 9-Track, Console/Freestanding, 230 vac	214	8,500	40
9572/3	Tape Transport, 7-track, Console/Freestanding, 230 vac	214	8,500	40
9580/1	Tape Transport, 9-Track, 1,600 bpi, Console/Freestanding, 115 vac	294	12,200	50
9590/1	Tape Transport, 9-Track, 1,600 bpi, Console, 230 vac	294	12,200	50
	DATA COMMUNICATIONS			
9400	Async Communications Adaptor, EIA Interface	26	910	11
9401/2	Async Communications Adaptor, 103/202 Compatible Modem	42	1,500	15
9403	Async Communications Adaptor, Telegraph High Level Keyer Interface	42	1,500	15
9404	Sync Communications Adaptor, EIA Interface, Without Internal Clock	26	910	11
9405	Sync Communications Adaptor, EIA Interface, with Internal Clock	32	1,160	11
9420	Parallel Communications Adaptor, Logic Interface	22	750	11
9450	Multiple Communications Adaptor Card Tray, 115 vac	N/A	3,600[1]	—
9451	Async Communications Adaptor, EIA Interface For Use With 9450 and 9455	25	710	15
9452/3	Async Communications Adaptor, 103/202 Modem Compatible For Use with 9450 and 9455	42	1,300	15
9454	Async Communications Adaptor, Telegraph High Level Keyer Interface for Use with 9450	59	1,023[1]	—
9455	Multiple Communications Adaptor Housing	24	2,300	30
9456	Sync Communications Adaptor, EIA Interface for use with 9450 and 9455	—	790	15
9457	IBM Selectric Interface for use in 9450 and 9455	—	400[1]	—
9459	Parallel Communications Adaptor, Logic Interface for use with 9450		567[1]	—
9460	Multiple-Port Async Communications Adaptor	38	1,250	30
9461	Connector Kit for 9460	—	22	
9462	Multiple-Port Communications Adaptor (with Dataset Ready Signal Provided)	38	1,250	30
9490	Multiple Communications Adaptor Card Tray, 230 vac	—	3,600*	—

(1) Preliminary prices only
* 2-yr lease plan. 1 year and three year plans available as well as a short term rental plan.
— Information not available
N/C No charge

DATAPOINT

5500 Processing System Report Update

ANSI COBOL

Datapoint has announced the availability of an ANSI (American National Standard Institute) compatible COBOL compiler for its 5500 processing system. The Datapoint COBOL is largely an implementation of ANSI-68 standards (about 99 percent) with selective implementation of COBOL-74 features, primarily in the arithmetic statement areas.

With the introduction of ANSI COBOL for the 5500, Datapoint changes the competitive complexion of its 5500 product line. Prior to the availability of COBOL, the 5500 was a system with more of the earmarks of a powerful intelligent terminal (Datapoint's traditional strength) than a small business computer. The introduction of COBOL, along with the recent announcement of Datapoint's intention to establish marketing force to target the small business user, clearly indicates a fresh commitment on Datapoint's part to the small business marketplace.

In the areas of dispersed (or distributed) processing, in which Datapoint has always claimed to be a leader, the availability of ANSI COBOL now lays strength to some of those claims. To the user with a large network, a standard version of COBOL implemented on a small, user-oriented system is a valuable asset. It means that small systems in the field can process and store files in the COBOL language that are compatible with the COBOL files of a host processor.

Datapoint's COBOL is designed to compile on a 5500 (5548 processor) with 48K bytes of memory and at least 2.5M bytes of disc storage. COBOL programs can be executed on any Datapoint 5500 with at least 24K bytes of memory. COBOL support is offered for the following peripherals: nine-track magnetic tape, cassette tape, card readers, CRTS, and local printers.

Datapoint implements ANSI recommendations at the following levels:

- NUCLEUS Level 1.
- TABLE FACILITIES Level 2.
- SEQUENTIAL ACCESS Level 1.
- RANDOM ACCESS Level 1.
- SORTING FACILITIES Level 2.
- SEGMENTATION Level 1.
- LIBRARY FACILITIES Level 2.

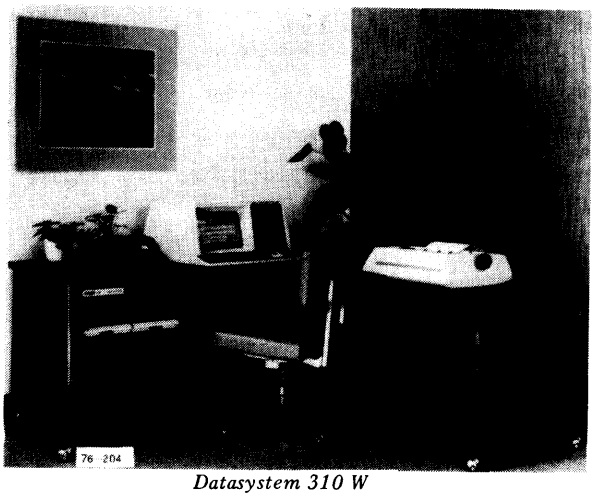
Datapoint stresses that any files created under any of the Datapoint special-purpose languages or standard programming languages are readable by COBOL. This includes files created under DATABUS, DATAFORM, DATASHARE, RPG, and BASIC. To further the use of COBOL on a Datapoint system, the following extensions have been added to the language: GEDIT format files, cassette tape support, DATABUS and EBCDIC numeric formats indexed sequential file access; CALLING precompiled subprograms, and DEBUGGING facilities.

Pricing

Datapoint's COBOL can be licensed for a one-time charge of $2,500 plus a $20-per-month maintenance charge. Monthly installments of $65 plus a $20-per-month maintenance charge are also available.

DIGITAL EQUIPMENT CORP.

DEC Datasystem 300 Series



Datasystem 310 W

OVERVIEW

Digital Equipment Corporation's (DEC) Datasystem 300 family of small business computers comprises the Datasystem (DS) 310, the DS 340 Series (Models H, J, K, and L), and the DS 350 Series, which includes Models 352, 354, and 356.

DEC introduced the multi-terminal DS 340 Series in June 1972. The four models of this series were the only family members until January 1975 when the single-terminal DS 310 was introduced. Shortly thereafter (July 1975) followed the DS 350 Series, which logically added timesharing enhancements to the multi-terminal capabilities of the DS 340 to produce a powerful small business system such as is found at the low end of DEC's larger DS 500 Series.

DEC uses its popular and powerful minicomputers as central processors for the DS 300 systems — the DS 310 and 340 are based on the 12-bit PDP-8, and the DE 350 systems are based on the 16-bit PDP-11s (either 11/10 or 11/40). Since DEC recently expanded the modular PDP-11 line to include the PDP-11/34, there is the distinct possibility that the DS 300 Series might also be expanded to reflect this. See Table 1 for DS 300 Series specifications.

DS 310

The DS 310 serves well in small business environments requiring local data management and either local batch or interactive processing for business applications such as payrolls, order entry, accounts payable and receivable, billing, and inventory. Its communications capabilities make it useful as a satellite system in a distributed processing network.

DS 310W Word Processing Systems. In February 1976 Digital targeted a more specific field in the small business computer market with the introduction of the DS 310W Word Processing System. Based on the DS 310, the DS 310W can be a word processing system with data processing capabilities, or vice versa. The DS 310W can be used effectively to expedite and enhance the production of contracts, sales proposals, direct mail letters and lists, engineering documents, and legal documents.

All word processing functions are handled by a separate turnkey software package that resides on a system disc; ordinary data processing applications can be developed and run on the DS 310W under the COS 310 operating system. Text editing is accomplished on the video display terminal with the special keypad; a letter-quality printer provides single or multiple copies.

Mass storage for the system is on dual floppy discs, each of which stores 100 full pages of text or 1,000 names and addresses. A communications option allows the DS 310W to exchange text or data with a host computer, other 310Ws, or a communicating timesharing system.

DS 310 systems already in use can be converted to a 310W system by adding a CRT, keyboard with special keypad, printer, and operating software.

For users who are interested in a word processing system without DS 310 data processing capabilities, Digital offers the WS-100. Priced $3,000 less than the DS 310W, the WS-100 uses the same hardware minus the COS 310 operating system.

DS 340

The DS 340 Series is designed not only for small business accounting operations but also for applications requiring interactive processing such as monitoring of sales and salesmen's activities or management reports. A foreground data entry option allows an operator-initiated data entry or inquiry program to run concurrently with a background job stream. One terminal can execute any system utility or application program in the background while up to six data entry terminals are operating in the foreground.

HEADQUARTERS

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Table 1. DEC Datasystem 300 Series: Specifications

CHARACTERISTIC	DS 310	DS 340	DS 350
CPU	PDP-8A	PDP-8E	PDP-11/10 or 11/40
MEMORY			
Type	Core	Core	Core
Size	16Kb-64Kb	16Kb-64Kb	32Kb-56Kb
Word Size	12-bit	12-bit	16-bit
Cycle Time	1.5 usec/word	1.2 usec/word	.9 usec/word
CONSOLES			
Keyboard	Typewriter keyboard, numeric pad, 24 programmable function keys		
Display	12 lines, 80 char/line	20 lines, 72 char/line	12 or 24 lines, 80 char/line
Printer	132 col; 30/180 cps or 300 lpm	132 col; 165/180 cps or 300 lpm	132 col; 30/180 cps or 240/300 lpm
DISKETTE			
Use	Direct-access storage		Software distribution and diagnostics
Capacity	.67Mb each drive		256Kb each drive
DISC STORAGE	1-4 drives	2 drives	2-8 drives
Type	RK05 removable cartridge	RK05 removable cartridge	RK05 removable cartridge RPRΦ2 disc pack
Capacity	3.2Mb each drive	3.2Mb each drive	2.4Mb each RK05 drive 20Mb each RPRΦZ drive
AVG ACCESS	12-85 msec	12-85 msec	70 msec
SOFTWARE			
Operating System	COS310	DIBOL DS340	COS350
Language	DIBOL	DIBOL	DIBOL-11
Communications Package	2780	2780	2780
FIRST DELIVERY		May 1975	

transcribing source data, creating, editing, or interrogating files (of which 15 may be open at one time), and sharing the line printer.

Digital is not actively marketing the DS 340 systems, because of their similarity to the newer and more versatile DS 350 systems. It is likely that the DS 340 will be dropped entirely from the Datasystem 300 line sometime in the near future.

DS 350

The DS 350 systems have most of the capabilities of the DS 340 systems plus the added speed and power of the PDP-11 processors and the timesharing enhancements of the COS 350 software. The DS 350 systems support fewer concurrent users (up to four) than the DS 340 systems (up to seven), but the four DS 350 users can run different DIBOL programs simultaneously, while the DS 340 can handle only one program at a time.

Both the DS 352 and DS 354 can be field-upgraded to the DS 356.

Digital provides a Commercial Operating System, COS 300, for the DS 300 Series, with extended versions for the 340 and 350 models. These operating systems are programmed in DIBOL, a comprehensive business language that uses simple, English-like instructions (RUN PROGRAM) and offers at least 15-place accuracy. Though similar to COBOL, it isn't COBOL — a fact that prospective users should consider. Digital will also provide the necessary conversion aids for users with DS 354 or 356 systems that have a PDP-11/40 processor to upgrade to CTS/E, a more powerful operating system used on the larger DEC Datasystem 500 Series.

Digital sells computers either directly to end-users or indirectly through business OEMs. Digital supplies the tools: processing system software, programming languages, and computer systems. Large companies that maintain a programming staff can buy directly from Digital, but the more typical small business user will want to work through a local business OEM distributor, who will provide applications programming or applications packages that can be tailored to that user's needs.

PERFORMANCE AND COMPETITIVE POSITION

The DS 300 and DS 500 Series, announced simultaneously in mid-1972, were the first systems DEC marketed specifically to the commercially-oriented end-user. DEC is a major manufacturer of minicomputers that up until recent years were marketed as general-purpose systems for real-time, scientific, or timesharing applications; commercial processing was usually done to make use of processor time left over from the primary application. DEC recognized the need for mass storage devices, high-level languages, and operating systems for use with small computers, and provided them. DECtape was used on small systems long before discs were inexpensive enough to be used as mass storage devices for them; DEC-developed FOCAL provided a high-level interpretive language for systems with as little as 4K words of memory; and the OS-8 operating system provided features that made the PDP-8 a versatile minicomputer system.

DEC sells the Datasystems directly to larger companies for use in distributed processing networks, and to distributors (OEMs) who buy the systems from DEC, add applications software, and sell it as a turnkey system. System responsibility is thus shared by DEC (for the hardware and system software) and the distributor (for the applications software).

DEC Datasystems compete in two spheres of the small business computer marketplace:

- Among those systems offered by minicomputer manufacturers. Usually these end-user systems have been built up around the manufacturers' own general-purpose minis.
- Among systems offered by the mainframers. These include Burroughs, NCR, and IBM.

Competition from minicomputer manufacturers includes the Microdata REALITY, General Automation DM 100 Series and DM 250 Data Management System, Qantel 1200 and 1300, and Basic/Four Systems. While DEC does not offer any application packages, these manufacturers do: Microdata REALITY has a data base management system; General Automation offers packages for inventory accounting and management, order entry, and accounts receivable for its DM 100 systems; Basic/Four has packages for payroll, general ledger, accounts payable and receivable, sales analysis reporting, and order entry and inventory control, with refinements for specific environments (fuel oil dealers, travel agencies, CPAs, and property management firms.)

The mainframer manufacturers offer a number of small business systems that DEC competes with including the Burroughs B 730 and B 80 systems, NCR Century 8200, and IBM System/32 and System/3. All these systems are designed to compete specifically as small business computers and come equipped with the goodwill inherent in the established names of the companies marketing them. This gives these systems a "visibility" edge over the Datasystems; users in this market are apt to purchase a Burroughs, NCR, or IBM system because of familiarity and satisfaction with other office machinery from the same manufacturer.

DEC detractors point to the lack of upward compatibility within the models of the 300 Series, and then to the same lack in moving from the DS 300 to the DS 500 Series. Exchanging a one-terminal 310 system for a two-terminal 340 is not too difficult; programs can be revised for use with multi-terminal DIBOL. However, moving from the DS 300 Series to the larger DS 500 Series is a major conversion effort. The DS 500 Series supports COBOL, not DIBOL, and DEC does not offer a DIBOL-to-COBOL conversion aid.

The DS 310 Meets the System/32

Because they were introduced to the same market at the same time, DEC's DS 310 and IBM's System/32 are likely candidates for comparison.

Both systems have 16Kb of memory, expandable to 64Kb. The DS 310 uses core memory with a cycle time of 1.5 microseconds per 12-bit word; the System/32 has MOSFET memory with a cycle time of 600 nanoseconds per eight-bit byte. Both systems include a keyboard, CRT display, and printer integrated into a console. Data entry for both is from the console, although the System/32 programs can also be entered from a diskette, prepared off-line. Printer capabilities are comparable, but the DS CRT display has four to eight times the capacity of the System/32 display.

The System/32 can support one integrated communications modem or EIA interface, while the DS 310 has a communications option to link it to a large-scale host computer.

System/32 is marketed as a turnkey system. System software consists of the System Control Program (SCP), RPG II compiler, and utilities. Applications programs are available for a number of industries including construction companies, membership organizations, hospitals, wholesale food distributors, paper suppliers, and the lumber and building material trades.

Software for the DS 310 consists of the COS 310 Commercial Operating System, DIBOL, and utilities. No applications software is available directly from Digital.

A minimum System/32, without applications software, costs $33,560 and a basic DS 310 costs $12,500. The Datasystem should do well on this score in the marketplace. However, one of Digital's problems with its commercial processing systems is market penetration. Knowing little about computers, the novice user tends to select a system on the recommendation of a business colleague. About 2,500 Datasystems have been sold to date, compared with the multi-thousands sold by Burroughs, NCR, and IBM. Perhaps Digital can produce pockets of high visibility in vertical markets and thus broaden its share of the market. Certainly the cost of the DS 310 will appeal to users unable to afford the System/32. Ferreting out those users will be the key.

USER REACTIONS

Interviews were conducted with several DEC distributors and some of their customers. The interviews brought DEC's marketing practices under scrutiny. The general feeling seems to be that this manner of marketing (with DEC supplying the hardware and system software and the OEM the application software and installation) is working well in the field. With distributors concentrating on applications and installations and garnering a lot of experience (some of it highly specialized) in those spheres, the manufacturer is thus free to direct his efforts to building better computers. If the manufacturer chooses its distributors carefully, as Digital apparently does, the user benefits from the knowledgeability and cooperativeness of an OEM that installed his personal Datasystem.

Credit Union. A 400-member credit union in an eastern New Jersey township has been using a DS 310 for almost a year. This user moved from a service bureau because the credit union lacked control over the work done, and the long-distance (150 miles) telephone calls to rectify errors seemed all too frequent. After looking at IBM (who didn't want to be bothered with that small an installation) and the Japanese manufacturer Facom (which just didn't fit their needs), the user decided on a DS 310 minimum configuration. It does everything they asked for: full bookkeeping functions plus dividend calculations, tax reporting, and insurance programs. They find the system simple to operate and "practically foolproof." They found the OEM accessible, knowledgeable and cooperative. Most problems were of a minor nature (blown fuses, wrong key pushed) and were corrected with telephone instructions. The only real problem this user had was getting prompt factory service from DEC.

Lumber Company. The main office of a $2.5M lumber business in upper New York state with four wholesale branches and two retail outlets was on-line to a service bureau with a GE terminal before purchasing a DS 354. Its system, configured with 56Kb memory, 3 disc drives and 3 CRT's (one for inquiry) has been operational since the first of the year. This knowledgeable user, who had studied the market thoroughly, also looked carefully at IBM, Burroughs, NCR and Data General before choosing a DEC Datasystem, which he considered superior to its competitors in performance. He especially liked the 24-line CRT and the new DEC printer. His DS 354 handles a very sophisticated inventory control system for 1200 items, including a 24-month history and comprehensive forecasting, plus bookkeeping, billing, invoicing and payroll for all branches. A departmental budgeting system is being developed. To date the computer and applications are running in top form and the user is truly delighted with the entire package.

Food Distributor. An Ohio wholesale food distributor has one of the first DS 350 systems to be installed — a DS 354 with 2 drives, 3 CRTs and 56Kb memory that handles inventory control, sales order entry, general ledger and payroll for his $20M/year business. Accounts payable is due to be added shortly. When this user outgrew an IBM System/3, Model 12, he went to two service bureaus for a while. By purchasing a DS 354 a savings of time and $15,000 per year was affected. According to the user, software and service are "great."

Manufacturer. A Michigan manufacturer of sewer pipe and concrete products had a dual disc drive DS 354 installed in January, 1976. This company had an NCR 500 which was technologically obsolete, and a staff programmer. The replacement had to perform more than just accounting functions. DEC was chosen over NCR, IBM, Microdata and Data General because of DEC's good performance record in other manufacturing applications, and the OEM had come highly recommended. Presently the DS 354 handles payroll, accounts payable and general ledger; order entry billing, inventory control, cost reporting and account maintenance are being implemented. This user says both the hardware and software are excellent, and added that his staff adjusted readily to the new system.

Fuel Oil Dealer. A Massachusetts fuel oil dealer has had an operational DS 356 in house for eight months. In shopping for a computer this user found that only the DEC systems could actually deliver what they promised, with no delays. His DS 356, with a 56Kb memory, two disc drives and 3 CRTs, now handles degree days, accounts payable and receivable, inventory and general ledger for the company's 7,000 accounts. Payroll will continue to be done by a service bureau. An oil burner service program may be added at a later date.

CONFIGURATION GUIDE

The basic DS 310 consists of a PDP-8A processor with 8K words of core memory, one dual diskette drive unit (335,000-word capacity), a VT50 or VT52 Display System with CRT (12 or 24 lines of 80 characters), and a keyboard. The 310 can be expanded to a maximum of 32K words of memory. Additional peripherals can be another dual diskette drive, one to four cartridge disc drives (12.8M characters in total), an electrolytic printer on the VT50, and a line printer, the LA36 DECwriter II.

The DS 310W consists of a PDP-8A processor with 32Kb of memory, a VT52 video display terminal, a keyboard with special keypad for text editing functions, a high-speed Diablo printer, dual floppy disc drives, and operating software.

The DS 340 Series consists of four models, based on the PDP-8/E minicomputer with either 8K or 16K words of memory. The PDP-8/E CPU includes a chassis, power supply, Omnibus® with 20 slots, an asynchronous line unit for the console, and a hardware bootstrap loader. The optional Omnibus expander provides 20 more slots for connecting additional memory and peripherals to a system. Memory can be expanded to 32K words in 4K or 8K modules. Peripherals, such as a card reader, high-speed printer, paper tape reader/punch, magnetic tape drives, and an additional terminal, can be added to a system.

Model DS 340-H includes 8K words of memory, two cartridge disc drives totaling 6.4M characters, a VT05 CRT system console, and the COS 300 operating system with the DIBOL compiler. The DS 340-J system uses the same configuration as the 340-H except the DECwriter replaces the CRT system console. The DS 340-K and 340-L systems are the H and J models respectively except with 16K words of memory.

The DS 350 Series comprises three models: the DS 352, 354, and 356. They differ mainly in the type and amount of disc storage they support. Configurations of the three models are as follows:

- DS 352 — PDP-11 central processor with 32K characters of core storage, two 256-character floppy disc drives and control, and COS 350 software. Options include up to four video or hard-copy terminals, a

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30-cps, 180-cps or 300-lpm printer, two additional floppy disc drives (for a total of four drives), an 80-column card reader, magnetic tape drives, and up to 56K characters of core storage.

- DS 354 — PDP-11 central processor with 32K characters of core storage, two 2.3M-character cartridge disc drives and control, and COS 350 software. Options include those available for the DS 352, except that the DS 354 supports a total of eight cartridge disc drives.
- DS 356 — PDP-11 central processor with 32K characters of core storage, two 20M-character disc pack drives and control, a floppy disc drive for software distribution and diagnostics, and COS 350 software. Options include those available for the DS 352, except that the DS 356 supports a total of eight disc pack drives.

Both the 352 and 354 models can be field-upgraded to the next higher model. All peripheral I/O processing is overlapped, including floppy discs.

DS 350 systems are generally based on a PDP-11/10 processor. The PDP-11/40 is available only for the DS 354 and DS 356, usually in entry-level configurations for users who intend to migrate to the more powerful CST/E operating system.

See Table 2 for peripherals specifications for all DS models.

CENTRAL PROCESSOR

The DS 310 is built around the PDP-8, a 12-bit-word computer, that Digital introduced in 1965. Despite the proliferation of minicomputers on the market, the PDP-8 family remains a significant system in the minicomputer field. It is a dynamic system that Digital keeps competitive by introducing new models that reflect current technology. The PDP-8 also remains popular because of the amount of software that users have developed for the system.

Table 2. DEC Datasystem 300 Series: Peripherals

Peripheral Device	Performance Characteristics	Comments	310	340	350
Terminals					
VT05	20 lines, 72 char/line, 2,400 baud	DS340 can have up to 6		x	x
VT50	12 lines, 80 char/line, displays 960 cps	Included in DS310-A, C	x		x
VT52	24 lines, 80 char/line, displays 960 cps	Included in DS310-E, H	x		x
LA36 DECwriter	97- or 128-char keyboard, 132 char/line, 64-char print	Prints 1 original and 5 copies			x
Mass Storage					
RK05 DECpack	Cartridge disc drive, cap. 1.6M words, 12-85 msec avg access, 20 msec avg latency, transfer rate 250K words/sec, 2 surfaces, 200 tracks/surface, 16 sectors/track, 256 words/sector	Cartridge similar to IBM 2315; requires controller for up to 8 drives with 19.2Mb on-line storage	x	x	x
RPR02 Disc Pack	20Mb storage/drive	System supports up to 8 drives			x
RX8B Dual Floppy Disc Drive	670K 6-bit char/dual drive, .5-sec avg access	System can support 2 dual drives, with control	x		
RX11 Dual Floppy Disc Drive	256Kb 8-bit char/dual drive	Includes control			x
DS5TD Magnetic Tape Drive	9-track, 800 bpi, 12.5 in/sec Read speed, 10K cps transfer				x
DS5TB Magnetic Tape Drive	9-track, 800/1,600 bpi, 45 in/sec read speed, 72Kcps transfer speed				x
TD8-E	Dual DECtape drive	Block-addressable, includes control			
I/O Devices					
LA35 Printer	132 col, 132 col, 30 cps, 96 ASCII char set	Multi-copy, pin-feed forms handling	x		x
LA11 Printer	132 col, 180 cps, 96-char set	Prints upper/lowercase char, multiple-copy			x
LS8-F Printer	132 col, 165 cps		x	x	
LA8-P Printer	132 col, 180 cps		x	x	
LS11 Printer	132 col, 60 lpm, 64-char set				x
LP11 Drum Printer	132 col, 240 lpm, 96-char set	Prints upper/lower case			x
LE8-V Printer	132 col, 300 lpm			x	x
LP11V Drum Line Printer	132 col, 300 lpm, 64 uppercase ASCII char set	96-char set (upper/lowercase) also available			x
CR11 Card Reader	80-col cards, reads 300 cpm, 550-card hoppers	Tabletop unit			x
PC8 Paper Tape Reader/Punch		Includes control		x	
CR8-F Punched Card Reader	Reads 300 cpm	Includes control		x	

The PDP-8/E computer, used in the DS 340 systems, is a single-address, parallel binary processor that uses a 12-bit word. Two general-purpose registers are provided: an accumulator and an MQ register. All arithmetic operations are performed in two's complement form. Of the arithmetic operations, only single-word, fixed-point add is hardware implemented in the basic system. Hardware multiply and divide and a floating-point processor are available as options. DIBOL provides 15-place accuracy without any hardware arithmetic options.

The PDP-11, base processor for the DS 350 Series, is Digital's 16-bit minicomputer, introduced in January 1970. It is the leading system from the leading minicomputer manufacturer and the one against which all other minicomputers are pitted in the marketplace.

PDP-11's design incorporates features not found in most other systems, such as the UNIBUS®; multiple internal general-purpose registers used as accumulators, index registers, address and stack pointers and special-purpose registers (program counter and interrupt pointer); and I/O registers that operate like memory locations.

Most PDP-11 models are organized around this single fast UNIBUS that connects all system components. The processor, memory, and peripheral devices operate as UNIBUS subsystems; the processor allocates UNIBUS time to system components, which communicate with each other in a master-slave relationship. The distances between devices and the speeds of the connected devices are immaterial because of the master-slave communications technique. This arrangement means, for example, that memory modules with different speeds can be connected to a system.

All processors are microprogrammed rather than hardwired.

Main Memory

DS 310 and 340. Main memory consists of core modules available in 8K-word increments. Each word is 12 bits long. Modules can be added for a maximum memory of 32,768 words. Cycle time is 1.5 microseconds per word for the DS 310 and 1.2 microseconds for the DS 340.

DS 350. Main memory can be expanded from 16K words to 28K words in 4K or 8K word increments. Each word is 16 bits long. Cycle time is 0.90 microseconds.

CONSOLE

The operator's console on the DS 310 and DS 350 models can be a VT50 or VT52 CRT display terminal. The screens have capacities of 960 characters (12 lines by 80 characters) and 1,920 characters (24 lines by 80 characters), respectively, with direct cursor control. The keyboards are typewriter-like, with 36 alphanumeric and 28 special-character keys and separate numeric cluster pads.

*UNIBUS is a registered trademark of the Digital Equipment Corp.

The operator's console on the DS 340 models is a VT05 CRT display terminal with refresh memory and alphanumeric keyboard. The screen displays 1,440 characters in 20 lines of 72 characters. A keyboard cursor operates under program control to allow interactive data entry. The console weighs 55 pounds.

PERIPHERALS

Peripherals offered for the DS 310/340 Series include cartridge disc and floppy disc drives, block-addressable DECtape, line printers, a card reader, paper tape reader/punch, high-speed line printer, and a hard-copy terminal.

For the DS 350 Series, peripherals include a variety of video and hard-copy terminals, cartridge disc and disc pack drives, magnetic tape devices, drum and serial printers of varying speeds, and a card reader.

Table 2 lists specifications for these devices.

Digital provides a wide range of peripherals for its PDP-8 and PDP-11 computers: conventional paper tape and punched card devices (including a mark-sense card reader), fixed-head and removable-head disc units, graphic subsystems, analog/digital I/O subsystems, and a variety of communications interfaces. Though not specifically designated for use with the DS systems, Digital will try to accommodate a user who has special requirements for an unusual application, or who wants to convert a PDP-8 or PDP-11 processor to a Datasystem.

DATA COMMUNICATIONS

The DS 300 Series have hardware and software options that provide facilities for communicating with an IBM System/360 or 370 (running HASP, ASP/RJP, POWER, or RJE), or with another DEC Datasystem 300 or 500, PDP-11, or DECsystem 10. The communications package on the DS 310 features automatic on-line answering of incoming calls as well as double-buffered, two-way transmission of disc files, unit data, and programs at up to 4,800 bps. DS 350 software additionally transmits transactions, summary information, and reports or data files and converts DS 350 file formats to EBCDIC for transmission.

SOFTWARE

DS 310 software, Commercial Operating System (COS 310), is a floppy-disc-resident operating system designed specifically for small-to-medium-sized commercial data processing environments requiring either batch or interactive applications. COS 310 is programmed in DIBOL, a comprehensive business language similar to COBOL Level 1. Using simple, English-like instructions, DIBOL offers 15-place accuracy. It features source line editing, direct access capability, device-independent I/O, user file directories, multi-volume file capability, a large message library, and cursor control for video terminals. COS 310 also provides the following programs for developing and maintaining programs and data files:

- Monitor — provides master control via two segments, one core resident and the other system device resident, through a monitor command language; contains I/O handlers, program loaders, editors, file directories, and operation message.
- Editor — consists of a basic source language editor for input from source console keyboard, cards, or paper tape, and outputs files to a line printer, paper tape, or console display.
- COMPiler — compiles source programs written in DIBOL.
- PIP (Peripheral File Interchange Program) — transfers files from one peripheral device to another and provides system file maintenance.
- BUILD (a key-word data entry package) — utility program to create data files.
- SORT/Merge — sorts data files in ascending or descending order; can also merge files.
- UPDATE — provides facilities to maintain a master file; change, delete, or insert records; and print all changes.
- Conversion program — converts data files that run under OS-8 to the COS 300 environment.
- SYSGEN — configures system I/O handlers, assigns logical devices to physical I/O units, and prints table of device assignments.
- DDT (DIBOL DEBUGGING TECHNIQUE) — an interactive debugging feature that allows a programmer to stop program execution at a specified statement, examine selected variables, and modify them if needed. The programmer can specify subsequent breakpoints from his terminal.
- PATCH — used to update system programs. It provides the means for correcting the COS 300 operating system and utilities.
- CREF (CROSS REFERENCE) — an optional report from the DIBOL compiler that lists all symbols used in a program alphabetically, together with the line numbers where the symbols are used.
- DAFT (Dump and Fix Technique) — DIBOL utility program for selective dumping of and making minor changes to data files.
- PRINT — creates programs to read data files and generate reports.

COS 340, the operating system for the DS 340, offers a Foreground Data Entry Option as an extension of COS 310. It allows an operator-initiated data entry or data inquiry program to operate concurrently with a background job stream. The background or system console can execute any system utility or application program. Up to six data entry terminals can operate concurrently in the foreground, with a seventh terminal handling data in the background. The terminals can be transcribing source data and creating a disc transaction file while interrogating and editing existing files. Fifteen files can be open at a time.

The foreground entry package includes a format description program that allows the user to define data entry formats using a format descriptor language for display on the CRT. It permits interactive data validation, since errors cause an audio signal and an error message to be displayed on the bottom two lines of the CRT screen. It provides cumulative hash totals for up to 10 fields, automatic duplication of identical information, initial value definition, and free-form data entry with automatic right justification of numeric fields. The operator can use either the keyboard or the numeric keypad for numeric fields.

The format descriptor language provides facilities to define the fields and coordinates displayed on the screen.

Multi-Terminal DIBOL is another extension of COS 310 adapted for the DS 340. It features multi-tasking capabilities within a user-written control program. A terminal can be dedicated to one task or used to process any task within the program. Additional DIBOL verbs provide file update protection by enabling one terminal to lock out all others from a file record when updating it. As with the Foreground Data Entry Option, 15 files can be open at one time.

Multi-Terminal DIBOL requires a minimum of 16K words of main memory. As more terminals are added to the system, memory requirements increase to a maximum 32K words for six terminals.

Software for the DS 350 Series is the COS 350 Commercial Operating System programmed in DIBOL-11, which facilitates timesharing by adding more verbs to DS 340's Multi-Terminal DIBOL.

Programs for COS 350 reside in memory in dynamic partitions, giving fast terminal response time and freeing more memory for user programs. Multiple users can share files simultaneously without special programming; only a record in use cannot be accessed. Files can be accessed directly or sequentially.

COS 350 has a detached job function that enables program tasks to be executed while detached from the terminal that initiated execution, so that more jobs can be running than there are terminals. Line-printer spooling allows data to be queued for output, making maximum use of both printer and processor.

In addition to most of the operating programs found in COS 310, COS 350 also contains:

- LINKER — joins together several relocatable object modules produced from DIBOL compiles to form one load module. LINKER can provide automatic overlay capabilities to large programs or can build a user-defined overlay structure if one is specified.
- LIBRARIAN (LIBR) — used to create and maintain libraries of commonly used subroutines or modules that are input to LINKER.
- DUMP — prints all of a file in octal words or bytes, in ASCII characters.
- OPTIMIZED I/O — improves response time under file sharing and during SORT.

All COS 300 Series operating systems offer a 2780 Communications Package that provides the facility for communicating to or from a remote IBM 360/370 (running

HASP, ASP/RJP, POWER, or RJE), another Datasystem, PDP-8 or 11, or a large DECsystem 10.

MAINTENANCE

Digital provides hardware service through its network of sales and service offices in more than 48 cities in the United States and 50 cities in Europe, Canada, Central and South America, Australia, India, and Japan. Maintenance is included in the lease; it can be obtained for purchased systems on a per-call basis or through a variety of service contracts.

Software maintenance is usually provided by the systems house or DEC dealer that installed the system.

PRICE DATA

Model No.	Description	Purchase Price $	Monthly Maint. $
	DS 310 Series		
DS310-A	PDP-8A central processor with 16Kb core memory, 6 expansion slots, bootstrap loader, dual floppy diskette drive, VT50H video terminal, COS-310 software	12,500	99
DS310-C	Same as DS310-A except with 32Kb core memory	13,500	109
DS310-E	Same as DS310-A except with VT52 video terminal	12,995	99
DS310-H	Same as DS310-C except with VT52 video terminal	13,995	109
MM8-AA	16Kb memory module	1,500	15
MM8-AB	32Kb memory module	2,500	25
DS310W	PDP-8A central processor with 32Kb core memory, VT52 video terminal, keyboard with special keypad for text editing, dual floppy disc drive, printer, operating software	22,600	
WS-100	Same as DS310W except without data processing software	19,800	
	DS 340 Series		
DS340-H	PDP-8E central processor with 16Kb core memory, 4 expansion slots, dual disc drive and control, VT05 video terminal, COS 300 software	30,010	193
DS340-K	Same as DS340-H except with 32Kb core memory, 1 expansion slot	32,010	236
BA8-A	OMNIBUS expander with box and power supply (provides 20 additional quad slots)	2,500	5
DS3D1-A	First multi-terminal VT05, interface, and software	4,730	140
DS3D2-A	Additional multi-terminal VT05 (up to 5)	3,305	34
	DS 350 Series		
DS352-A	PDP-11/10 central processor with 32Kb core memory, 1 expansion slot, 60Hz line clock, bootstrap loader, dual floppy disc drive and control (does not include console terminal or printer), COS 350 software	17,495	85
DS354-A	Same as DS352-A except with dual DECpack drives and control, 2 expansion slots	28,850	170
DS354-G	Same as DS 354-A except with PDP-11/40 central processor, 3 expansion slots	40,980	200
DS356-A	PDP-11/10 central processor with 32Kb core memory, 1 expansion slot, 60Hz line clock, dual disc pack drive and control, floppy disc drive and control, COS 350 software	47,995	340
DS356-G	Same as DS356-A except with PDP-11/40 central processor with 2 expansion slots	55,180	360
	Memory		
MM8-AA	16Kb core memory module for PDP-8A	1,500	15
MM8-AB	32Kb core memory module for PDP-8A	2,500	25
MM8-EJ	16Kb core memory module for PDP-8E	2,500	42
MM11-S	16Kb core memory module for PDP-11/10	2,100	38
MM11-U	32Kb core memory module for PDP-11/10	4,900	32
MM11-UP	32Kb core memory module for PDP-11/40	5,600	27
	Terminals		
VT05B	Video terminal; 20 lines, 72 char/line	2,870	23
DS3D1-AA	First multi-terminal VT05 station	4,730	34
DS3D2-AA	Additional multi-terminal VT05 station (max 5)	3,305	34
VT50-HA	DECscope video terminal; 12 lines, 80 char/line	1,500	22
VT52-AA	DECscope video terminal; 24 lines, 80 char/line	1,995	20
LA36-CA	DECwriter II	2,175	25
	Mass Storage		
RK05J	DECpack cartridge disc drive	5,100	39
RK05K	Disc cartridge	99	—
RPR02	Disc pack drive (20 Mb)	9,500	145
RX8B	Dual floppy disc drive and control for DS310	3,900	33
RX11	Dual floppy disc drive and control for DS350	3,900	33
RX01K	Package of 10 floppy diskettes	75	—
TD8-E	Dual DECtape drive and control	5,800	42
DS5TA	TU10 magnetic tape transport and control — master	11,500	101

PRICE DATA (Contd.)

Model Number	Description	Purchase Price $	Monthly Maint. $
TU10-D	Magnetic tape transport – slave	8,000	74
DS5TD	TS03 magnetic tape transport and control	7,750	75
TS03-S	Slave drive for DS5TD	3,500	50
	I/O Devices		
DS3D5	LA35 printer with interface and cable; 132 col, 30 cps	2,660	38
LA11-P	Printer with interface and cable; 132 col, 180 cps, 96-char set	3,585	50
LS8-F	Printer; 132 col, 165 cps	5,900	58
LA8-P	Printer; 132 col, 180 cps	3,585	53
LS11	Printer; 132 col, 60 lpm, 64-char set	6,200	58
LP11-W	Printer; 132 col, 230 lpm, 64-char set	12,500	72
LE8-V	Printer; 132 col, 300 lpm	10,500	72
LP11-V	Printer; 132 col, 300 lpm, 96-char set	10,500	72
CR11	Card reader; 80 col, 300 cpm	5,100	53
PC8	Paper tape reader/punch and control	4,200	37
CR8-F	Punched card reader and control; reads 300 cpm	5,100	53

OVERVIEW

DEC's 500 Series DATASYSTEMS are small business computers aimed at the "highly self-sufficient" end user capable of doing the applications software in-house. In contrast to offering a turnkey system with completely customized applications software, Digital supplies the systems software for the series and offers easy-to-use high-level languages, assistance in software design, and a lower price.

There are three choices of operating systems, the time-sharing CTS 500 (a general-purpose, interactive multiuse time-sharing system that supports up to 16 users), the time-sharing and data base management CTS 500/E (an extended version of CTS 500 for up to 32 users, optionally), and the management-oriented CDMS (a multi-terminal data base management system that provides a hierarchical structure of the data base).

All models of the series use the PDP-11/40,45, and 50 processors, Digital's most technically advanced members of the 16-bit PDP-11 line. In fact, the DATASYSTEMS are functionally identical to certain configurations of the PDP-11 that have already been supplied to minicomputer users in the past. What has been added is business-type packaging, leasing arrangements, commercially oriented operating systems, and the kind of service and support needed for end users with business applications.

DATASYSTEMS/PDP-11s have an average main memory cycle time of 900 nanoseconds and range in memory size from 32K to 248K bytes. Available options include ROM and semiconductor read/write memories; hardware multiply/divide and a floating-point processor; memory management options that permit virtual addressing; discs, tapes, printers, card and paper tape equipment; and terminals of several kinds. Digital does not have a magnetic stripe ledger card reader or a printing terminal with the double platen found on some small business computers that are more like programmable accounting machines.

This report is confined to details of Digital's commercial marketing of the PDP-11 minicomputer as the Datasystem 500 and presents only a broad outline of the system's architecture. Tables 1, 2, and 3 summarize specifications for the PDP-11 processor, main storage, and data structure.

Table 1. DEC DDS 500 Series: PDP-11 Central Processor Characteristics

Model	No. of Registers	Addressing		No. of Instructions		Arithmetic		Interrupts	
		Direct	Indirect	Indexed	(Std; Opt)	Decimal	Floating Point	Lines	Levels
11/40	9	No	1 level	Yes	70; 10	No	Hardware option	4	Multilevel
11/45	16	No	1 level	Yes	83; 50	No	Hardware option	8	20 (7 software levels)
11/50	16	No	1 level	Yes	83; 50	No	Hardware option	8	20 (7 software levels)

Table 2. DEC DDS 500 Series: PDP-11 Main Storage Characteristics

Model	Cycle Time (msec)	Parity	Addressable Units	Bytes per Access	Capacity (bytes)			Memory Protection
					Min	Max	Increments	
11/40	0.90	No	Byte, word	1 or 2	8K	248K	16K, 32K	Option
11/45	0.90 (1)	Opt on MOS only	Byte, word	1 or 2	32K	496K	4K, 8K, 16K, 32K	Option
11/45	0.45 (2)	Opt	Byte, word	1 or 2	8K	64K	8K	Option

Notes:
(1) Time listed is for core. MOS (0.45 msec) and bipolar (0.30 msec) memory also available.
(2) MOS memory only on the 11/50.

Table 3. DEC DDS 500 Series: PDP-11 Data Structures

Characteristic	500 Series
DATA FORMAT	
Bits per Word	16
Bits per Byte	8
Operand Lengths (bits)	16; 32; 48
ARITHMETIC	
Operands	
Decimal	No
Binary	8, 16 bits
Floating Point	
Exponent (bits)	8
Fraction (bits)	23 or 55 + sign

COMPETITIVE POSITION

Digital introduced its DATASYSTEM 500 Series along with the 300 Series as the company's first products aimed exclusively at the commercial market for small business computers. Both series were for limited application areas based on older systems that had been marketed but without much vigor. Digital's introduction of DIBOL for the PDP-8 took place several years ago; but it had small success, primarily due to the language limitations. Digital cleaned up and improved DIBOL for the DATASYSTEM 300.

The DATASYSTEM 500 Series is based on RSTS-11 (Resources Time Sharing System), which Digital introduced initially for the education time-sharing market. RSTS-11 supports interactive Basic for a number of terminals. DATASYSTEM 500 extends RSTS-11 to support interactive Basic/Plus for up to 32 terminals. The system is primarily marketed for on-line multiterminal applications.

Within the DATASYSTEM 500 Series, Digital initially pushed the DATASYSTEM 520 model, which supports RPG II and batch-oriented applications. Although it is still available, it is no longer actively marketed. Apparently Digital's marketing strategists had second thoughts about competing directly with IBM's System Model 3/10. Digital's RPG II is not completely compatible with IBM's RPG: collating sequences differ and Digital has no equipment comparable to IBM's multifunction card unit. In addition, the initial software had some bugs in it that caused support problems.

While Digital paused to clean up its RPG II software, sales for the other DATASYSTEMS snowballed. These systems are sold in markets that Digital understands very well. Thus, Digital has chosen, probably wisely, to market to its proven strength: on-line multiterminal applications. RPG II (COS 500 software) is now bug free, but it is used primarily as a transition language while users are converting programs to Basic/Plus.

Competitors for the DATASYSTEMS include some of Digital's traditional minicomputer rivals: Hewlett-Packard 3000, Data General Nova/Supernova, and Honeywell System 700. Other competitors include Singer System Ten and IBM System Model 3/15.

Digital has recently expanded the market for the DATASYSTEM 500 with the introduction of a hardware/software package that emulates the IBM 2780 Model 1. This allows communication with other DATASYSTEMS, both 300 and 500, or an IBM System/360 or 370 running HASP, ASP, DOS/POWER, or RJE software plus 270X or 370X hardware. The 2780 communications can operate concurrently with interactive multiterminal processing. Thus, the DATASYSTEM 500 can operate as a stand-alone processing system locally at the same time it operates as part of a distributed processing network.

Digital appears to have clearly defined the market for the DATASYSTEM 500. It is a market Digital knows. Furthermore, the Series 500 is based on one of the most powerful minicomputers available today. This combination should give competitors a system that is hard to beat on the basis of price/performance.

USER INTERVIEWS

The users interviewed were very pleased with the performance of their DATASYSTEMS. All spoke of sound reliability and very good maintenance. All agreed the Basic/Plus language is powerful and effective for on-line terminal use.

A manufacturer of small parts uses the DATASYSTEM for production control, scheduling, engineering bill-of-material control with inventory control and accounting functions. Eventually this user hopes to handle on-line order entry also. He is using the RSTS-11E operating system with Basic/Plus. Although the language is powerful, this user finds the lack of meaningful variable names slightly annoying. The company had startup problems with the 600 line-per-minute printer, but Digital's maintenance has been excellent. For this company, price/performance was the deciding factor in choosing the DATASYSTEM 500. This firm plans to add two terminals and more core memory to the present system. The only time this company experienced problems with its system was when the building was struck by lightning!

A midwestern systems house buys DATASYSTEMS based on the PDP-11/45 (Model 550) on an OEM basis. This company has two main users of the DATASYSTEM: one is developing applications programs for on-line life insurance policy processing, and the second uses the system to control electrical parts distribution. The DATASYSTEM handles on-line order entry, accounts payable and receivable, cash receipts and purchase inventory. It provides verification of purchase orders while checking back orders.

The operating system for the DATASYSTEM is RSTS-11E with Basic/Plus. This user's system provides good response times and it is highly flexible for on-line applications. The LOCKOUT feature is very useful; it prevents access to a record while it is being updated. After the update is completed, the file becomes accessible again. This user bought the DATASYSTEM because of the operating system and Basic/Plus. While this user did experience initial hardware bugs, the system has run for 250 hours with no downtime. When 32 users run on the system, the response time is a bit slow but is never more than 2 seconds.

A northeastern bank uses the DATASYSTEM in a time-sharing mode, with many terminals located throughout the bank. The DATASYSTEM handles bank planning and forecasting, portfolios, pricing, personnel functions, management information systems reports, corporate financial planning, and analytical research. The bank uses RSTS-11E operating system with Basic/Plus. Cost and reliability were the major reasons for purchasing Digital's equipment over its competitors. This user has enjoyed very good maintenance and few problems. The bank has added about $30,000 worth of equipment to the original system and will add more as its needs change.

A midwestern railroad uses extensive configurations of PDP-11/40s, 11/45s, and dual 11/50s. The DATASYSTEMS monitor activity in train terminals where the cars are switched and interconnected, forming new trains. The system keeps a perpetual inventory of the location of railroad cars. The method of accounting for cars had been done manually, using a punched card to represent each car. When the car moved from one track to another, the card was physically removed from one pigeonhole, representing a specific track, to another pigeonhole. A card reader then output a listing of the cars on a track. Sorting to determine status or position of a car or track was often a lengthy procedure.

With the DATASYSTEM, track files are kept to replace the pigeonhole inventory. A yardmaster sitting at a CRT receives a message from the central system that cars bound for a particular destination usually follow a specified pattern. The yardmaster approves or disapproves the plan. After compiling all information, the system outputs a listing, with orders to switch specific cars. Utility programs now perform sorts on data, to search for a particular car and to provide a summary of cars destined for a particular destination. These sorts can be done in a minute rather than the 45 minutes or more previously required. The dual 11/50 systems effectively handle a distributed processing network. Digital is marketing this railroad's particular configuration to other railroads. The railroad provides the software it has developed, current updates, and instruction in the use of the system.

CONFIGURATION GUIDE

ALL DATASYSTEM 500s are configured around PDP-11 Processor as a primary building block. Many configurations are available of memory modules, mass storage devices, operator terminals, standard peripherals, and operating systems available to the user. The primary DATASYSTEM 500 configurations are DS-530, 535, 540, 550, and 560.

The DS-530 processor is a PDP-11/40 with 32K bytes of core memory expandable to 56K bytes. A desk, real-time clock, bootstrap loader, and LA30 DECwriter console are also included. A DS-530 will support Commercial Timesharing System (CTS 500) or Commercial Data-Base Management System (CDMS 500) or the Commercial Operating System (COS 500 RPG II).

The DS-535 is the newest addition to the DATASYSTEM family. It includes a PDP-11/40 with 96K bytes of core memory, expandable to 128K bytes. Memory management, real-time clock, bootstrap loader, extended arithmetic unit, desk, two RK05 disc drives with 4.9M bytes capacity, LA30 DECwriter console, four terminal interfaces and CTS 500/E Operating System software. This can be expanded with a magtape drive, line printer, and 2780 communications capabilities.

The DS-540 is also based on the PDP-11/40 with 32K bytes of core memory expandable to 248K bytes. The DECwriter console, extended arithmetic and memory management are included in the system cabinets with the real-time clock and bootstrap loader.

The DS-550 is identical to the DS-540 except the 550 is built around the powerful PDP-11/45 processor, which allows 32K bytes of high performance, solid-state memory to be added for system upgrade, for computer bound job, or large number of users.

The most powerful DATASYSTEM is the DS-560 which includes 32K bytes of MOS solid-state memory, 450-nanosecond cycle time, for those users requiring extensive computing power for their commercial applications.

The DATASYSTEM 500 has a wide selection of peripherals. Discs can be either the RS11 fixed-head type or the removable RK05 with 2.4M-byte capacity or RP03 with 40M-byte capacity per drive. Magnetic tape support is available using the TU10 in 800-bpi format in either 7 or 9 tracks. The choice of controllers allows each system to be configured with two disc controllers capable of supporting 8 drives each or total of 16 disc units, with or without magtape units. Line printers include a choice between 60-lpm and 300-lpm models.

Digital recently enhanced the communications capability of the DATASYSTEM 500 with the CTS-500/E 2780 package, which includes both hardware and software components that allow a DS-500 to emulate an IBM 2780 Data Transmission Terminal. The new 2780 package can communicate transactions, summary information, reports or data files between a DATASYSTEM 500 and another remote computer system simultaneous with the execution Basic/Plus application jobs.

Running under the CTS-500/E operating system a DATASYSTEM 500 can communicate in 2780 mode with another DATASYSTEM 300 or 500 or an IBM System/360 or 370 running HASP, ASP, DOS/POWER, or RJE software plus 270X or 370X hardware. The DS-500 central processor requires a minimum of 96 bytes of core memory to support 2780 communications.

COMPATIBILITY

The DEC DATASYSTEM 500 is based on the PDP-11 processor: the 530, 535, and 540 on the 11/40, the 550 on the 11/45, and the 560 on the 11/50. Thus, the 500 Series is upward compatible with other members of the PDP-11 line. All can use the same core memory modules and peripheral devices. The PDP-11/50 uses solid-state semiconductor memory that is unavailable for the 11/40. The PDP-11/40, 11/45, and 11/50 use supersets of the basic instruction set used on the other members of the PDP-11 line.

DATASYSTEM 500 is not compatible with the DATASYSTEM 300 Series, which is based on the PDP-8/E and supports DIBOL, a Cobol derivative. The 500 series supports Basic/Plus as the primary programming language and RPG II as a secondary language.

MAINFRAME

The PDP-11 line has three characteristics that distinguish it from other computers in its class: the UNIBUS, multiple general-purpose registers, and the manner of handling I/O operations.

Every PDP-11 model except the PDP-11/45 is organized around a single, fast UNIBUS that connects all system components. The processor, memory, and peripheral devices operate as UNIBUS subsystems; the processor allocates UNIBUS time to system components, which communicate with each other in a master-slave relationship.

Distances between devices and the speeds of the connected devices are immaterial because of the master-slave communications technique. This means, for example, that memory modules with different speeds can be connected to one system. A single UNIBUS inherently limits system speed to that of the UNIBUS because units in the system must time-share it. PDP-11/45 overcomes this limitation because it is a dual-bus system.

The 11/40 processor optionally has two processor modes and a floating-point arithmetic option, in addition to all the features of the PDP-11 line. The memory management option allows addressing 248K bytes of core and provides for programmed memory protection.

The PDP-11/45 is a major upward expansion of the PDP-11 line and offers many features unavailable for the other models, including semiconductor bipolar or MOS memory and three processing modes. It is designed for applications requiring large memories, fast computation speeds, or multiprocessor configurations.

The PDP-11/45 memory segmentation option is functionally similar to the 11/40 memory management option but differs because of the larger number of registers and processing modes on the 11/45. Memory segmentation (memory management) provides virtual addressing for memories larger than 64K bytes and is a means of providing memory protection for multiprogramming environments.

The PDP-11/50 uses the same processor as the 11/45. The only difference between them is that MOS semiconductor memory is the standard main memory on the 11/50, but it is optional on the 11/45.

SOFTWARE

There are three basic operating systems for the Datasystem:

CTS 500, CTS 500/E, and CDMS 500. COS 500, based on RPG II, is still available but no longer actively marketed. CTS 500 provides time-sharing facilities for up to 16 terminal users. It consists of the basic features of DOS, a monitor, and the Basic/Plus language interpreter and run-time system. CTS 500 requires 40K bytes of memory, 512K words of fixed-head disc storage, two DECtapes, a real-time clock, and user terminal interfaces.

CTS 500/E (Commercial Timesharing 500 Extended) is a disc- or tape-resident operating system for Models 540, 550, and 560. It allows 16 or 32 users (optional) to access common files and to process interactively large amounts of data. Twelve files can be simultaneously accessed by each user. Job size can range from small "desk calculator" tasks to 32K-byte-long programs. Files can contain numeric or alphanumeric data and be random, indexed, or sequential. Files can be controlled either from the user's terminal (high-speed CRT, DECwriter, or Teletype) or under program control. File protection is available on an individual, group, or universal basis.

CTS 500/E uses a commercial version of Basic/Plus. Basic/Plus is a significant extension of Dartmouth Basic and includes four conditional statements; CHAIN statement; ON ERROR, GOTO and RESUME statements; and eight matrix statements. Basic/Plus has a total of 50 program statements, 34 system commands, 24 operators, 3 kinds of variables (floating point with up to 17 digits of accuracy, integers for indices and counters, and character strings of unlimited length), and 40 functions. It includes a variety of mathematical functions, such as logarithmic, trigonometric, absolute value, truncation, pi, random number generator, and square root. All program commands are checked for errors upon entry. Applications include on-line order entry; inventory control; payroll; text processing, such as Computer Assisted Instruction (CAI); and automatic letter or document editing and production.

Numeric data can be arranged in 1- and 2-dimensional arrays or matrices. Matrix commands allow addition, subtraction, multiplication, and inversion of entire matrices in one operation. A virtual memory capability expands main memory to the size needed. In-core 256-word buffers are used when processing virtual memory arrays. Programmable timing control is another feature. The user can control certain operations in actual time. A SLEEP function suspends a program for a specified amount of time, then resumes its execution when the time elapses. Two date functions and five time functions are also under programmable timing control.

CTS 500/E features disc sort, indexed file access, decimal arithmetic, and line printer spooling.

Up to 15 fields can be selected to sort on; the sequencing on each key can be specified as ascending or descending. Keys can be of varying length and can consist of alphanumeric, integer, floating-point, or decimal data. Input files can contain up to 32,650 records of up to 512 characters each. The sort can be initiated from the user terminal or the parameters can be specified in a command file.

The user can access disc files by key rather than by disc address with the use of the Indexed File Access Method (IAM), then specify the function (inquire, update, add, delete, and peek) to be performed on the specified file. A utility program provides a file builder and a file reorganizer.

The decimal arithmetic option replaces the standard floating-point arithmetic with fixed-point arithmetic (4-word). The line printer spooling package enables the user to specify the output device, either disc or magnetic tape.

CTS 500/E supports up to eight discs, for maximum storage of 343 million bytes. Discs can be fixed head, moving head, moving-head disc packs, or any combination of the three types. The RECORDSIZE option provides for more buffer space than is normally allocated. Programs can be stored on disc in source or object code format.

Record input/output files can be accessed using fixed-length data transfers with no special conversion between data formats. This feature permits data to be written and accessed in a format compatible with all computer systems.

CTS 500/E, through the system manager, dynamically allocates processor time, memory space, file space, and peripherals for optimum system performance. User access can be controlled by the system manager, which can send messages to the terminals. System status is determined through the SYSTAT program; MONEY is a more detailed status utility to obtain status of a specific user or of all users. A ROLLIN/ROLLOUT feature and a BACKUP feature (selective copying of files on a file-by-file basis) are included. Terminal response time is never more than 2 seconds. Data can be entered from user terminals or punched cards.

CTS 500/E differs from its predecessor, the CTS 500, in that:

- It is available only for Models 535, 540, 550, 560. CTS 500 is available for all 500 Series models, including 530.
- Memory capacity ranges from 80K to 248K characters. CTS 500 supports up to 56K characters.
- It uses RS11, RP03 or RP05 swapping disc. CTS 500 uses RS11 or RK05.
- It allows 32 users standard. CTS 500 allows 16 users maximum.
- It can reside in high-speed MOS memory; CTS 500 cannot.
- It has high-speed hardware floating-point processor that is unavailable with CTS 500.
- Its maximum program size is 16K bytes compared to 32K bytes for CTS 500.
- Its standard communication is via 16-line individual interfaces; 8-line interfaces are used for CTS 500.
- It supports an LP11 line printer 1,200 lines per minute, multiple line printers, and comprehensive error logging. None of these are supported on CTS 500.

CDMS 500 is a compact time-sharing system designed primarily for data management. It was originally developed for the PDP-15 by the Laboratory of Computer Sciences of the Department of Medicine, Massachusetts General Hospital, and the Harvard Medical School. The development effort was supported by grants from the National Institute of Health and the National Center for Health Service Research and Development.

The CDMS 500 time-sharing monitor contains facilities to support the DEC disc, the RP02 Disc Pack, DECtapes, paper tape reader/punch, and a set of terminal scanners used to interface remote devices, such as Teletypes, buffered display scopes, line printers, and so forth. Core memory, exclusive of space required by the monitor and the interpreter, is divided into partitions; each partition contains an application program and its local data. All active users are assigned partitions of core memory. Activating a program requires finding an available partition and loading it with a program from the disc; as long as the program is active, it remains in core. The monitor also automatically overlays external program segments when required by an active program.

Proper linkages are set up to return automatically to the program when execution of the segment terminates. Typically, 20 to 30 users can be simultaneously active; as many interactive terminals as required can interface to the system.

MAINTENANCE

Service is provided by Digital through its network of sales and service offices in more than 48 cities in the United States and 50 cities in Europe, Canada, Central and

South America, Australia, India, and Japan. Maintenance is included in the lease; it can be obtained for purchased systems on a per-call basis or through a variety of service contracts. Field offices also have software specialists to provide users with a fast response to software problems.

Training in 300 or 500 system software is provided by Digital usually in either Maynard, Massachusetts, or Sunnyvale, California. The training courses, which last from two to three weeks, are provided free of charge for users of purchased systems.

PRICE DATA

Model Number	Description	Monthly Rental 3-year lease $	Monthly Rental 5-year lease $	Purchase $	Monthly Maint. $
	DEC DATASYSTEM 500 Series				
	CENTRAL PROCESSORS and WORKING STORAGE				
DS-530-A	PDP-11/40 32K-Byte Processor (with LA30 DECwriter system console, desk, bootstrap loader, and real-time clock)	731	541	22,529	133
DS-535-A	PDP-11/40 96K-Byte Processor (with 1 LA30 DECwriter console, 2 RK05 disc drives, CTS-500/E operating system, 4 terminal line interfaces, bootstrap loader, real-time clock, memory management, desk, and extended instruction set)	1,809	1,242	54,000	419
DS-540-A	PDP-11/40 32K-Byte Processor (with Extended Instruction Set, 1 LA30 DECwriter system console, memory management, bootstrap loader, real-time clock and desk)	915	676	28,149	170
DS-550-A	PDP-11/45 32K-Byte Processor (with 1 LA30 DECwriter system console, real-time clock, memory management, bootstrap loader, desk; can support up to 32K Bytes of MOS memory)	1,255	925	38,544	230
DS-560-A	PDP-11/50 32K-Byte MOS Memory Processor (with 1 LA30 DECwriter system console, memory management, bootstrap loader, extended instruction set, real-time clock and desk; additional mounting space for peripherals)	1,543	1,136	47,344	384
	Processor Options				
	System Memory (model numbers refer to total system storage)				
DS5MC-UP	56K-Byte Memory System	201	148	6,160	27
DS5MD-UP	64K-Byte Memory System	291	213	8,888	27
DS5MF-UP	96K-Byte Memory System	517	380	15,818	53
DS5MH-UP	128K-Byte Memory System	719	527	21,978	80
DS5MK-UP	160K-Byte Memory System	945	694	28,908	106
DS5MM-UP	192K-Byte Memory System	1,147	842	35,068	133
DS5MP-UP	224K-Byte Memory System	1,373	1,008	41,998	159
	MASS STORAGE				
	Controllers				
DS5X1	RK05 Controller (max 8)	212	156	6,490	42
DS5X2	RK05 & TU10 Controller (max 8 each)	329	241	10,055	69
DS5X3	RK05 & RS11 Controller (max 8 each)	406	331	13,773	69
DS5X4	RP03 & TU10 Controller (max 8 each)	544	399	16,630	101
DS5X5	RP03, TU10 & RS11 Controller (max 8 each)	738	574	23,913	127
DS5X6	RK05, TU10 & RS11 Controller (max 8 each)	523	416	17,338	95
	Discs				
RS11-E	512K-Byte Fixed Head Disc Drive	324	261	10,880	42
RK05-C	2.4M-Byte DECpacks Disc Drive	174	128	5,335	60
RP03-A	40M-Byte Disc Pack Drive	654	480	20,000	150
	INPUT/OUTPUT				
	Magnetic Tape				
TU10D-E	Magtape Drive (9-track; 800 bpi)	270	198	8,255	74
TU10D-F	Magtape Drive (7-track; 200/556/800 bpi)	270	198	8,255	74
	Printers				
LS11-C	Line Printer & Control (60 lpm)	193	142	5,915	58
LP11-VA	Line Printer & Control (300 lpm)	572	238	9,900	72

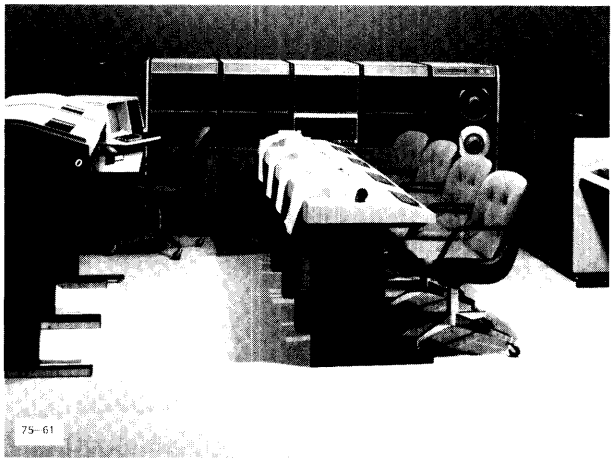
PRICE DATA (cont.)

Model Number	Description	Monthly Rental 3-year lease $	Monthly Rental 5-year lease $	Purchase $	Monthly Maint. $
	Punched Card				
CR11-A	Punched Card Reader (300 cpm)	159	117	4,860	53
	Terminals				
LA30	DECwriter (30 cps) Hard-copy Terminal	104	77	3,195	32
VT05B-AA	CRT Terminal (240 cps; for local connections)	91	67	2,795	23
VT05B-AX	CRT Terminal (for remote connections using EIA modem)	94	69	2,870	23
LT33-C	Keyboard Printer (10 cps; for local connection)	42	34	1,400	32
	DATA COMMUNICATIONS				
DS5C1	Type I Communication Subsystem (supports up to 4 lines, 2 subsystems/processor)	7	7	275	NC
DS5C3-AA	Local Terminal Interface	15	13	550	6
DS5C4-AA	Remote (dialup) Interface	16	15	605	6
DS5C6-A	Type II Communications Subsystem (supports up to 16 lines)	220	161	6,715	42
DS5C7-AA	Type II Communications Expander (expands Type II to 32 lines)	216	159	6,620	48
DS5C5-AF	4-Line Interface (local terminals)	6	4	187	5
DS5C5-AA	4-Line Interface (dialup lines)	77	52	2,370	23
DS5C5-AG	4-Line Dialup Expander (adds additional lines to DS5C5-AA)	31	23	946	5
DS5CA-A	CTS-500/E 2780 Communication System (includes hardware and software options for 2780 communications)		159	6,050	11

HEADQUARTERS

Digital Equipment Corporation
146 Main Street
Maynard MA 01754

DIGITAL EQUIPMENT CORPORATION (DEC)
DEC DATASYSTEM 570



OVERVIEW

With the introduction of the LSI-11 and PDP-11/70, Digital quietly announced the DEC DATASYSTEM 570 based on the PDP-11/70 system, which can triple the throughput of the PDP-11/45 for certain applications with heavy I/O requirements. The DATASYSTEM 570 uses an enhanced version of the Commercial Timesharing System (CTS 500/E) software for on-line, multi-terminal operation. It can support up to 63 interactive terminals via the BASIC PLUS language in the foreground and one batch background COBOL program.

The PDP-11/70 system uses a PDP-11/45 processor with a cache memory interposed between main memory and the processor, UNIBUS, and four high-speed device controllers. The communication path to and from the processor and over the UNIBUS remains 16 bits wide; but the communication path is 32 bits wide between cache and main memory or the high-speed device controllers. Thus, traffic for high-speed devices is removed from the UNIBUS, which has been a limiting factor on throughput for the PDP-11/45. In addition, two words are read each time memory is accessed and stored in cache, which can store up to 1,024 words. Each time memory is addressed, the processor checks to determine if the contents of the location is already in cache. If so, the word is read from cache and memory is not accessed. Digital estimates the hit rate for finding a word in cache is from 90 to 95 percent for typical applications.

Maximum memory capacity for the PDP-11/70 is two million bytes, but the DATASYSTEM 570 can support 1,536,000 bytes. Like other DATASYSTEMS, the 570 is housed in office-type cabinets. Table 1 lists the PDP-11/70 mainframe characteristics.

Prices for the DATASYSTEM 570 range from $130,000 to $250,000. Rental for a typical system—PDP-11/70 computer with 192,000 bytes of main memory, magnetic tape drive (1600 bits per inch), disc drive (88M bytes capacity), printer (300 lines per minute), and ten on-line terminals—will rent for about $5,700 per month on a 5-year lease that includes maintenance. Deliveries are scheduled for late summer 1975.

COMPETITIVE POSITION

The addition of the powerful 570 system as well as COBOL to the DATASYSTEM 500 line clearly indicates Digital is seriously committed to commercial data processing. The emphasis is still on real-time, interactive, on-line processing for such applications as order entry, file inquiries, sales analysis, inventory management, and in-house timesharing, but batch programs can be developed using COBOL and run in the background. This is in tune with the trend in data processing away from exclusive batch processing. Digital wisely continues to avoid head-to-head competition with IBM on batch processing while strengthening its on-line, interactive processing capability.

HEADQUARTERS

Digital Equipment Corp.
Maynard MA 01754
(617) 897-5111

Table 1. DEC DATASYSTEM 570: Mainframe Characteristics

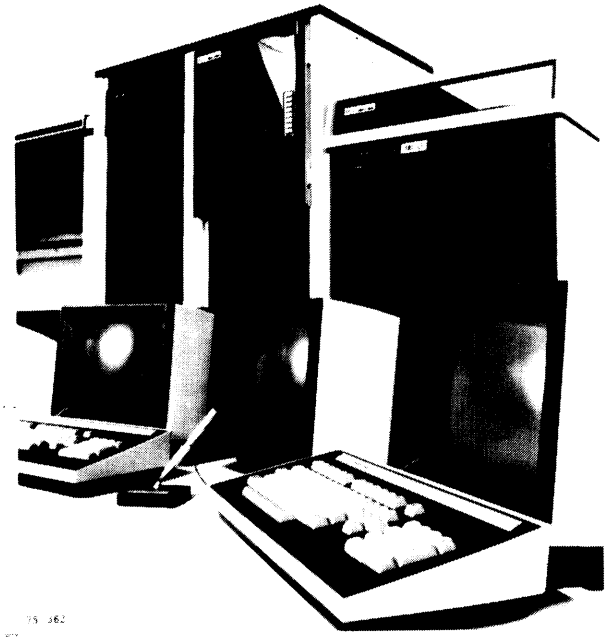
MODEL	PDP-11/70
CENTRAL PROCESSOR	
Microprogrammed	Yes
Control Memory	ROM
No. of Registers	12 accs; 3 stack pointers; 1 program counter; all 16-bits; all can be used as indexers
Addressing No. of Wds.	
Direct	64K bytes
Indirect	Single level
Indexed	Yes
Mapping	Yes to 2M bytes
Instruction Set	
Implementation	Firmware
Types	Single-word
Number	400 std, 46 opt
Floating Point	Hardware option
Hardware Stack	Yes
Instruction Execution Times, μsec	
Fixed Point	
Add	3.1
Multiply	5.3
Divide	9.9
Floating-Point (1)	
Add	9.9
Multiply	11.9
Divide	12.9
Writable Control Store	No
Interrupts	4 lines
Levels	8
Type	Hardware
MAIN STORAGE	
Type	Bipolar (cache), Core (main memory)
Cycle Time, μsec	0.24 (bipolar), 1.0 (core)

Table 1. (Contd.)

MAIN STORAGE (Contd.)	
Basic Addressable Unit	Word, byte
Bytes per Access	4
Cache Memory	Bipolar (up to 2,048 bytes)
Capacity, bytes	
Min	64K (192,000 on DEC DATASYSTEM 570)
Max	2M (1,536,000 on DEC DATASYSTEM 570)
Increment Size, bytes	64K
Ports per Module	1
Error Checks	Parity
Memory Protection	Yes; memory management and 3 operating modes
Memory Management	Yes
Interleaving	Yes, 2-way
INPUT/OUTPUT	
Max Devices Addressable	No limit
Programmed I/O	Yes (UNIBUS)
DMA	Std (UNIBUS; plus high-speed data channel (2)
DMA Transfer Rate	4M bytes/sec (UNIBUS); 5.8M bytes/sec via data channel

Notes:
(1) PDP-11/70 times include operand load times. Also floating point processor operates in parallel with central processor once operands are loaded.
(2) UNIBUS is 16 bits wide; high-speed data channel is 32 bits wide.

FOUR-PHASE SYSTEMS
System IV/40 and IV/70



OVERVIEW

Four-Phase is considered by many to be the pioneer in the field of distribution processing systems. In a series of announcements, it has firmed up, for the moment, its posture in a market it helped to create. The new lineup of hardware and software products takes a broad cut at distributed applications, including those functions usually handled by key-to-disc models, clustered CRT systems, programmable remote batch terminals, and combination systems.

There are two major model series — the Four-Phase IV/40 and IV/70 — and two major software packages supporting these models — Data IV/70 and Network Transaction Processing (NTP). Not all the IV/40 and IV/70 models utilize Data IV/70 and NTP. Some are specialized models that have a fixed hardware configuration and run a special set of software routines not directly related to either of the major software packages.

Configurable System IV/40 models can support up to 16 video displays and 16 printers with 24 to 72K bytes of main memory and a limited amount of disc storage. Options for the IV/40 models include a selection of character and line printers and communications options. Configurable System IV/70 models can support up to 32 video displays and 32 printers with 24 to 96K bytes of main memory. System IV/70 is program-compatible with IV/40 and additionally offers magnetic tape and up to 264 million bytes of disc storage as well as communications.

The addition of the large-capacity discs for the IV/70 models is unique for intelligent terminals. In fact it is even unusual for a small business computer to host such a large amount of disc storage. Disc capacity of up to 264 million bytes is usually reserved for medium-scale computers. The large-capacity disc is coupled with a multi-key access to several different file structures supported by the Four-Phase systems. Most importantly, large-capacity discs represent Four-Phase's belief that users, especially those in remote offices of large corporations, wish to maintain their complete data base — not just their most recent transactions, exceptions lists, or a vestigal listing of their full file.

Through the addition of peripherals and software packages, Four-Phase system can evolve quickly as conditions change from one environment to another. This mobility is unique to the Four-Phase systems. In effect, the systems are transparent to the applications; there is not the rigidity associated with many commercially vended systems that forces the user to make a decision regarding processing method at the time of purchase. The Four-Phase systems recognize the growing and evolving nature of the data processing environment and provide an orderly means to make a change — in many cases, without a model change. They also recognize the combination of applications that supports several different processing methods on a single system, such as interactive data entry and remote batch capability.

The software packages offered by Four-Phase also demonstrate recognition of the several levels of sophistication required by the market. Data IV/70 and NTP are two different packages designed for essentially the same applications. Data IV/70 is a parameter-driven system that performs local data entry and remote batch communications. NTP is a set of COBOL packages that permits more sophisticated data entry and remote inquiry capabilities. The choice between the two software packages is the option of the user. He can seek the level of sophistication and capability that is appropriate to his application.

HEADQUARTERS

Four-Phase Systems
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PERFORMANCE AND COMPETITIVE POSITION

In keeping with the tenor of today's market, Four-Phase no longer describes its systems as intelligent terminal systems. Instead, the IV/40 and IV/70 models are described as distributed processing systems. The distributed processing logo is being adopted by more and more intelligent and some non-intelligent systems to accent their versatility. By actual count there are few systems with as much versatility as the Four-Phase line. Included in the systems that offer a versatile line of equipment are Sycor's 340, 350, and 440; Datapoint's 1100, 2200, and 5500; Raytheon's PTS/100 and 1200; and the IBM 3790 configurations.

The Four-Phase systems and competitive systems are rapidly moving away from the functions traditionally associated with terminal operation and extending the local processing capabilities of their respective units. The decision between the Four-Phase systems and their competitors is contingent on the amount of independent or dependent processing that must be performed. The Raytheon PTS/1200 system and the Datapoint 2200 and 5500 systems are small business computers and consequently offer more in the way of local processing capabilities than the rest of the field. However, the Datapoint 1100, IBM, and Four-Phase units offer local processing capabilities coupled with a strong communications orientation. Much of the decision between one system and another resides with the specific user application and the system design of the distributed network.

USER REACTIONS

A large New York bank has been leasing three 24K-byte systems (7001 processors, 12 terminals each) for more than a year for data entry purposes. The systems are used for savings transactions, dollar control, and commercial loan and brokers loan entries, which currently amount to 15,000 items daily. The fully-edited output tapes are processed on an IBM 370/165. The three Four-Phase systems are utilized about 75 percent by the day shift and 100 percent by the evening shift. They were chosen because of their cost and because the software allows user modifications.

A manufacturer of farm equipment uses 150 IV/70 video terminals in 11 parts depots to replace IBM 2260's for unit-down emergency orders and data base inquiries (stock checks, dealer addresses, etc.). The terminals operate on a multidrop private line together with IBM 360/20's that are used for data entry and general output purposes. Both systems communicate with a central 370/155 but not directly with each other, although the central computers can handle an indirect form of communication. The IV/70 was leased about 2 years ago primarily to save money; the cost was $45,000 per year for the 2260/2848 systems. At that time, Four-Phase was the only manufacturer that was strictly compatible with IBM; thus their system required absolutely no changes in the mainframe software. This user felt particularly pleased with his choice because IBM showed signs that they would drop the 2260/2848. This user stated that Four-Phase generally responds to maintenance requests in an hour for most installations, but some remote locations serviced by Honeywell have waited close to the 4-hour limit specified in the service contract. This user stated that the Four-Phase units seem to be both more reliable and easier to fix than IBM's units, probably because of the modular semiconductor logic boards.

A diversified company engaged mostly in processing television and movie films uses its IV/70 as a key-to-disc data entry system for all kinds of standard accounting jobs. It replaced 10 keypunches with a 7-terminal system that transfers fully edited batches from the disc to magnetic tape for final processing on a Burroughs 3500 computer. The company is considering switching to an IBM mainframe that would enable it to put the Four-Phase system directly on-line. The firm chose Four-Phase over Entrex, Redcor, Mohawk, CMC, and Burroughs partly because of price, and partly because it frequently uses variable length records of considerable length (frequently 400 characters); the company liked the Four-Phase flexibility in this regard. It has been using the Four-Phase software with no alterations; the occasional additional program is written by the EDP installation manager himself. This user particularly remarked on the improvement in operator performance he observed with his key-to-disc system. After the initial adjustment period, all operators averaged from 16,000 to 22,000 keystrokes per hour, depending on the job, as opposed to a rather invariable 8000 keystrokes per hour on the old IBM 029 keypunches. Another strong plus was the trouble-free operation of the system, which has required very few emergency calls. The Four-Phase service organization responded quickly when the occasional problem did occur.

CONFIGURATION GUIDE

Configurations for the Four-Phase IV/40 and IV/70 systems are dependent on the chosen hardware model and software package. Tables 1 and 2 outline the configuration possibilities of the models and the software packages they support. However, to obtain an exact configuration, Table 3 also must be consulted to find the specific peripheral models and the number of each supported by the software packages.

Network Transaction Processing (NTP) requires a further clarification because of its several versions. NTP comes in 6 versions delineated by their function and configuration potential. The following is a list of the available NTP packages.

Function	Configuration
NTP/100 is an enhanced 3270 simulator. It is a plug-compatible alternative to IBM'S 3270 operation. NTP/100 is intended for data entry and inquiry activity.	Processor with up to 32 operator displays, disc storage, line printer, and a single communication line featuring an IBM 3270 protocol.
NTP/130 is an enhanced 2780/3780 simulator with COBOL and RPG. It is a plug-compatible programmable replacement to IBM's 2780 and	Processor with a single video control console, a card reader, disc storage, a line printer, and a single communication line with a

3780 remote batch terminals, featuring disc spooling.

NTP/150 is an enhanced 3270 simulator with COBOL. It provides local intelligence to the terminal for control and editing functions.

NTP/200 is a COBOL package with screen processing. The package supports a stand-alone system and does not have a communications capability. It offers a generalized local data base processing capability.

NTP/230 is a COBOL package with IBM 2780 and 3780 access. It permits local interactive capabilities to be added to remote batch entry facilities of NTP/130.

NTP/250 is a COBOL package with 3270 access. It offers a local inquiry mode of operation by adding local data base capabilities to the 3270 access. Inquiries can be made of the local or remote data bases.

2780/3780 protocol.

Processor with up to 8 operator displays, disc storage, a line printer, character printers, and a single communication line with an IBM 3270 protocol.

Processor with up to 12 operator displays, disc storage, magnetic tape, and character printer.

Processor with up to 8 operator displays, disc storage, line printers, and a single communication line with an IBM 2780/3780 protocol.

Processor with up to 4 operator displays, disc storage, line and character printers, and a single communication line with an IBM 3270 protocol.

The minimum configuration required to run NTP software varies with the package. In general, models with diskette storage can only run NTP 100. Models with disc cartridge can run compiled NTP COBOL programs (object code) but lack the facilities to compile the programs themselves. The larger models of the series that permit disc pack attachments can run and compile NTP software.

The Models 4100 and 4300 can run NTP/100 only. The Model 4200 can run NTP/100 and NTP/200 object code. The Model 4500 can run all NTP software. The 7001 and 7008 offer their own software packages and run none of the NTP software. The Model 7002 can run all of the NTP software.

PERIPHERALS

Systems IV/40 and IV/70 support a variety of high- and slow-speed peripherals. Most notable among Four-Phase's peripheral offering is a large-capacity disc pack, 66MB, which can be added to System IV/70 for a capacity of 264MB. Other offerings include a wide variety of printers, operators' terminals with keypunch or typewriter keyboards and a varying number of display lines per screen. Magnetic tape and card readers complete Four-Phase's peripheral offerings.

Since peripheral selection is model- and software-package dependent, please refer to Table 3 for the appropriate peripheral configurations.

DATA COMMUNICATIONS

System IV/70 can perform stand-alone processing or communicate with a mainframe computer in either a local or remote mode; System IV/40 is designed only for remote operation. A local System IV/70 connects to IBM computers via a channel-to-channel adapter (Four-Phase Systems

Table 1. Four-Phase System IV/40 Model Specifications

Processor				
Model	4100	4200	4300	4500
Memory Size (bytes)	24K	24K	24–72K	24–72K
Word Size	24 bits	24 bits	24 bits	24 bits
Max I/O chan	8	8	8	8
Peripherals				
Disc Support				
Diskette	354Kb	NA	290Kb	290Kb
Cartridge	NA	2.5mb	NA	2.5mb
Pack	NA	NA	NA	NA
Mag Tape	NA	NA	NA	NA
Card Readers	300-600 cpm	300-600 cpm	300-600 cpm	300-600 cpm
Line Printers	245-1800 lpm	245-1800 lpm	245-1800 lpm	245-1800 lpm
Max CRT Units	12	12 key-to-disc or 32-cluster display	4-12	4-12
Data Communications				
No. of Lines	1	1	1	1
Protocol	IBM 2780, 3780, or 2260	IBM 2780, 3780, or 2260	IBM 2260, 2780, 3780, and 3270	IBM 2780, 3780, and 3270
Line Speed	up to 4800	up to 4800	up to 4800	up to 4800
Software				
Packages				
Data IV/70	Version 1	Version 1	2260 Simulator	Versions 1, 2 & 3
NTP	No	No	Yes	Yes
DOS	No	No	No	No
Comments	Intel remote batch or cluster display system	Key-to-disc or cluster display system	Limited configurable member of IV/40 series	Fully configurable member of IV/40 series

Table 2. Four-Phase System IV/70 Model Specifications

Processor			
Model	7001	7002	7008
Memory Size (bytes)	12-24K	48-96K	24K
Word Size	24 bits	24 bits	24 bits
Max I/O chan	8	8	8
Peripherals			
Disc Support			
Diskette	290Kb	290Kb	290Kb
Cartridge	2.5-10.0 mb	2.5-10.0mb	2.5-10.0mb
Pack	50-264mb	50-264mb	50-264mb
Mag Tape	7- or 9-track, 556, 800, 1600 bpi	7- or 9-track, 556, 800, 1600 bpi	9-track, 800 bpi
Card Readers	300-600 cpm	300-600 cpm	300-600 cpm
Line Printers	245-1800 lpm	245-1800 lpm	245-1800 lpm
Max CRT Units	4-32	16-32	8
Data Communications			
No. of Lines	1	1	NA
Protocol	2260, 2780, & 3270	2260, 2780, 3780 & 3270	NA
Line Speed (bps)	up to 4800	up to 4800	NA
Software			
Packages			
Data IV/70	Version 1	Versions 1, 2 & 3	No
NTP	NTP/130	Yes	No
DOS	Yes	Yes	Yes
Comments	Key-to-disc model with on-line inquiry or remote comm capability	Totally configurable member of IV/70 series	Stand-alone key-to-disc unit; no comm facilities

Model 7071). Remote systems communicate with the mainframe in synchronous or asynchronous modes via one or two data set controllers at speeds of 1200 to 9600 bps.

Both System IV/40 and IV/70 are compatible with IBM 2780 or 3780 data communications (remote batch) terminals and HASP multileaving workstations.

Systems IV/40 and IV/70 have the following emulation capabilities:

- IBM 2260/2848 display systems for up to 32 terminals.
- IBM 3270 information display system for up to 32 terminals.

SOFTWARE

There are a full range of software packages available for the Four-Phase IV/40 and IV/70 models. The Disc Operating System (DOS), which performs program entry and storage functions for the System IV/70 models, can also be transferred to the System IV/40 via interchangeable diskettes or disc cartridges. The descriptions that follow catalog the software features available with IV/40 and IV/70 models.

- Disc Operating System (DOS): A control system for program entry, library storage, editing, assembly or compilation, loading, and execution. DOS is completely disc resident and is not required in memory during application program execution.
- COBOL: An industry-compatible high-level language consistent with ANSI standards. Four-Phase COBOL provides video extensions for support for interactive multiterminal applications.
- CODE Assembler: An assembler providing external reference, storage allocation, constant-defining, and conditional assembly features.
- FCODE/360 Assembler: A CODE-compatible assembler that compiles on an IBM 360/370 system under DOS or OS to produce System IV/70 object code.
- Video Display Library: A set of keyboard and video subroutines used to implement specific terminal characteristics.
- Sort: A general-purpose program for sorting disc files. Variable length record handling and user comparison exits are included.
- Relocatable Overlay Loader: A linking loader with overlay capability used to combine DOS object modules and disc library files.
- Utilities: A collection of programs to aid in system development. Included are media conversion routines, a symbolic editor, and input/output drivers for all System IV/70 peripherals.
- Diagnostics: Hardware check-out programs for the processor, memory, and peripheral devices. Data set diagnostics incorporate loop-back tests for quick isolation of transmission line faults.

Data IV/70 Versions 1, 2, and 3 and Network Transaction Processing (NTP) are software packages designed to facilitate data entry. Complete descriptions of Data IV/70 Versions 1, 2, and 3 follow. For a description of NTP functions, please refer back to the CONFIGURATION GUIDE.

Data IV/70

The Data IV/70 package is key-to-disc entry software. In spite of its name, the package can operate on both the

Table 3. Peripheral Configurations for Data IV/70 Version 3 and NTP

Display Configurations for Data IV/70, Version 3

Char/ Line	Lines/ Screen	Total No. of Chars.	No. of Data Chars.	Maximum Record Size	Maximum Number of Displays: 72K System IV/40 or System IV/70	Maximum Number of Displays: 96K System IV/70
48	24	1152	1056	750	8	10
48	12	576	480	480	10	14
48	6	288	192	192	12	16
80	24	1920	1760	750	4	6
80	12	960	800	750	8	10
80	6	480	320	320	10	14

Application requirements may affect display support.

Display Configurations for NTP/100 and NTP/150:

Characters Per Line	Lines Per Screen	Characters Per Screen	Maximum Number of Displays: System IV/40	Maximum Number of Displays: System IV/70
40	12	480	16	32
80	24	1920	8	16

Application requirements may affect display support.

Display Configurations for NTP/200, NTP/230, and NTP/250:

Characters Per Line	Lines Per Screen	Characters Per Screen	Maximum Number of Displays: System IV/40	Maximum Number of Displays: System IV/70
48	6	288	16	32
48	12	576	16	32
48	24	1152	8	32
80	6	480	16	32
80	12	960	16	32
80	24	1920	8	16

Application requirements may affect display support.

DISC STORAGE Configurations for Data IV/70 and NTP

Model	Type	Capacity	Transfer Rate	Number Per System: System IV/40	Number Per System: System IV/70
8230	Cartridge	2.5M bytes	184K bytes/sec	1	4
8240	Pack	50M bytes	312K bytes/sec	–	4
8250	Diskette	354K bytes	31K bytes/sec	1	1
8260	Pack	66M bytes	250K bytes/sec	–	4

PRINTER Configurations NTP Data IV/70 Version 3

Model	Speed	Number of Characters	Number of Columns	Number Per System: System IV/40	Number Per System: System IV/70	Number Per System: System IV/40 or IV/70
8121	30 cps	96	132	16	32	4 –
8131	30 cps	64	132	2	2	1 2
8135	165 cps	64	132	2	2	1 or 2
8146	145-1110 lpm	64	132	2	2	1 2
8148	300 lpm	64	132	2	2	1 2
8151	700-1800 lpm	64	132	2	2	1 2

Table 3. (Contd.)

MAGNETIC TAPE Configurations for Data IV/70 and NTP

Model	Type	Reel Size	Density	Speed	Number Per System	
					System IV/40	System IV/70
8501	9-Track	2400 ft.	800 bpi	12½ ips	—	4
8502	9-Track	1200 ft.	800 bpi	12½ ips	—	4
8503	9-Track	1200 ft.	1600 bpi	37½ ips	—	4
8504	9-Track	2400 ft.	1600 bpi	37½ ips	—	1
8507	7-Track	1200 ft.	556/800 bpi	12½ ips	—	1

CARD READERS NTP

Model	Columns	Speed	Hopper Capacity	Number Per System	
				System IV/40	System IV/70
8001	80	300 cpm	450 cards	1	1
8003	80	600 cpm	1000 cards	1	1

IV/40 and IV/70 systems. Data IV/70 is now available in three versions. Versions 1 and 2 were released some time ago. Version 3 is new.

Versions 1 and 2. The basic Version 1 runs up to 12 terminals, allows up to six formats and nine value sets per job, and assigns up to six balance accumulators per batch. Version 2 expands the number of terminals supported to 22; it can support the 1920-character display model and allows up to 15 formats and 15 value sets per job, and it can assign up to 24 accumulators per batch. Additional logical operands allow conditional formats to be nested in this version; as a result, alternative branches with totally different editing sequences can be specified based on validation tests of previously entered data. Version 2 can also mix IBM 029 and typewriter keyboards, but one or the other must be selected with Version 1. IBM 2780-compatible communication, however, is supported by both Versions; minimum processor memory size is 24K bytes for a Version 1 package and 72K bytes for Verion 2.

Control of the keystations follows the same general pattern as most large key-to-disc systems. Operators can key in an identifier that places the keystation under control of a formatting program stored on the disc. The program can define automatic skipping; duplication; left justification; modulus seven, 10, or 11 check digit fields; balance fields; validity checks (numeric or alphanumeric entries);range checks; and so on for each format. Meanwhile, the processor automatically keeps a tally of operator performance statistics and batch control statistics, and it can automatically re-format records while adding control data needed for each batch. The CRT terminal allows visual verification and keyed verification by the same or different operators as well as various types of checks on individual fields.

Version 3. Four-Phase has announced (Sept. 29, 1975) a new version of its Data IV/70 software package. Named Version 3, the new package incorporates the following capabilities:

- Data entry — users are able to enter and validate source data on formatted video display screens. Operating under Version 3, Four-Phase systems can extract file information for automatic entry, update local files on-line, produce local reports, and exchange batch work with a host computer.
- Increased storage — from 2.5 to 264 million bytes of disc storage are available for inventory records, customer records, and other data. On-line access is provided for up to 1000 indexed sequential files.
- Information retrieval and update — Data IV/70 Version 3 retrieves and updates information automatically when record numbers of record information are keyed into the system. Records of up to 750 characters may be retrieved instantly and displayed; any file may be accessed simultaneously by up to 16 operators. When records are being updated, the system automatically inserts inventory items, unit prices, and customer information.
- Communications — IBM-compatible bi-sync communications up to 9600 bps is supported. IBM 2780/3780 emulation is provided using leased or dial-up lines.

Version 3 provides many of the same features that the two previous versions of Data IV/70 offered: table checks, multiple range checks, arithmetic checks, batch balancing, cross footing, format chaining, field generation, and conditional logic. However, Version 3 expands on its predecessors' capabilities by increasing the available disc size from 2.5 MB, the maximum available with Versions 1 and 2, to 2.5MB, 10MB, or 66MB (the 66MB disc is available only to System IV/70 models). Version 3 extends its emulation capabilities to include IBM 3780, while Versions 1 and 2 offered only IBM 2780 emulation. Minimum processor size for running Data IV/70 packages has been increased from

24K to 72K bytes for the System IV/40 and from 24K or 72K to 72K or 96K bytes for the System IV/70.

In addition to these capabilities, Version 3 offers distributed processing networks the ability to generate documents such as invoices, purchase orders, and sales reports. With Version 3, data can be preprocessed, reformatted, and printed with headings and text inserted. COBOL and RPG compilers can be used to implement extensive local processing.

Data IV/70 Version 3 is intended for use on Four-Phase System IV/40 with 72K bytes of memory or System IV/70 with 72K or 96K bytes of memory.

Currently Version 3 is being delivered with disc capacities from 2.5 to 10 million bytes. Deliveries of the 66-million byte disc will begin in the second quarter of 1976.

NTP and Version 3. NTP and Data IV/70 Version 3 are two packages designed to do essentially the same thing for the Four-Phase systems — increase their local processing capabilities. However, the two packages differ in their orientation and complexity. NTP is designed to permit interactive inquiry with the host processor, while Version 3 is not. Version 3 is designed to do data entry, local file updating and retrieval, and then transfer the preprocessed data to the host computer in a batch, IBM 3780 mode. Version 3 is a simpler software system; it has pre-defined parameters for the functions it is designed to perform. NTP must be programmed using COBOL. Table 4 lists the features that differentiate NTP from Data IV/70 Version 3.

Table 4. Differences Between NTP and Data IV/70 Version 3

Description	NTP	Version 3
No. of displays	Max of 32	Max of 16
Mode	Interactive inquiry (IBM 3270)	Batch (IBM 2780/ 3780)
Programming Methods	COBOL	Pre-defined parameters; COBOL package available
Access Methods	Direct sequential (DISAM); variety of other methods	Indexed sequential using alpha/ numeric keys
Available Disc Sizes (MB)	2.5, 10, 66[1]	2.5, 10, 66[1]

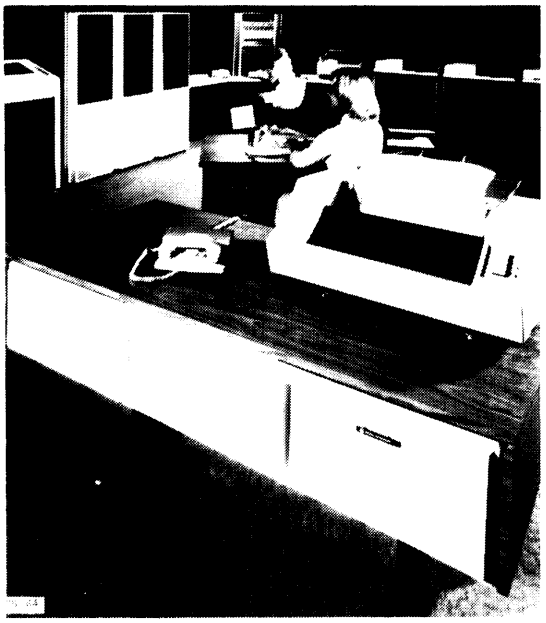
Note:
[1]66MB disc is not available on System IV/40 models.

PRICE DATA

The following are representative prices supplied by Four-Phase Systems. The absence of a purchase price or one-year lease price does not necessarily mean they are unavailable from Four-Phase.

System IV/40 Model 4100:	Lease Price $
Processor with 24K byte memory, 354K byte diskette, 300 cpm card reader and 300 lpm printer.	744/month, 3-year lease
Processor with 24K byte memory, 354K byte diskette, 16 video terminals with 480-char screen.	1401/month, 3-year lease
Processor with 24K byte memory, 354K byte diskette, 32 video terminals with 240-char screen.	1729/month, 3-year lease
Model 4200:	
Processor with 24K byte memory, 2.5 M byte disc cartridge drive, 4 video terminals with 1152-char screens and IBM 2780/ 3780-compatible communications.	614/month, 3-year lease
System IV/70	
Model 7008:	
Processor with 24K byte memory, 2.5 M byte disc cartridge drive, and 800 bpi, 9-track tape.	800/month, 1-year lease; 755/month, 3-year lease
Data entry terminal with 288-char video display (up to 8 per system). Includes operator desk and all cables.	20/month, 1-year lease; 20/month, 3-year lease
556/800 bpi, 7-track tape in place of 9-track standard unit.	50/month, 1-year lease; 45/month, 3-year lease
1600 bpi, 9-track tape in place of 800 bpi, 9-track standard unit.	200/month, 1-year lease; 190/month, 3-year lease
132-col, 30 cps printer	90/month, 1-year lease; 90/month, 3-year lease

All lease prices include maintenance, software, systems engineering support, and systems education services.



OVERVIEW

General Automation's DM 100 Series is a family of data management systems performing remote job entry, satellite processing, and limited commercial applications. Primarily, the DM 100 is being marketed to OEM users, systems houses, and service bureaus, although General Automation is occasionally marketing it to end users. General Automation will supply turnkey systems for users large enough to justify the software development required, but it prefers to sell the DM 100 to OEM users who will add applications software to the GA hardware.

Currently there are six systems available in the DM 100 series. The systems differ from each other in their orientation, and therefore in their hardware configurations. Three of the systems (120, 130, and 130/1 are primarily for satellite processing configurations. The remaining three (130/2, 135, and 140) are stand-alone systems. For the most part, the systems increase in power as their number increases. The differences in the various offerings are listed in Table 1.

Most of the DM 100 Series is based on GA's SPC-16/65 minicomputer; the 130/2, however, is based on the SPC-16/40. Except for the 130/2, every system can be field-upgraded, which means that the differences listed in Table 1 are technically arbitrary: they should be viewed as GA's suggestions for initial configurations. As you can see from Table 1, the 130/2 is being marketed as a dedicated, entry-level small business computer. It is designed to be distributed through service bureaus who will develop applications software for turnkey systems. Software houses authorized to distribute the 130/2 include Coastal Data Services (Miami), Neoterics, (Cleveland), Q.E.D. (Minneapolis), WESCOMP (Santa Ana), Information Systems Development (Kansas City), Information Systems Inc. (Pawtucket, R.I.), and Advanced Systems (Wellesley, Mass.).

In addition to the disc systems (see Table 1 and PERIPHERALS, following), the DM 100 supports printers (line and character), card readers, paper tape reader/punches, 9-track magnetic tape and CRT terminals of various screen sizes. The system can be programmed in Commercial FORTRAN and ASSEMBLY language, and can handle BASIC and FORTRAN IV. Software support includes standardized applications programs as well as customized alterations to standard software. The Commercial Operating System (COS) was developed especially for the DM 100 line.

Table 1. General Automation DM 100 Series: Configurations

Item \ Model	120	130	130/1	130/2	135	140
Orientation	RJE	Satellite or stand-alone	Satellite	Dedicated entry level small business	Stand-alone data management	Central network processor
Memory (bytes)	32K-64K	64K	64K	64K	64K-128K	64K-256K
Disc	5M byte	10M byte	5M byte	10M byte	10M-100M byte	10M-100M byte
CRT Console	1	1-4 (or)	1	2-4	1-11	1-32
512-char						
1,998-char	No	1-4	–	–		
Character Printer	165 cps	165 cps	165 cps	165 cps	–	No
Line Printer	300 lpm only	600 lpm opt	–	Yes	Yes	1 std, 1 opt
Paper Tape	No	Opt	–	No	Yes	Opt
Card Reader	Opt	Opt	–	No	Yes	2 (opt)
Card Punch	No	No	–	No	Opt	Opt
Magnetic Tape	No	No	–	No	1-4 opt	1-4 opt
Operating System	RJE-16	COS	COS	COS	COS	COS

(1) These configurations are GA's recommended initial configurations. Every system but the 130/2 can be field upgraded to the next larger system. Configuration restrictions above are due to a particular system's orientation. When a dash appears, it usually means that the addition of the relevant equipment will change the model number/orientation and also require a change in operating system support.

Relationship to Other GA Products

The DM 100 line is based on GA's SPC-16 line of minicomputers (please reference the AUERBACH report on the SPC-16). The DM 100 is actually an outgrowth of GA's expansion of the minicomputer market into commercial data management areas. The company also offers the DM 200 line, which is based on its 18/30 minicomputer line. GA is marketing the DM 200 as a product for a wide spectrum of applications which require a batch environment with limited on-line capabilities. It is marketing the DM 100 as a tool for custom-tailored situations. For example, nowhere near as many application programs are available for the DM 100 as are available for the DM 200. The DM 100 is not upward compatible with the DM 200.

COMPETITIVE POSITION

Data base management systems concentrate particularly on applications requiring frequent references to data bases; moving portions of the data to the local site to improve response time and turnaround time; and reducing the complexities of the central computer (thereby, usually, lowering costs). Many of the minicomputer manufacturers have recognized a market here, and therefore are now competing with the small business computers offered by the large mainframe manufacturers as well as with each other. Hewlett-Packard, for example, offers the M230, M260, and S250 data management systems based on the 21MX minicomputer (please reference the appropriate AUERBACH reports). GA's standalone 130/2 also follows the same route Microdata has taken with its Reality system, based on Microdata's 1600 series. In each case, the minicomputer manufacturers have taken existing hardware lines and developed the software and support needed for various types of business applications. Often, they have taken advantage of a natural growth path from satellite processor to stand-alone in-house business systems.

Competitive situations are often centered around the problem of upgrading from an IBM 1130. The DM 100's smaller systems have met with Basic/Four, Qantel, and IBM's System/32. The larger systems have met with the Singer System Ten, the IBM System/3, Hewlett-Packard, and DEC; GA expects to meet with the more recently announced Data General C/300. Predictably, General Automation feels that the DM 100's strong points are its price/performance ratio.

Two things interest us about the DM 100 and its competitive position. First, we find it curious that any company would introduce stand-alone business systems to today's market — and *not* offer a full complement of application packages such as accounts receivable, accounts payable, payroll, and general ledger. Second, we find it surprising that GA expects that its top-of-the-line 140 is "as high as anyone would want to go." This optimism is shared by many manufacturers of the minicomputers-turned-business-machines, however. Most have dreams of competing head-for-head with machines such as the IBM System/370 Model 145.

Ironically enough, in some situations they can. But usually these are environments requiring more than a fair share of interactive applications, with minimal emphasis on batch processing.

USER REACTIONS

Users of the system are for the most part in installation stages. One user who purchased a 140 turnkey is preparing to perform inventory management, accounts receivable, order inventory, and invoicing. Later, he plans to add general ledger and accounts payable (no payroll). His equipment currently comprises a 64K byte processor, eight CRTs, 100M bytes of disc, a 600 lines per minute printer, and a 600 cards per minute reader. He will be paying over $164,000.

This user is delightfully objective. He had an IBM 1130 and needed a place to go. He looked at the Honeywell Series 58, Burroughs, NCR, DEC, Xerox, Interdata, Microdata, and IBM. What he wanted was a hardware/software package with a single vendor responsibility to provide at least a 10-year growth path. GA was the only company which offered such facilities. The Data General Eclipse hadn't been announced when he made his decision — but, he adds, he would probably do the same thing over again. This user feels that the DM 100 isn't the best software or hardware, but as a package, it's best for a single vendor responsibility.

We asked him where he plans to go from the DM 100. He is hoping that GA will announce larger machines later. As for security and privacy, although neither has been officially announced for the DM 100 line, the programs being developed turnkey for his system may nevertheless be the prototypes for future installations; and his system does have a form of protection. There is password protection at the terminal level, of course. Beyond that, there is also a facility to protect on the basis of a particular application. Specifically, one terminal may perform an application which is denied another terminal.

The user is working exclusively with indexed sequential files. One man currently debugging on-site claims that GA's ISAM is the "easiest I've ever worked with."

CONFIGURATION GUIDE

The suggested configurations for initial systems for the DM 100 line appear in Table 1. Each of the configurations can be expanded in some way, even if it is only the addition of more memory — but then, the point behind the line is that it offers a compatible growth path from satellite processing to stand-alone central processing. The smaller systems are subjected to limits on optional peripherals, but technically the restrictions are due to software constraints.

Altogether, up to 64 peripherals can be connected to a full-blown system. In general, however, all systems that

can be expanded must still be restricted to one subsystem of each type. Model 135, for example, can have one magnetic tape subsystem of from one to four drives, one printer, and so on. Model 140 is an exception: this system can have one or two printers, and one or two card readers as well as the other peripherals. However, if every option is included in the 140, the system is short one channel so one of the subsystems would have to be excluded.

All high-speed devices, including magnetic tape, disc, card I/O, and line printers, are attached to the one to eight possible DMA channels. Serial printers, paper tape I/O, and CRTs are attached to the programmed I/O channels. Disc subsystems of up to 100M bytes could consist of one to eight of the 10M byte discs, one to four of the 25M byte discs, or one or two of the 50M byte discs, or one 100M byte disc. Different types of drives cannot be mixed on the same computer system. Up to 400M bytes can be configured on a 140.

The COS operating system can run on Models 130 and up — but the version of the operating system changes with the model. The 130 COS allows nonconcurrent multitasking, for example, whereas the 140 does not allow multitasking but does support true foreground/background operations. The minimum main memory listed in Table 1 is the minimum design point which will support the various versions of the COS operating system for each model. For the 130, GA originally announced a 48K byte minimum, but now advises that 64K bytes is more realistic.

Table 2 lists all peripheral options for expanding the basic systems, as well as the basic system characteristics.

MAINFRAME

The DM 100 line is based on GA's compatible fourth-generation industrial minicomputer family, the SPC-16 (please reference your AUERBACH Minicomputer Reports for the detailed technical specifications on the SPC-16).

Central Processor

Tables 2 and 3 summarize information on the SPC-16 central processor characteristics and data formats. Of interest but not shown in the tables is the fact that the SPC-16 computers have a set of 83 instructions. The repertoire is well rounded and thoughtfully designed. It includes bit and byte instructions convenient for packing/unpacking information and for setting/resetting switches and status.

Main Storage

Read/write (R/W) memory uses 3-wire core made of lithium (lightest known metal) for reliability and environmental stability. The R/W memory is available in 4,096-, 8,192-, and 16,384-word (16-bit) models.

Table 2. General Automation DM 100 Series: Mainframe Characteristics

CHARACTERISTICS SPC-16 Series	
CENTRAL PROCESSOR	
No. of Internal Registers	8 std; 8 opt
Addressing Direct (no. of words)	32K
Indirect	32K
Indexed	32K
With Paging	128K
Instruction Set Number	78 std; 5 opt
Decimal Arithmetic	No
Floating-Point Arithmetic	No
Priority Interrupt Levels	64
MAIN STORAGE	
Type	Core
Cycle Time (msec)	1.44; 0.960; 0.480
Basic Addressable Unit	Word, byte, or bit
Bytes per Access	2
Min Capacity (bytes)	8K
Max Capacity (bytes)	256K
Increment Size (bytes)	4K, 8K, 16K
Parity	No
Protect	Opt
ROM	Opt
Use	Program and/or loaders
Capacity (bytes)	32K
I/O CHANNELS	
Programmed I/O	Yes
DMA Channels (no.)	Opt (8)
Multiplexed I/O	No
Max Transfer Rate (words/sec)	
Within Memory	173K; 260K
Over DMA	700K; 1,040K
PERIPHERALS	
Mass Storage	
Discs	5M, 10M, 15M, and 100M byte drives
Magnetic Tape	9-track; 25, 37.5, 75 ips
Terminals	512 and 1,998-char CRT
Printers	165 cps; 200, 300, or 600 lpm
Card I/O	300, 400, 600, and 1,000 cpm readers
Paper Tape I/O	400 cps reader, 75 cps punch
SOFTWARE	
Operating System	COS (Commercial Operating System)
Languages	Commercial FORTRAN, ASSEMBLY language, BASIC, FORTRAN IV
OTHER	File Management, RJE (2780)

Table 3. General Automation DM 100 Series: Data Formats

DATA NAME	REPRESENTATION
Character	ASCII
Byte	8 bits
Hollerith	12 bits (IBM 029 code)
Word	2 bytes or 16 bits
Instructions	1 or 2 wds (16 or 32 bits)
Fixed-Point Arithmetic	
Single Precision	15 bits + sign
Double Precision	31 bits + sign
Floating-Point Arithmetic	
Single Precision	24 bits + sign in Mantissa; 6 bits + sign in Exponent
Double Precision	56 bits + sign in Mantissa; 6 bits + sign in Exponent

The SPC/65, basis for most of the DM 100, can expand to 256K bytes, with eight memory modules located in the mainframe. The SPC-40, basis for the 130/2, is capable of being expanded to 256K bytes by using 16K word memory boards. The systems can address a maximum of 32K words of memory. When memory exceeds 32K words, a memory swapping technique is used to access all of memory. The first 16K are treated as standard memory and are never swapped. The modules in the 16- to 32K-word block can be swapped with any other modules via a single I/O instruction. This technique allows the program to select which modules are currently active.

The SPC-16s are dual-speed processors, with the speed determined by the type of memory used. Memory cycle time is 1,440 (core) or 720 (ROM) nanoseconds for the SPC-16/40; and 960 (core) or 480 (ROM) nanoseconds for the 16/65.

Maximum transfer rate within core memory is 173,000 words per second for the SPC-16/40 and 260,000 words per second for the 16/65.

Input/Output Control

SPC-16 has a flexible I/O system, which provides for interrupt-driven I/O or the polling of devices for I/O service. Data is transferred word by word via the general-purpose registers. Direct memory access enables block transfers directly between memory and I/O devices.

PERIPHERALS

The DM 100 line offers a fine assortment of peripherals, all of which are carry-overs from the SPC-16 line.

3322 Paper Tape Punch and Controller — 8-channel tape; 75 cps.

3323 Paper Tape Reader/Punch and Controller — Combines 3321 and 3322; requires 2 slots.

3325 Paper Tape Reader/Punch and Controller — 8-channel tape; unidirectional 300-cps reader; 75-cps punch; fanfold option; requires 1 subunit slot.

PUNCH CARD (std 80-col card)

3315 Card Reader and Controller — 300 cpm; light duty; uses 1 subunit slot.

3316, 17, 18 Card Reader and Controller — 400, 600, 1,000 cpm; heavy duty; uses 1 subunit slot.

3314 Card Punch and Controller — 35 cpm; includes keyboard; uses 1 subunit slot.

LINE PRINTERS

3353 Line Printer and Controller — Up to 132 cols/line, 600 lpm; ASCII code; uses 1 subunit slot.

3357 Line Printer/Card Reader and Controller — Printer: 132 cols, 600 lpm; Reader: 80-col cards, 400 cpm; uses 1 subunit slot.

3354-1000 Series Low-Speed Printers with Controller (with or without card reader) — 132 cols, 7 x 8 dot matrix, 6 lpi; 125 lpm; card reader 300, 400, 600, 1,000 cpm; requires 1615-0209 and 1 slot.

3354-1200 Series Low-Speed Printers with Controller (with or without card reader) — 132 cols, 5 x 7 dot matrix, 6-8 lpi; 200 lpm; card reader, 300, 400, 600, 1,000 cpm.

3355 Line Printer/Card Reader and Controller — 600-lpm printer, 132 cols; 1,000-cpm card reader (80 cols); print 6-8 lpi option; requires 1615-0209 and 1 slot.

3358 Line Printer/Card Reader and Controller — 600-lpm printer, 132 cols; 6-8 lpi; 300-cpm card reader (80 cols); requires 1615-0209 and 1 slot.

MAGNETIC TAPE

3331, 3332, 3333 Magnetic Tape Subsystems — 9-track; 25, 37.5, 75 lps; 800 bpi; 20K, 30K, 60K bytes/sec; 2,400-ft reel; master unit includes 1 drive, can handle 3 more slave drives; master requires 3 subunit slots.

3334, 3335, 3336 Magnetic Tape Subsystems — 7-track; 25, 37.5, 75 ips; either 556/800 or 200/556 bpi; 2,400-ft reels.

FIXED HEAD DISCS

3342 Head/Track Storage Drive and Controller — 128K or 256K-word capacity; access time 8.5 msec; transfer rate 2 MHz; requires 2 subunit slots.

MOVABLE HEAD DISCS

3346 Disc Storage Subsystem — Capacity 2.5M wds/drive; 4 surfaces; 204 tracks/surface; seek time 14-85 msec; latency 20 msec; 1 fixed and 1 removable disc.

Double Density Disc Storage Subsystem — Capacity 5M wds/drive; 2 surfaces; 408 tracks/surface; seek time 14-85 msec; latency 20 msec; 1 fixed and 1 removable disc.

Disc Pack Storage Subsystems — Capacity 25M, 50M, and 100M bytes per pack, 100M bytes capacity per subsystem; different capacity packs cannot be mixed on same subsystem or same computer system.

DATA COMMUNICATIONS

DM 100's parent, the SPC-16, provides for asynchronous and synchronous modes of data transmission. The range of data set interfaces provides 110- to 9,600-baud rate and either half-duplex or full-duplex operating modes. Support is also provided for Bell's 801 Automatic Calling Unit. The following data communications facilities are available for the SPC-16 and therefore for the DM 100.

1561 Asynchronous Communication Controller — For RS232-compatible data set (Bell 103 and 102); full-duplex; 75, 110, 134.5, 150, 300, 600, 1,200, and 2,400-bps rates available; 1, 2, or 4 lines; requires 1615-1101 or SPC-16/40.

1571 Synchronous Communication Controller — For Bell 201 or equivalent data set; double-buffered, full-duplex; external timing permits wide range of data rates; requires 1615-1101 or SPC-16/40.

1581 Series Asynchronous Communications Controller — Interface for full-duplex lines; std rates are same as 1561; 1, 2, or 4 lines.

1567 Automatic Calling Unit Subsystem — Provides interface for 4 automatic calling units; requires 1561, 1571, or 1590 series interfaces.

1590 Communication Multiplexor Common Equipment — Double-buffered, full-duplex interface for async lines; same baud rates as 1581; up to 16 or 32 lines.

SOFTWARE

All DM 100 series systems run under versions of the Commercial Operating System (COS), except Model 120 which is an RJE system that runs under a special stand-alone version of RJE-16. COS is a modular system that has an orderly expansion capability depending on the number of terminals it can support, how it divides main memory into partitions, and how it handles "background" programs. Smaller systems divide memory into dedicated partitions that depend on the number of terminals that can be supported, plus one "shared" partition that permits each terminal to initiate one "background" job, like printing. The "background" partition is shared on a round-robin basis.

The largest expansion of COS, used on the model 140, is a true foreground/background system. It supports two partitions, a foreground that can be shared on a real-time interactive basis determined by a variety of parameters, and a background, with only one terminal capable of initiating the background programs.

The various levels of COS are best understood by relating them to system model numbers, the level of concurrent activities, and the number of partitions. Models 120 and 130/1 have one terminal, with two partitions on the 130/1; Models 130 and 130/2 have five partitions which can handle multitasking but not true foreground/background; Model 135 has 12 partitions and Model 140, the true foreground/background system, has two partitions.

There is a File Management System which is an important element of COS. The File Management System (FMS-16) uses Partitioned Sequential Access Methods (PSAM) and Index Sequential Access Methods (ISAM) to organize and access an unlimited number of on-line random access files with fixed or variable record sizes. FMS-16 comes in two versions: a base level and upper level. Both consist of the same five modules: File Generation Module, User Interface Module, File Access Methods (FAM), Core and Random Access Manager (CRAM), and Disc Input/Output. The base level FAM provides for automatic ISAM record packing, optional PSAM record packing, duplicate ISAM or PSAM keys, random and sequential forward/background ISAM record processing, and n-level ISAM directories. The upper level FAM includes all base level features; it also allows the user to index a PSAM file (ISAM over PSAM) and to append additional ISAM files to the ISAM/PSAM construct.

Record size can range from 1 to 790 bytes less the key. ISAM keys can be from 1 to 392 alphanumeric bytes while PSAM subkeys can be two binary or alphanumeric bytes. ISAM files can be up to 8 million records long while PSAM files can be up to 65 thousand records long. Records can be inserted on-line to create file directories and data records, while physical records can be deleted to allow reuse of space and to eliminate reorganization. A system overflow file prevents record loss if records are inserted beyond the allotted limits.

FMS-16 requires a system with 16K words of memory (20K words under RTOS), a Teletype, either a 1311 card reader or 1321 paper tape reader, and a disc.

RJE-16. Remote Job Entry-16, offers the remote terminal functions of an IBM System 360/20 communicating with IBM computers operating with HASP. RJE-16 can run as a batch system in the background using Commercial FORTRAN or File Management System-16 for local processing. In real-time environment, it can run in the foreground with data collection.

Applications Software

The DM 100 line software is actually being developed in turnkey situations. Available now are packages to perform inventory accounting, inventory management, work-in-process inventory, order entry, and accounts receivable. Accounts payable and general ledger should be available soon.

LANGUAGES

GA announced that FORTRAN IV, Commercial FORTRAN, BASIC, and ASSEMBLER are available on the DM 100 line.

ASSEMBLER (CAP-16) and Macro ASSEMBLER (CAP-16M). CAP-16 includes the basic mnemonic instruction set and directives to permit memory allocation and register utilization to define literals and constants.

CAP-16M has all the features of the CAP-16 assembler and provides access to the SPC-16 IOS macros as well.

Commercial FORTRAN. General Automation's Commercial FORTRAN package is an adaptation of FORTRAN for business users. Extensive string handling capabilities have been added to facilitate report generation, and I/O handling has been modified to fit the appropriate configuration. Decimal arithmetic, text manipulation, and COBOL-like PICTURE formatting are included.

Utilities

The subroutine library includes ANSI FORTRAN external and intrinsic functions, floating-point and extended precision integer operations, error processing, and monitor interface subroutines; these are available to the ASSEMBLER as well as to the FORTRAN user. CLB-16, the core load builder, links programs and produces absolute or relocatable output. The Basic Utility System, BUS-16, provides a variety of utility functions useful for debugging. The PGS Loader-Puncher loads/punches object programs. Other utilities include a tape preparation

routine, text editor, and a Test and Verify diagnostic facility.

MAINTENANCE

General Automation maintains its own systems out of 30 sales and 59 domestic service centers in the United States. It also maintains offices/distributors throughout Europe, Scandinavia, Australia (ITT), China, and India. It is involved in a joint venture with Koyo Electronics in Japan (Koyo-General Automation).

HEADQUARTERS

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GENERAL AUTOMATION INC.
DM 200 Series Data Management Systems

OVERVIEW

The General Automation DM 200 Series are disc-based business computers capable of both batch and transaction processing. The DM 200 Series is the offspring of a successful parent — it is based on the 18/30 minicomputer that General Automation used to trounce IBM's 1130 (a small-scale scientific computer also widely used for business applications). Consequently, when evaluating the DM 200 Series, care should be taken not to think of the systems only in terms of 1130 replacement. The DM 200 may be one of the most cost-effective computer solutions for the small-business user or a company with an existing computer system wishing to off-load certain data-processing functions onto satellite computers.

Five standard models are offered by General Automation: the 220, 230, 230/2, 240 and 250. These models are distinguished by their software rather than by their hardware.

- Model 220 is a remote job entry (RJE) system operating under IBM 2780 or HASP with stand alone capabilities.
- Models 230 and 230/2 are identical IBM 1130-like batch systems which run under a Disc Monitor Operating System (DMS). The 230 is designed for new users and is marketed by General Automation's distributors; the 230/2 is an IBM 1130 replacement system.
- Model 240 is a foreground/background system which can combine either communications or spooling concurrently with batch processing under the control of a Communications Monitor Operating System (CMS).
- Model 250 is a time-sharing system that operates under the Time-Sharing Operating System (TSO). The DM 250, the most recently announced of the DM 200 Series (May 1975), performs batch processing, on-line time sharing, and real-time operations concurrently.

Each of these basic systems is configured to meet the needs of different user environments. Table 1 compares General Automation's suggested minimum configurations for each model in the DM 200 series; it also lists orientation and software support for each model.

The DM 200's special capabilities as an IBM 1130 replacement system enable it to take advantage of many software packages — not only those written specifically for the 1130 and the DM 200, but also the special turnkey systems developed by independent software houses. In addition, BASIC, FORTRAN IV, RPG II, COBOL, APL, and — Assembly language are available for users who wish to write their own programs. Applications software includes packages for accounts receivable, sales analysis, accounts payable, payroll, general ledger, and balance forward. Other software packages are available for plotter spooling, IBM 1130 compatibility, dual partition processing and time sharing.

PERFORMANCE AND COMPETITIVE POSITION

The DM 200 challenges the small-business computer market from two directions — as an 1130 replacement and as a new system for the first-time user. General Automation has three main competitors in the 1130 replacement market: Digital Scientific, Logicon and Computer Hardware Corporation. The latter is a new entry and therefore difficult to evaluate. The others appear competitive at the top end of the market where the 1130 and 1800 overlap, but they may be too expensive in smaller configurations to be competitive at the lower end. The small size of these companies also handicaps them in service facilities. Although the entrance of a new contender suggests that there is still room for competition, General Automation is clearly in the forefront of the 1130 replacement market at this time.

Competition for new users' patronage is fierce. In this market, General Automation meets all of the big computer manufacturers IBM, Burroughs, Honeywell, etc. plus most of the minicomputer manufacturers. Price-wise, all of the minis have the edge on the larger competition. Among the minicomputer manufacturers, Digital Equipment Corp., Hewlett-Packard, Varian, Microdata, Basic-Four, Wang, GRI, Lockheed Electronics, and Quantel are competing for the small-business user.

General Automation appears to be end-user oriented, much more so than, say, Digital, which relies on its OEMs to provide software support for their business users. A wealth of applications software is available for the DM 200 series, much of its resulting from the 1130 connection, and General Automation offers it in packaged form to business users. The DM 200 computers should appeal

HEADQUARTERS

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Table 1. DM 200 Series: Specifications

FEATURE	220	230	230/2	240	250
ORIENTATION	RJE	Stand alone batch system sold through distributors	IBM 1130 replacement	Foreground/background system, combines communications & batch	Foreground/background system, multiple batch some time sharing
SOFTWARE	DMS-RJE HASP, DMS-RJE 2780, RJE HASP	Disk Monitor System (DMS)	Disk Monitor System (DMS)	Communications Monitor System (CMS)	Time-Sharing Operating System (TSO)
MINIMUM CONFIGURATION					
Memory, K bytes	16	16	16	16	32
Disc, K words	–	512	512	512	10M
Printer, lpm	300	300	300	300	300
Card reader, cpm	400	400	400	400	400
Communications	Sync	Sync/Async	Sync/Async	Sync/Async	Sync/Async
Console	TTY	TTY	TTY	TTY	TTY or CRT

to batch-oriented business users who may or may not require on-line terminals. The DM 100 series caters to the transaction-oriented user and is discussed in another report.

General Automation found that is new business customers had usually looked at IBM's System/3 and then discarded it because of the significant price differential. A DM 230 with 20-million bytes of disc storage costs $47,650 — a similarly configured System/3 Model 10 would cost more than $100,000. A customer can usually lease General Automation equipment at a monthly rate of about 2.2 percent of the purchase price. For the DM 230 system, monthly rental would be approximately $1,072. Table 2, which compares purchase prices of several small-business computers, shows that General Automation's prices are less than those of its main competitors. However, it is difficult to be sure that we are comparing apples to apples, since the configurations shown vary in disc-storage capacity, basic system components, and card reader/line printer ratings.

Like any wine list, Table 2 contains some items which will appeal to the connoisseur. The Eclipse C/300 is more of an interactive than a batch system. The Singer System Ten, the highest-priced, has a reputation for being easy to use and highly business-oriented with good applications and data-management software. Table 3 compares the DM 200 Series with IBM System/3, 1130, and 1800.

Table 2. DM 200 Series Model 230: Purchase Price Comparison with Competitive Systems

Configuration	Purchase Price (excluding maintenance) $
DM 230 – 32K bytes main memory, 20M bytes disc storage, TTY, line printer (600 lpm), card reader (400 cpm)	47,650
DEC Datasystem 356 – 32K bytes main memory, 40M bytes disc storage, TTY, line printer (300 lpm).	61,345
Hewlett-Packard M260 – 32K bytes main memory, 23.5M bytes disc storage, paper tape input, mag tape device, TTY and line printer (200 lpm)	79,200
Singer System Ten – 30K bytes main memory, 20M bytes disc storage, workstation, line printer (450 lpm)	82,595
Eclipse C/300 – 96K bytes main memory, 10M bytes disc storage, console, CRT, mag tape device, 60 lpm printer, 4-line async multiplexor	77,400

Note: These figures reflect mid-1975 prices.

User Reactions

We interviewed several 1130 replacement users. An educational institution, engineering firm and architectural firm had all replaced 1130s with DM 220/2s. The educational institution configured its DM 200 system with a 20 million-byte disc, tape drive, and standard printer, card reader and console. The engineering firm configured its system with 5M-byte discs, a plotter, and the standard peripherals. The architectural firm chose a DM 200 configuration with a larger system memory. None of these users experienced any 1130 compatibility problems. Although one user had to make some adjustments because he had tinkered with the IBM software, he felt the changes had not been difficult. The engineering firm was particularly happy with General Automation's operating system (CMS), compared to IBM's DMS, because it could reference more disc space in a single program.

Another user interviewed, a liberal arts college, was in the process of upgrading its GA 18/30 to a DM 250. The original decision to move up from an IBM 1130 to an 18/30 was made in 1973 for several reasons: the 1130 had run out of file space and could not cope with the work load; and furthermore, the 18/30 could be purchased for the equivalent of two years 1130 rental.

Conversion from the 18/30 to a DM 250 cost $33,000. This included the cost of the TSO operating system, Modems, CRTs, and a replacement board for the CPU. The DM 250 was going to be used not only by students but also for administrative work.

Table 3. DM 200 Series: Specifications Comparison with IBM Systems

DESCRIPTION	MODEL			
	DM 200	IBM S/3 10	IBM 1130	IBM 1800
CENTRAL PROCESSOR				
Real-Time Clock	Yes	Opt	No	Yes
Programmed I/O	Yes	Yes	Yes	Yes
MEMORY				
Cycle Times, microseconds	1.2	1.2	2.2, 3.6	2.0, 4.0
Parity	Std	Std	Std	Std
Protect	Std	Std	None	Std
Memory Size, bytes	16K-128K	64K	64K	128K
PERIPHERALS*				
Card reader, cpm	1,000	500	1,000	400
Line printer, lpm	600	1,100	600	600
Mag tape drive, ips	75 ips	50	None	None
Disc subsystem				
Cartridge disc wds/drive, capacity	512K, 2.0M	5M, 10M	512K	512K, 2.5M
Removable disc wds/drive, capacity	10M, 40M	20M, 40M	None	None

*General Automation also offers Card Punches and Plotters.

This user, after evaluating competitive models of several other manufacturers, said that General Automation had won on all counts. Although both Digital and Hewlett-Packard could provide computers adequate for teaching FORTRAN, their systems could not support the administrative applications the college had programmed in RPG.

IBM had proposed a (pause) System/370 Model 135, since Models 115 and 125 were unable to support the type of interactive usage the college had specified. Not surprisingly the college was reluctant to spend the extra $100,000 which the Model 135 would cost.

All the users interviewed thought General Automation's service and maintenance adequate and up to IBM's standards.

Compatibility

The DM 200 models 220 and up are all hardware compatible and can be field-expanded up to the maximum configuration. Different operating systems (DMS, CMS, and TSO) account for model differences.

General Automation built the 18/30 base processor for the DM 200 series as an IBM 1130/1800 replacement. Any software developed for these computers will run on a DM 200, often without modification. General Automation's ANS FORTRAN IV is fully compatible with IBM 1130 FORTRAN; its RPG II is an extension of 1130 RPG and is similar to IBM System/3 RPG; COBOL and BASIC are implemented to ANS and Dartmouth standards, and APL is IBM compatible.

CONFIGURATION GUIDE

The various submodels of the DM 200 are differentiated by software rather than hardware and by the minimum configurations they can support. In all cases, a DM 200 system can be expanded to a maximum configuration that includes 32K 18-bit words (64K bytes) of main memory and forty million words of disc storage.

The mainframe I/O enclosure has 16 slots for peripheral subsystem interfaces and numerous extenders can be added. The addressing system allows up to 59 device controllers to be addressed.

Two specialized versions of the DM 200 series, the DM 220 and 250models, are described below.

DM 220 RJE/HASP Workstation

With the DM 220 a user has access to IBM 360/370 processing resources operating under either HASP or ASP. When the system is not being used as a workstation the user has his own on-site computer at his disposal. The DM 220 configuration consists of:

- 18/30 CPU (8K words, 1.2 usec/word).
- Card Reader (400 cpm).
- Line Printer (300 lpm).
- Console Keyboard (10 cps).
- Synchronous Communications Controller.
- Data Set Interface Cable (25 ft.).
- RJE/HASP Software Services Package.

Optional peripherals include disc, higher-speed card readers and line printers, card punches and reader/punches.

DM 250 Time-sharing System

The other DM 200 models are primarily batch-oriented systems. General Automation introduced the 250 to give the user a machine he could "grow into" — one capable of simultaneous batch and on-line operations. Up to 16 concurrent terminal users can use the system, with batch jobs initiated either from the system console or from remote batch terminals. The DM 250 can be expanded to a maximum of 64K words.

The minimum DM 250 configuration consists of:
- 18/30 CPU (16K words 1.2 Msec/word).
- Console Teletype Device.
- Disc Storage (10 million words).
- Card Reader (400 cpm).
- Line Printer (300 lpm).

Optional peripherals include expanded disc storage capacity, additional teletypes or CRTs, higher-speed card readers and line printers, magnetic tape equipment, a paper tape reader and punch, plotters, and asynchronous and synchronous line controllers.

MAINFRAME

The DM 200 processor is a word-oriented rather than a byte-oriented system. The basic unit of data is the 16-bit word with parity and protection bits appended. Fixed-point binary arithmetic is performed in two's complement form: Floating-point operations are performed by subroutines or via a floating-point processor option. Instructions can be one or two words long. See Table 4 for an itemization of the data structure.

One 16-bit register serves as an accumulator for single-precision arithmetic; a 16-bit extension register is used with the accumulator for double-precision arithmetic and extended shifts. The DM 200 also has three index registers. A set of five channel-address and five scan-control registers are associated with the five DMA channels, one pair to a channel. Additional sets of registers are added if DMA is extended. The two accumulators, three index registers and DMA registers are all programmable in Assembly language.

Table 4. DM 200 Series: 18/30 CPU Data Structure

Character	6 or 8 bits
Byte	8 bits
Half-word	8 bits
Word	16 data bits + parity + protect
Word double-length	32 bits
Instruction	16 or 32 bits
Binary Operand	16 or 32 bits
Floating-point Operand (short)	2 words (8-bit exponent, 23-bit fraction, 1 sign bit)
Floating-point Operand (long)	3 words (8-bit exponent, 31-bit fraction, 1 sign, 8 unused bits)

The DM 200 instruction set consists of 32 basic instructions, some of which are further subdivided to achieve a total of 68 instructions. Over 400 modifications are possible. Arithmetic, logical, load/store instructions come in both single- and double-precision versions. Almost all instructions, regardless of precision, can be implemented by a single- or double-word format (indicated by a flag in the first instruction word); the latter allows indirect and indexed addressing. The DM 200 contains three basic register/register instructions not found on the 1130. Two of these are found on the IBM 1800 and one is unique to the DM 200. Since the DM 200 18/30 cycle is 1.2 microseconds, instruction execution time is generally faster than those of either IBM system with cycle times of 2,000 nanoseconds and up.

Input/Output Control

Two types of I/O channels are standard on the 18/30: a parallel data channel and a set of 5-13 Automatic Data Channels.

All DMA channels can operate concurrently. Although I/O devices can be connected to any channel, devices that will be operated simultaneously must be assigned to separate channels. When more than one channel requests service at the same time, requests are serviced on the basis of channel priority, with channel 1 the highest-level. Maximum access time for channel 1 is 1.36 microseconds; maximum access time for channel 5 with all other channels sharing is 21 microseconds.

Each DMA is provided with a separate interrupt, thus obviating the need for interrogating servicing routines. Up to 16 devices can be connected through one interrupt level. User-coded subroutines must determine the device requiring service if more than one device is involved.

One internal, one trace and six external interrupt levels are included in the basic system. External levels can be expanded up to 59 levels in groups of eight. One device is usually assigned to each level, but since each level can handle 16 devices, the interrupt system can conceivably handle up to 944 devices.

MAIN MEMORY

Working storage for the DMS-200 is provided by magnetic cores with a cycle time of 960 nanoseconds (when cycle stealing) per 18-bit word (16 bits plus parity and protect). DM 200 systems come in 8K, 16K, 32K, and 64K word versions.

The memory parity bit is set for odd parity (including the storage protection bit) each time a word is written into memory, and it is checked each time it is read. Protection can be set on a word-by-word basis.

PERIPHERALS

Current peripheral offerings include low-speed devices (i.e., printers, and card and paper tape I/O devices) and disc and magnetic tape mass-storage devices listed below. If the user wants to interface his own peripherals, General Automation will supply the controller only.

- Line Printers — 200, 300 or 600 lpm; 132 col; ASCII code; controller integral; each requires two slots.
- Card Reader — 200, 400 or 1,000 cpm, 80-col; controller integral; requires one slot.
- Paper Tape Reader — 400 cps; fanfold or reel; controller integral; requires one slot.
- Paper Tape Punch — 75 cps; fanfold or reel; controller integral; requires one slot.
- 2314 Equivalent Disc Subsystem — 10M-wd capacity drive; 45 msec avg access; each master requires eight slots and can attach two slaves.
- Mini DMS 2310 Equivalent Disc Storage Subsystem — 512K-wd capacity; first drive included with processor; can attach four drives.
- Magnetic Tape Subsystems — 9-track; 800 bpi; 25, 37.5 or 75 ips; 2400-ft reel; each master requires six slots and can attach one slave.
- Calcomp 565 and 563 Plotters — 11-in. and 28-in. drums, respectively; both have interrupt-driven controllers; require one slot.

DATA COMMUNICATIONS

General Automation's communications interfaces are basically single-line interfaces. In addition, GA has introduced a new type of low-cost multi-line interface that functions somewhat like a multiplexor but does not require polling or sampling hardware and software support. It can handle up to 16 lines per interface, but generates only one interrupt signal. If multiple units are attached, the first terminal to dial up the computer gains control of the line and other terminals will receive a busy signal.

Single-line interfaces include interfaces for Bell 103A2 modems and 801 ACUs, 202C2 modems and 801 ACUs, 103A2 modems, 202C modems, and 201B1 synchronous four-wire modems (up to 2400 baud). All can operate in half-duplex or full-duplex mode.

Binary synchronous communication with IBM mainframes has been supported by General Automation for several years. Interfaces are offered for point-to-point, switched or unswitched communications, or for multipoint dedicated line support. The DM 220 Model is marketed specifically as an RJE/HASP workstation device.

SOFTWARE

Disc Monitor System (DMS)

DMS is a disc-oriented batch processing system that can support most system peripherals except the analog/digital I/O. It is compatible with IBM's 1130 DMS, allowing programs executable on the 1130 to run on a DM 200 after local generation. DMS uses a roll-in/roll-out feature to handle real-time situations and permits segmenting of large programs. General Automation claims that DMS users achieve at least twice the processing speed and a throughput 15 times greater at half the cost of equivalent systems.

Communications Monitor System (CMS)

CMS is a two-partition concurrent foreground/background processing system that typically uses the foreground for communications processing or spooling. The use of two hardware partitions allows both foreground and background programs to reside in memory simultaneously, cutting back on swapping activity, and improving response time for terminals. CMS can be interfaced to a General Automation SPC-16 minicomputer front end. Spooling programs for card punch, line printer and plotter are available. On-line inquiries and RJE entries to a large computer are also typically processed in the foreground. CMS requires at least 8K words (16K bytes) of memory, TTY console, 512K word disc, 300-lpm line printer and 400-cpm card reader.

Time-Sharing Operating System (TSO)

TSO is a new operating system designed to handle multiple batch job streams and time sharing in a balanced environment. It requires a DM 250 system with 16K words of main memory and 10M words of disc storage capacity. TSO allows user initiation and accessing of batch processing by three methods; from the console, a remote batch terminal, or a local terminal. Remote users have full file capabilities for creating, updating, extending and deleting files. TSO allows simultaneous file access by multiple users and provides a full complement of system management commands and operations which can be invoked by on-line users or via the system console.

Language Processors

Assembler. GA offers 3 different versions of the symbolic Assembler, depending on the configuration required (see Table 1). The Assembler is compatible with IBM's 1130 and 1800 Assemblers.

FORTRAN IV. The FORTRAN compiler is an ANSI FORTRAN IV compiler with extensions for commercial processing. It is a superset of ANSI X3.10-1966 specifications compatible with IBM 1130 FORTRAN IV. Ex-

tensions include random access I/O, mixed mode arithmetic, and a variety of others. It is compatible enough with IBM 1130 FORTRAN so that it is not even necessary to recompile most 1130 programs to run on a DM 200.

RPG II. The RPG II compiler runs under all three GA operating systems, including DMS, CMS, and TSO. Programs are generated on easy-to-use program specification sheets. As a result the user needs a minimum of language training as compared with FORTRAN or COBOL. RPG programs can include non-RPG subroutines.

COBOL. Required by the government in any computer system being bid for government contracts, COBOL is an indispensable business applications language — which is not to say it is the best possible language. General Automation offers an ANS 74 COBOL compiler.

BASIC. General Automation's BASIC is implemented to Dartmouth standards and is an interpreter, not a compiler. This precludes certain features like disc I/O which would allow it to be used for batch-type programs.

APL. APL is an increasingly popular time-sharing language. APL on DM 200 models under TSO is compatible with IBM's APL offering.

Applications Software

The standard general-purpose applications software consists of five packages, written in FORTRAN or RPG, as follows:

- Accounts Receivable/Sales Analysis — two modules with 15 programs, balance forward and open invoice methods; can consolidate companies or divisions on any report on a customer statement; detail and summary reports; interface to order entry; runs under DMS.
- Accounts Payable — one module with 16 programs, accepts voucher input; batch proven on each set of vouchers; integrated to general ledger, remittance only output possible; end of month purchase reporting and accounts payable.
- Balance Forward Billing — one module with 19 programs, designed for businesses and "country clubs" which do not need open invoice billing, handles both cash and charges, detailed aged statements, detail and summary transaction reports, general-ledger interface.
- General Ledger — one module with 21 programs; interfaces with all other accounting systems; includes both multicompany general-ledger and intercompany billing; reports include budget information, trial balance, standard journal analysis.
- Payroll — one module with 15 programs; card back-up for master file and yearly/quarterly reporting, automatic deductions for taxes, insurance, credit unions, etc.; for hourly and salaried personnel; creates general-ledger entries.

In addition to the above general-purpose packages, General Automation supports two turnkey systems. One is a system for automating the inventory procedures in public warehouses that runs on a DM 230 with an extra 5M byte disc. The second is a data-base handling system for small to medium-sized insurance companies, running on a DM 240 system; this system is a joint venture with Lycor, an Indianapolis-based software house specializing in software for life, property and casualty insurance.

MAINTENANCE

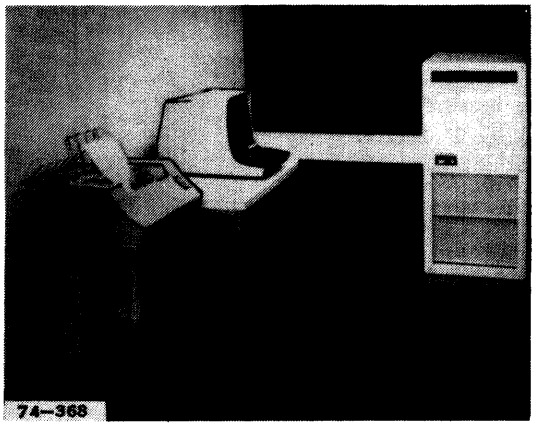
General Automation maintains around 50 service centers in 30 cities in the United States and about 100 centers worldwide, staffed with approximately 300 service personnel. The standard maintenance contract is for the prime shift, but 24-hour contracts and various intermediary types can be negotiated.

PRICE DATA

The model 200 minimum configuration sells for $27,000; models 230 and 230/2 sell for $36,650, and model 240 sells for $37,650. The price for the 250 was not yet established at the time of writing, but will be in the neighborhood of $75,000. See Table 2 for minimum configurations. Leasing is done through a third party negotiated by General Automation; monthly costs range from 2.1 to 2.3 percent of the purchase price for a typical five-year lease. General Automation is talking to a third party about one-year leases. In third-party leases General Automation usually still does the maintenance work.

GRI COMPUTER CORP.

GRI System 99



OVERVIEW

The GRI System 99 is a disc-based interactive small business system aimed chiefly at systems houses, software houses, and OEM manufacturers. GRI is a minicomputer manufacturer with much of its business in the OEM market; System 99 is based on the new 9950 processor, a recent addition to the 16-bit GRI-99 line. A basic system includes 16K words of memory, cartridge disc, keyboard/display, and printer. More memory, disc storage, magnetic tape, higher-speed printers, and card readers can be added to the system.

The system software supplied by GRI includes a multi-user disc operating system (OS/99) or a single-user disc operating system with a basic interpreter. The multi-user OS/99 can run the interactive RPG II compiler, RPG II subroutine library, and relocatable assembler. Disc file maintenance and utility routines (including a sort program), editors, loader, library utility programs, and an interactive execution control language (corresponding to the job control language on a batch system) are all available.

The system architecture is centered around a unique, dual universal bus* that connects all system components, including memory, peripheral interfaces, registers and instruction logic modules. This type of architecture is highly modular. The instruction set, register complement, and other elements of the system can be extended by the simple addition of printed circuit cards like those used for I/O interfaces. All devices are logically capable of DMA transfers occurring simultaneously with certain types of processing in the CPU; a selector channel is usually included, however, if the device interface does not have the logic to maintain count on block transfers and handle initiation and termination procedures. The System 99 processor has push/pop stack-handling instructions as well as block manipulation instructions. These instructions facilitate the management of multitask environments.

Under GRI's standard Distribution Agreement, which runs for 18 months, the distributor's name may be attached to the system, with either the System 99 label or another of the customer's choosing. Distributors need not maintain a spare parts inventory, but can instead rent local availability of a spare complement. Systems are purchased under an arrangement that allows increasing discounts as dollar volume increases. Payments can also be extended over a period of time. The system is available both in the United States and Europe.

COMPATIBILITY

The use of the RPG II languages allows the GRI System 99 to be source program-compatible with a number of manufacturers' systems, provided similar configurations are used.

PERFORMANCE AND COMPETITIVE POSITION

GRI joins the ranks of several minicomputer manufacturers that have recently entered the small business systems marketed via arrangements with distributors and OEM manufacturers of various kinds. Rather than build up its own applications software, the minicomputer manufacturer sells the system to a software house or similar organization, and then the house supplies turnkey systems for local customers. Some of the more sophisticated small business users will buy directly from the minicomputer manufacturer and do their own programming, with support from the manufacturer, but the large number of small business users like to begin with either a turnkey system or one with at least the majority of the software customized to some extent.

The success of this arrangement is indicated by the increasing numbers of minicomputer manufacturers entering into this type of marketing. Microdata, Wang, and

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*Patented by GRI Computer.

Lockheed, for instance, have entered into the market with very similar strategies. This type of marketing offers a lower price and the convenience of a local software house that can often be more responsive to the user (because of small size and consequent flexibility) than the larger computer manufacturers who make small business systems like IBM, Burroughs, and NCR.

Several small business system companies in Europe are based on the GRI system, notably the Allied Business Systems Multibus. Although GRI is a relatively small company, it is well established both in the U.S. and Europe.

USER REACTIONS

The accounting department of a company that moves oil tugs and barges has obtained two System 99s for general ledger, accounts payable, accounts receivable, check writing, and a number of other applications. The company needed a customized system because it deals with a great many kinds of invoices denoting sources and destinations of ships and cargo.The first GRI system was obtained from Focus IV, a local software house which subsequently went bankrupt. By that time, however, the user had been doing most of his own programming, so he simply negotiated with GRI for maintenance. Actually he had few problems — humorously, the only downtime he suffered last year was right after a preventive maintenance visit from a new GRI serviceman who hastily found out what he had done wrong and remedied it. This user then obtained his second system from another local distributor, KR Systems.

The accounting department liked the GRI system because it allowed them a time-sharing environment where several operators could work concurrently. They had thoroughly surveyed available systems before making their choice. IBM's System/3 and Burroughs' B1700 were rejected immediately — both were much too expensive. DEC's PDP-11 couldn't be delivered until 150 days later, so they rejected it too. Texas Instruments' 960A came closest to the GRI-99, but used a straight foreground/background type of operating system that did not give the same degree of simultaneity, so they decided on the GRI-System 99. Their first system was delivered three days later and was up and running a day later. The next system was delivered around three weeks after placing the order.

CONFIGURATION GUIDE

A typical System 99 consists of a central processor with 8K 16-bit words of memory, a 10.6M-byte disc subsystem with one fixed and one removable disc, a keyboard display unit, and a printer. The CPU memory and disc are housed within a single "data cabinet."

Main memory can be expanded in 8K-word increments to a maximum of 32K words (64K bytes). Three more drives can be added to the disc subsystem for a total of 42.4M bytes. Additional remote or local keyboard displays can be added to the OS 99 system for multi-user configurations. Additional peripherals can be attached. Users can choose several different printer models with speeds up to 250 lines per minute. Both 80-column and 96-column card units, as well as a magnetic tape subsystem can also be attached; the magnetic tape subsystem, which will support up to four drives per controller. Table 1 gives GRI System 99 specifications.

Table 1. GRI System 99: Specifications

CENTRAL PROCESSOR	
Microprogrammed	Yes
No. of Registers	17
Max No. of Devices (I/O slots)	25-unlimited
No. of Instructions	233
Block Manipulation/ Stack Handling	Yes
Extended Arithmetic	Yes
Priority Interrupt Levels	16-unlimited
Indirect Addressing	1 or 2 levels
Core Cycle Time (msec)	1.76
Memory Capacity (min/max bytes)	32K-64K
Memory Protect	No
DMA Transfer Rate (bytes/sec)	1,136,000
PERIPHERALS	
Disc	10.6M bytes
Magnetic Tape	800 bpi, 37.5 ips
Card I/O	96- or 80-col units
Printer	100 cps - 600 lpm
Display	640-char, 1280 char
Communications	Up to 9,600 baud
SOFTWARE	
Operating Systems	Single-User (DOS), multi-user (OS 99)
Compilers	Interactive RPG II
Assembler	Yes
Interpreter	Single-user BASIC

MAINFRAME

System 99 is a 16-bit word-based system, but both byte-handling and block handling instructions allow considerable flexibility in data manipulation. Register-to-register instructions are usually one word long while memory reference instructions are two words long. The standard set of 233 instructions includes stack manipulation instructions.

Addressing modes include combinations of direct, indirect, indexed, and relative addressing. Up to 32,768 words (65,536 bytes) of memory can be directly addressed. One or two levels of indirect addressing can be employed. Memory can be increased from a 16K word (32K byte) minimum system to a 32K-word (64K-byte) maximum system in 8K-word increments.

The interrupt subsystem determines device priority generally on the proximity of devices to the CPU. When several devices share a single data line connected to a single bit in the interrupt status register, the priority is the same and the service routine determines priority. DMA interrupts have priority over program interrupts.

PERIPHERALS

A variety of printers, card readers/punches, magnetic tape systems and disc storage systems are available for the GRI System 99.

Low-Speed Peripherals

9211 Keyboard/Display Subsystem (640-char)
9212 Keyboard/Display Subsystem (1280-char)
9240 Terminal Printer (prerequisite 9211 or 9212 Keyboard/Display Subsystem)
9303 Matrix Printer (80-cpl, 100-cps)
9303C Matrix Printer (80, 96 or 132-cpl, 100-cps)
9320 Matrix Printer (132-cpl, 88-cps)
9321 Matrix Printer (132-cpl, 120-cps)
9304 Matrix Printer (132-cpl, 165-cps)
9307 Matrix Printer (132-cpl, 330-cps)
9308 Matrix Printer (132-cpl, 660-cps)
9311 Line Printer (300-lpm, 136-cpl)
9312 Model 9311 Printer with u/l case
9313 Line Printer (600-lpm, 136-cpl)
9314 Model 9313 Printer with u/l case
9350 HyType Printer
9401 Card Reader (96-col)
9402 Card Reader/Punch (96-col)
9411 Card Reader (80-col, 300-cpm)

High-Speed Peripherals

9502 800 Bpi, 37.5 ips, Magnetic tape Subsystem
9512 800 Bpi, 37.5 ips, Magnetic tape add on
9105 10.6MByte Disc Drive Subsystem
9115 Add-on 10.6MByte Disc Drive

SOFTWARE

The basic System 99 software includes three disc operating systems (single-user DOS and two multiple-user DOS systems), an interactive RPG II compiler, BASIC interpreter, relocatable assembler, execution control language, editors, and a variety of utilities including a SORT package.

Operating Systems

The Single-User DOS system (DOS-99) is a straightforward system allowing a single job to operate in a batch or interactive mode. It requires 2K words of core and can support CRTs, Teletypes, discs, and printers. It is aimed at OEM manufacturers developing their own software. The BASIC Interpreter runs under this system.

The multi-user OS 99 system is highly modular and can support numbers of I/O devices. A multiterminal system requires 16K words of core with 8K words reserved for the executive. This operating system is "event-driven" rather than "time-sliced" with real-time service of I/O devices on a priority basis. Programs can be compiled and assembled on-line. The multi-user system supports RPG II but not BASIC.

PRICE DATA

Model Number	Description	Purchase Price $	Monthly Maint. $
9016	16K x 16 Central Processing Unit	22,600	132
9024	24K x 16 Central Processing Unit	26,890	157
9032	32K x 16 Central Processing Unit	31,180	182
9008	Additional 8K x 16 Bit Work Core Memory	4,290	25
9211	Keyboard/Display Subsystem (640-char)	3,738	25
9212	Keyboard/Display Subsystem (1280-char)	4,201	25
9240	Terminal Printer (prerequisite 9211 or 9212 Keyboard/Display Subsystem	2,685	20
9303	Matrix Printer (80-cpl, 100-cps)	4,673	29
9303C	Matrix Printer (80, 96 or 132-cpl, 100 cps)	5,173	35
9320	Matrix Printer (132-cpl, 88-cps)	5,210	37
9321	Matrix Printer (132-cpl, 120-cps)	5,973	43
9304	Matrix Printer (132-cpl, 165-cps)	6,472	46
9307	Matrix Printer (132-cpl, 330-cps)	8,086	54
9308	Matrix Printer (132-cpl, 660-cps)	10,204	70
9311	Line Printer (300-lpm, 136-cpl)	17,698	118
9312	Model 9311 Printer with u/l case	19,613	130
9313	Line Printer (600-lpm, 136-cpl)	22,752	152
9314	Model 9313 Printer with u/l case	24,640	164
9350	Hytype Printer	7,000	47
9401	Card Reader (96-col)	3,914	32
9402	Card Reader/Punch (96-col)	16,125	71
9411	Card Reader (80-col, 300-cpm)	4,785	35
9502	800 Bpi, 37.5 ips, Magnetic Tape	16,000	103
9512	800 Bpi, 37.5 ips, Magnetic Tape add on	10,250	63
9105	10.6 MByte Disc Drive Subsystem	13,403	103
9115	Add-on 10.6 MByte Disc Drive	8,875	74
9001	Multi-user Disc Operating System with Interactive RPG II Compiler, Assembler and all Utilities	Included with Central Processing Unit	
9005	Disc Cartridge tested and formatted	270	
9006	Enclosure for up to two 9114 or 9115 Disc Drives	1,250	
9114	Disc Drive (5.3M-byte)	8,115	65
9105	Disc Subsystem (10.6M-byte)	13,070	103
9115	Disc Drive (10.6M-byte)	9,282	74
9001	Multi-user Disc Operating System	Furnished with system	
9002	Interactive RPG II Software Package	Furnished with system	
9003	Single-User DOS with Basic Interpreter	Furnished with system	

HEWLETT-PACKARD

9800 Series Calculator Systems

HP 9825 and printer

OVERVIEW

Hewlett-Packard (HP) 9800 Series is a family of desktop, microprogrammed computer/calculators designed to cover the spectrum of capability between the popular HP hand-held calculators on the low end and the HP minicomputer line on the high end. The 9800 Series combines the immediate, interactive problem-solving capabilities of a calculator with the programmed operation and storage facilities of a small computer.

The most recently announced members of the 9800 family, the 9815 and 9825 programmable calculators, supplement the older, more powerful 9830 computer/calculator. All the models offer firmware-implemented operating systems and use high-level or keystroke programming languages. The models are differentiated by price, language offerings, speed, and I/O capabilities.

Model 9830. The oldest member of the 9800 Series, the 9830, includes a processor, 8K bytes of memory, LED display, keyboard, printer, and one cassette drive. To the basic configuration can be added another 8K bytes of memory, a disc subsystem, more printers or cassettes, card and paper tape I/O, plotter, digitizer, instrument interfaces, and several types of communication interfaces. The unit functions under control of a firmware operating system that includes a BASIC interpreter.

Extensions to the operating system take the form of additional ROMs, which may be factory installed or plugged into I/O slots like peripheral devices. One ROM, for instance, permits batch processing, program stacking, and use of other language statements in a time sharing environment (although other compilers are not provided).

Hewlett-Packard also supplies a variety of prepackaged application programs on tape cassettes. Areas covered include: accounts payable and receivable, inventory control, payroll, general ledger, cost accounting, investment analysis, real estate appraisal, bond calculations, statistics, structural design, electronics, numerical control, and medical and education problems.

First deliveries of the 9830 took place in January 1973. To date, more than 5,000 systems have been delivered.

Model 9825. The most recently announced member of the 9800 Series, the 9825, includes a processor, 6,844 bytes of memory, LED display, keyboard, printer, and HP's new mini-3M-type tape drive. To this configuration can be added up to 32K bytes of memory and up to three I/O interfaces, which can support a variety of peripheral devices including most of those supported on the 9830. The 9825 does not, however, support the disc subsystem and the cassette drives.

The 9825 functions under control of a firmware operating system that includes an interpreter for HPL, a high-level language similar to BASIC and designed for efficiency in calculation, data manipulation, and I/O operations. As with the 9830, HP offers special-purpose ROM extensions for added computational or I/O capability.

While the 9830 has been marketed for a number of years as a general-purpose supercalculator, the 9825 appears designed for the narrower market of data acquisition, reduction, and calculation. With a direct memory access channel, an industry standard (IEEE 488-1975) instrument interface, and an interrupt-driven keyboard, the 9825 seems to be an ideal device for attachment of instruments for sophisticated data reduction.

HEADQUARTERS

Hewlett-Packard
Calculator Products Division
PO Box 301
Loveland CO 80537
(303) 667-5000

First delivery of the 9825 took place in February 1976.

Model 9815. HP's 9815 includes a processor, 472 program steps or 10 data registers, the HP mini-3M tape cartridge, display keyboard, printer, and two I/O interfaces supporting most of the same devices as the 9825. Optional equipment includes increased program memory (up to 2,008 steps), and device attachment similar to the 9825.

The 9815 makes use of a large number of special keystroke functions (in a conventional calculator manner) rather than using a high-level language. The 9815 weighs only 13 pounds. It is the logical purchase for the user who needs more capability than is offered by the HP hand-held units or who has relatively simple instrument control applications.

First deliveries of the 9815 took place in October 1975.

COMPATIBILITY

While all models in the 9800 Series are technically and functionally well conceived and offer a graduated increase in capability at increasing price levels, HP has chosen to maximize performance at the expense of compatibility. There is no direct compatibility between the hand-held units and the 9800 models or the minicomputer line and the 9800s. However, there are some common peripherals (with differing interfaces) shared by the calculator systems and the minicomputer line. Also, within the 9800 Series, compatibility among models has not been stressed.

The apparent policy of HP has been to put as much capability as possible into a given product while meeting certain price constraints. In doing so, many standard elements of system compatibility (standard language, common media, etc.) have been omitted. Where convenient, however, HP has provided some compatibility, common I/O device attachment being the principal example.

From the viewpoint of a prospective user, lack of compatibility should be recognized but not necessarily considered a product flaw. In general, equipment of the class represented by the 9800 is purchased for a specific, often dedicated, purpose and the buyer's chief interest is that of obtaining adequate capability at the best price. By carefully tailoring the various 9800 products to meet this goal, HP has produced units for every pocketbook. Users should be cautioned to determine their maximum capability requirements prior to selecting from among the 9800 models, as attempts at upgrading within the line will require, at least, changing any software that will be transferred.

As data communications is not supported on either the 9815 or 9825, it is only the 9830 that can perform communication to other computer devices. Both asynchronous and binary synchronous modes are supported by the 9830. The 9830 systems may communicate with other 9830s, with terminals, or with mainframe computers by emulating the IBM 2780 remote batch terminal.

PERFORMANCE AND COMPETITIVE POSITION

Hewlett-Packard has historically been one of the leading manufacturers of electronic instrumentation and has an outstanding growth record. Over the years it has developed many computing devices to process instrumentation outputs and has discovered that its computer products have been well received in the much larger information processing market. HP has long recognized the potential of the lower end of the minicomputer market; and for a number of years it has been marketing a line of equipment running from full-blown minicomputer systems (the 3000 and 21MX series) to the enormously successful programmable hand-held units, such as the HP 35 and 65.

The 9800 Series is positioned in the area between those two classes of equipment. The three models now marketed as the 9800 Series form three levels of supercalculators.

All of the 9800 models make use of firmware-developed operating systems and interpreters. The 9815 uses an algebraic keystroke-type language similar to that found on the hand-held units where, for example, a single keystroke can represent syntax elements, such as IF (conditional branching), FOR (loop start control), or RETURN (subroutine). The 9825 implements a high-level language called HPL, which appears to the user as a variant of the popular BASIC language. Finally, the 9830 employs BASIC Plus, a superset of Dartmouth BASIC.

HP's 9800 line has a number of well-known competitors. The 9830, the largest model, meets rivals in the area of stand-alone BASIC systems. For several years Wang Laboratories' System 2200 was the only major competitor of the 9830. However, the recent announcements of the Tektronix 4051 and the IBM 5100 Portable Computer have introduced two strong new competitors into this arena and shifted the marketing emphasis to portability and desktop computing. Most likely, the 9825 will help HP confront this new market; it is somewhat less expensive than the new competitors (and the 9830), and in most areas it meets the Tektronix 4051 or IBM 5100 in terms of functional capability. The Wang 2200 Portable Computer System (PCS) is the 9825s most equally matched competitor.

The 9830, which has considerably more I/O capability than the 9825, will still prove to be the most likely to succeed in those applications where fairly complex supercalculator system configurations (e.g., discs, card readers, teleprocessing) are needed. In this large system configuration ($20,000 plus), the 9830's main competitor remains the Wang System 2200. The Wang 2200 and the 9830 have both attempted to serve the supercalculator market and, in general, offer similar capabilities. In certain configurations the 9830 is slightly less expensive than the 2200, but the 2200 can offer floppy discs and somewhat faster internal speeds.

The 9815 does not compete with the higher-level language calculators, but rather with the large number of

keystroke calculators now on the market. Its most formidable competitor is probably the recently announced Texas Instruments SR60A, which stands in the same relation to the hand-helds as does the 9815. The 9815 is more expensive than the Texas Instruments product but is more powerful. Its cartridge medium exceeds the strip recording of the TI unit, and it provides I/O interfaces that are unavailable on the TI device.

Several features on the 9815 and 9825 are worth special mention. Both models are well packaged and lightweight: 13 pounds for the 9815 and 26 pounds for the 9825 (versus 50 pounds for an IBM 5100 without printer and 57 pounds for the Wang 2200 PCS). Both make use of the minicartridge jointly developed by HP and 3M. This device is small, fast, and can store 100,000 (9815) or 250,000 (9825) bytes of data. It appears, in most respects, to be superior to the older Philips cassette technology used on the 9830. Finally, both the 9815 and 9825 have a "live" keyboard, a first in the calculator field; this feature allows overlapped keyboard entry and data calculation or I/O device control.

USER REACTIONS

Only 9830 users are included in these interviews. At the time of writing, the 9815 and 9825 had been on the market for just a short period of time. Generally, users emphasize the ease of use of the 9830 system and the variety of functions and programs that can be implemented on it. Once a primary application was running, most users began to think of additional tasks for the system.

Hospital Laboratory. One large hospital laboratory purchased a large 9830 configuration with paper tape reader and punch, card reader, line printer, disc and plotter. The system is principally used in conjunction with a blood analysis system, with analyzer output punched on paper tape for subsequent reduction and report preparation on the 9830. An attempt was made to use the 9830 as a direct controller of the analyzer, but this proved infeasible due to the signal output of the analyzer. Difficulty of this sort should become less common as new instruments begin to adhere to the instrument interface standard now supported by HP.

This user was also applying the 9830 to its lab inventory — a use unforeseen at purchase time. This lab and all other users felt that the reliability of the equipment was quite high, although the lab's spokesman did mention that the inability of the 9830 to perform more than one task at a time was, on occasion, a small problem.

Another laboratory user of the 9830 found that besides its regular calculator functions, the 9830 could be programmed to act as a text editor or word processing system for the issuing of doctors' reports.

Engineering. An engineering lab user, who installed a 9830 for general calculation and statistical use, found that it had become so popular within his department that there was competition for access to the system. He had special praise for a video tape series, which was obtained from HP as a training aid for the engineers and allowed for the effective training of a large number of personnel. This user hoped to be able to expand his system to accommodate direct instrument control programs but was unable to do so without increasing the usage of the system. He is currently looking into the 9815 as a device controller but, due to the present lack of media compatibility, has not yet purchased the smaller unit.

CONFIGURATION GUIDE

The basic 9800 Series models look similar; they are all desktop units with integral display, keyboard, and storage medium. The 9815 and 9825 come with an integral 16-column dot matrix printer; the 9830 allows a 250 line-per-minute thermal printer to be directly superimposed on the basic processor chassis. The various models contain a minimum of 3,520 bytes (9830), 6,844 bytes (9825), and 472 steps (9815) of MOS read/write memory. User-available memory may be expanded to a maximum of 15,808 bytes (9830), 31,420 bytes (9825), and 2,008 steps (9815) in various increments.

In addition to the printer and tape I/O facilities, the devices have 2 (9815), 3 (9825), and 4 to 13 (9830) I/O slots. Three separate interfaces are supported by all models: 8-bit parallel output, 8-bit parallel bidirectional, and a general interface conforming to the IEEE 488-1975 standard. The 9830 also supports an RS232 interface for telecommunications.

Certain peripherals may be attached to all 9800 devices: plotter, digitizer, paper tape reader and punch, thermal line printer, and 30 character-per-second 132-column character printer. A hopper-punched or mark sense-card reader may be attached to the 9825 or 9830; and the 9830 (only) also supports additional cassette drives, a 5M-byte disc subsystem, and data communication interfaces.

The 9815 has no provision for expansion of the firmware facilities (except for the optional I/O interfaces, which use ROM for signal control), but both the 9825 and 9830 do. The 9825 has plug-in ROM options for string variable manipulation, advanced programming (subroutine parameter passage, etc.), matrix operations, and I/O interface and plotter driver firmware. The 9830 can be ordered with factory-installed ROM options of matrix operations, plotter control, string variable manipulation, data communication control, and I/O interface driver firmware. The 9830 also offers plug-in ROM functions for the preceding options, a batch BASIC ROM, and binary synchronous data communications. The characteristics of the 9800 models are shown in Table 1.

Table 1. HP 9800 Series: Specifications

CHARACTERISTIC	9815	9825	9830
Data Output			
Char Display	16-digit gas discharge	32-char A/N LED	32-char A/N LED
CRT Display	-	--	24 lines, 80 char
Printers	132-col, 30 cps char printer	Same as 9815	Same as 9815
	80-col, 250 lpm thermal dot matrix	Same as 9815	Same as 9815
	16-col, thermal dot matrix 168 lpm	Same as 9815	
Paper Tape (cps)	75	75	75
Other	Electrostatic x-y plotter	Same as 9815	Same as 9815
Communications	--	--	Async, bisync (2780)
Software			
Operating System	In firmware	In firmware	In firmware
Language	Keystroke function	HPL	BASIC Plus
Processor			
Type	Microprogrammed	Microprogrammed	Microprogrammed
Main Memory	472-2,008 steps	8-32K bytes	8-16K bytes
Addressable Registers	10	--	--
No. of I/O Channels	2	3	13
Auxiliary Storage			
Medium	Mini-cartridge	Mini-cartridge	Cassette std disc opt
Capacity (bytes)	100K	250K	64K (cassette); 4.9M (disc)
Transfer Rate (bps)	500	2,750	347 (cassette); 300,000 (disc)
Avg Access	1 sec	6 sec	60 sec (cassette); 42 msec (disc)
Data Entry			
Keyboard	Function keys w/numeric pad	Typewriter w/function keys & numeric pad	Typewriter w/function keys & numeric pad
Paper Tape (cps)	500 & 20	500 & 20	500 & 20
Mark Sense, Punch card	-	300 cpm	300 cpm
Other	Digitizer	Digitizer	Digitizer

MAINFRAME

Central Processor

All 9800 Series devices make use of a microprogrammed instruction set and a firmware operating system. The 9830 uses BASIC as its language, the 9825 uses HPL, and the 9815 uses a keystroke per-function calculator language. All systems can operate as interactive calculators with full trigonometric and exponential function capabilities. The 9830 and 9825 systems may be expanded by the addition of field- and factory-installed ROMs. Among the ROM functions available are: string manipulation, plotter control, matrix operations, extended I/O, data communications (9830 only), mass memory control (9830 only), and specialized advanced programming functions.

Main Memory

All 9800 series devices use MOS read/write memory. The 9815 comes with 472 steps and 10 data registers and may be expanded to 2,008 program steps. The minimum 9825 is provided with 8K bytes of memory, of which 6,844 bytes are available to the user; user memory may be expanded in 8K byte increments up to 31,420 bytes. The minimum 9830 is provided with 4K bytes, of which 3,520 are available to the user; memory may be expanded to [illegible] 15,808 bytes [illegible].

INPUT/OUTPUT

All 9800 devices come with a standard visual display, keyboard, and storage medium. The 9830 and 9825 use a 32-character alphanumeric LED display; and the 9815 uses a 16-character, numeric-only, 7-segment gas discharge display. The 9830 and 9825 offer a typewriter keyboard with numeric pad and a number of function keys; the 9815 has a calculator-type keystroke-function keyboard with a numeric pad. The 9815 and 9825 both make use of the new HP 3M mini-cartridge; the 9830 uses the Philips-type cassette drive, which has less capacity and is slower than the 3M cartridge.

Both the 9815 and the 9825 have an integral 16-column thermal dot matrix printer attached to the minimum system. The 9815 printer prints only uppercase alphabetics; the 9825 unit also prints lowercase (and, with a ROM extension, a number of special characters). The minimum 9830 may be purchased without a printer. However, an 80-column thermal printer that fits on top of the processor is available. This device, too, features an alphanumeric dot matrix with upper- and lowercase capability. It is also available as an option on the 9825 or 9815. HP recently announced a 30 character-per-second 132-column character printer, which may optionally be attached to any 9800 processor.

The number of I/O slots varies for each member of the 9800 Series. The 9815 has two I/O slots, the 9825 three, and the 9830 four expandable to 13 via an I/O expander option. All devices support three general I/O interfaces: 8-bit BCD parallel output, bidirectional 8-bit parallel I/O, and the recent IEEE standard instrument interface. In addition, the 9830 and 9825 support a series of dedicated device interfaces for a large number of peripheral devices; only a subset is supported by the 9815.

PERIPHERALS

A large number of peripheral devices can be attached to 9800 Series systems, with certain devices supported only by the larger units of the line. See Table 2 for a listing of the 9800 peripheral devices.

Table 2. HP 9800 Series: Peripherals

Device	Description	Attaches to
9862A	Plotter (10 x 15-in. axes)	All models
9863A	Paper Tape Reader (20 cps)	All models
9864A	Digitizer	All models
9866A	Thermal Page Printer (30 col, 250 lpm)	All models
9868A	I/O Expander	9830
9869A	Hopper Card Reader (300 cpm)	9830, 9825
9870A	Mark Sense Card Reader (300 cpm)	9830
9871A	Typewriter (30 cps, 80-132col)	All models
9880B	Disc Storage (42-msec access, fixed & removable platter, 4.9M bytes)	9830
9881A	Line Printer Subsystem (200 lpm)	9830
9882A	CRT Display (24 lines, 80 col)	9830
9883A	High-Speed Paper Tape Reader (500 cps)	All models
9884A	Paper Tape punch (75 cps)	All models

Certain peripherals require extended ROM options on some models. There are three types of equipment interfaces offered. For the 9815, special device interface controllers (which are microprogrammed) are required.

DATA COMMUNICATIONS

Data communications is restricted to the 9830 system and is currently unavailable on either the 9815 or 9825.

Four data communications systems can be configured using the HP9830A with the HP11285A Data Communications Interface and the HP11297B and HP11298B Data Communications ROMs. The first configuration uses the HP11285A, without either of the two additional ROMs. It can be used for 9830-to-9830 communications or 9830-to-terminal communications, in asynchronous or synchronous mode at data rates up to 9,600 bits per second using standard ASCII code.

The second configuration requires the HP11285A with the HP11297B ROM. A 9830 can communicate with a computer as a programmable binary synchronous terminal at data rates up to 4,800 bits per second. The 9830 is able to look like a particular binary synchronous terminal, for example, the IBM 2780. Transmission code can be ASCII EBCDIC, or binary.

The third data communications configuration requires the HP11285A with the HP11298B ROM. Operating in asynchronous mode at data rates up to 1,200 bits per second, the 9830 can function as an active teleprinter to a time sharing computer. Programs written in languages other than BASIC can be transmitted or received. Transmission code can be ASCII, EBCDIC, or binary.

The fourth configuration uses both the HP11297B and HP11298B ROMs and the HP11285A interface. It combines the capabilities of binary synchronous batch (high-speed synchronous operation) and interactive time share communications (low-speed synchronous operation) with only one interface and one 9830.

SOFTWARE

While the operating system and interpreter are implemented in firmware on all systems, programmability is a key element of the 9800 Series. HP has developed a considerable body of software for the older 9830 line but is currently offering only limited packaged software for the newer, smaller units. The software offered for the 9800 covers the areas of engineering, mathematics, statistics, surveying, and a variety of commercial applications. See "PRICE DATA" for a complete listing of software packages.

MAINTENANCE

Maintenance and sales support for all Hewlett-Packard products are provided by 172 offices throughout the world.

Maintenance rates are quoted for a 100-mile radius service zone. Three and five year leases are available on a selective basis. Contact the local HP office for complete leasing information.

PRICE DATA

Description 9815		Purchase Price (maint. not incl) $	Monthly Maint. $
9815A	Basic 9815 Calculator	2,900	16.92
	FACTORY-INSTALLED OPTIONS		
Opt. 001	2006 Total Program Steps	700	4.08
Opt. 002	2 I/O Channels	200	1.17
Opt. 003	3 Additional Data Cartridges	54	—
	FIELD INSTALLATION KITS		
98121A	2008 Total Program Steps	750	4.08
98122A	2 I/O Channels	250	1.17
Opt. 001	Field Installation Charge (required on all kits installed separately)	75	—
	PERIPHERALS		
	Option 015 is required for each peripheral ordered.		
9862A	Plotter	2,995	17.50
9863A	Paper Tape Reader	1,710	17.08
9864A	Digitizer	5,140	30.00
9868A	Thermal Page Printer	3,145	19.58
9871A	Character-Impact Printer	3,400	19.83/34.00[2]
9883A	High-Speed Paper Tape Reader	2,275	12.42
9884A	Paper Tape Punch	3,080	29.00
Opt. 015	Required Peripheral Interface for each peripheral	200	1.17
	PERIPHERAL INTERFACE CARDS		
	Peripheral interface cards should, therefore, only be ordered when the peripheral is already in buyer's possession.		
98132A	9862A Plotter Interface	400	2.33
98134A	9863A Paper Tape Reader Interface	300	2.33
Opt. 063		100	2.33
98134A	9864A Digitizer Interface	300	2.33
Opt. 064		100	2.33
98134A	9866A Thermal Page Printer Interface	300	2.33
Opt. 066		100	2.33
98131A	9871A Character-Impact Printer Interface	400	2.33
98134A	9883A High-Speed Paper Tape Reader Interface	300	2.33
Opt. 083		100	2.33
98134A	9884A Paper Tape Punch Interface	300	2.33
Opt. 084		100	2.33
	SPECIAL-PURPOSE INTERFACE CARDS		
98134A	General 8-Bit Parallel Interface	300	1.75
	ACCESSORY		
98145A	98145A Vinyl Carrying Case	35	—
9825A	Basic 9825A Calculator, (6844 bytes of read/write memory with 32-character LED display, 16-character strip printer, and built-in 250K-byte tape cartridge drive	5,900	34.42
	FACTORY-INSTALLED OPTIONS		
Opt. 001	15,036 Total Bytes of Read/Write Memory	1,600	9.33
Opt. 002	23,228 Total Bytes of Read/Write Memory	3,200	18.67
Opt. 003	31,420 Total Bytes of Read/Write Memory (will not operate with ROMs 98210A, 98213A, and 98214A	4,800	28.00
	PLUG-IN OPTIONS		
98210A	String-Advanced Programming (will not operate with 31,420 bytes of memory)	500	2.92
98211A	Matrix	350	2.08
98212A	9862A Plotter-General I/O	500	2.92
98213A	General I/O-Extended I/O (will not operate with 31,420 bytes of memory)	750	4.42
98214A	9862A Plotter-General I/O-Extended (will not operate with 31,420 bytes of memory)	1,000	5.83
	FIELD INSTALLATION KITS		
98221F	8,192 Bytes of Memory	1,600	
98222F	16,384 Bytes of Memory	3,200	
Opt. 001	Field Installation Charge (required on above kits installed separately)	—	
	PERIPHERALS		
	Opt. 025 is required unless otherwise specified.		
9862A	Plotter (requires 9862A Plotter ROM—98212A or 98214A)	2,995	17.15
Opt. 025		200	1.17
9863A	Paper Tape Reader	1,710	17.08
Opt. 025		200	1.17
9864A	Digitizer	5,140	30.00
Opt. 025		200	1.17
9866B	Thermal Line Printer	3,350	19.58
Opt. 025		400	2.33
9869A	Hopper Card Reader	3,575	19.58
Opt. 025		200	1.17
9871A	Output Printer	3,400	19.83/34.00[2]
Opt. 025		200	1.17
9871A	Output Printer HP-IB (also requires 98034A Interface Card)	3,400	19.83/34.00[2]
Opt. 001		—	—
9883A	High Speed Tape Reader	2,275	12.42
Opt. 025		200	1.17
9884A	Tape Punch	3,080	29.00
Opt. 025		200	1.17
	PERIPHERAL INTERFACE CARDS		
	Peripheral interface cards listed here are included with their associated peripheral when the peripheral is ordered as Opt. 025. Peripheral interface cards should, therefore, be ordered only when the peripheral is already in the buyer's possession.		
98032A	9862A Plotter Interface	400	2.33
Opt. 062			

PRICE DATA (CONTD)

Description		Purchase Price (maint. not incl) $	Monthly Maint. $
98032A Opt. 063	9863A Paper Tape Reader Interface	400	2.33
98032A Opt. 064	9864A Digitizer Interface	400	2.33
98032A Opt. 066	9866B Thermal Line Printer Interface	400	2.33
98032A Opt. 069	9869A Hopper Card Reader Interface	400	2.33
98032A Opt. 071	9871A Output Printer Interface	400	2.33
98034A	9871A Output Printer Interface (HP-IB)	400	2.33
98032A Opt. 083	9883A High Speed Tape Reader Interface	400	2.33
98032A Opt. 084	9884A Tape Punch Interface	400	2.33
	SPECIAL-PURPOSE INTERFACE CARDS		
98032A	16-Bit Duplex Interface Card	400	2.33
98033A	BCD Input Interface Card	400	2.33
98034A	HP-IB Interface Card	400	2.33
	ACCESSORY		
98025A	Vinyl Carrying Case	125	—
9830A	Basic 9830A Calculator (3,520 bytes of read/write memory with built-in tape cassette)	6,800	39.67
	FACTORY-INSTALLED OPTIONS		
Opt. 275	7616 Total Bytes of Read/Write Memory	1,600	9.33
Opt. 276	15,808 Total Bytes of Read/Write Memory	3,760	21.92
Opt. 270	Matrix Operations	525	3.08
Opt. 271	Plotter Control	525	3.08
Opt. 272	Extended I/O	525	3.08
Opt. 274	String Variables	525	3.08
Opt. 277	Terminal 1 (requires 11206A Modem Interface Card)	525	3.08
Opt. 296	Data Communications 1 Interface Control	525	3.08
	PLUG-IN FUNCTION BLOCKS		
11270B	Matrix Operations	525	3.08
11271B	Plotter Control	525	3.08
11272B	Extended I/O	525	3.08
11274B	String Variables	525	3.08
11277B	Terminal 1 (requires 11206A Modem Interface Card)	525	3.08
11278B	Batch BASIC ROM	525	3.08
11279B	Advanced Programming I	525	3.08
11289B	Advanced Programming II	525	3.08
11296B	Data Communications 1 Interface Control	525	3.08
11297B	Data Communications 2 Binary Synchronous	525	3.08
11298B	Data Communications 3 Interactive	525	3.08
	FIELD INSTALLATION KITS		
11281A	8192-Byte Memory Board	2,620	12.59
11270F	Matrix Operations	525	N/A
11271F	Plotter Control	525	N/A
11272F	Extended I/O	525	N/A
11274F	String Variables	525	N/A
11277F	Terminal 1 (requires 11206A Modem Interface Card)	525	N/A
11296F	Data Communications 1 Interface Control	525	N/A
Opt. 001	Field Installation Charge (required on all above kits installed separately)	—	
	MEMORIES		
9880B	Mass Memory Subsystem (dual platter) (includes 9867B Man Memory drive, dual platter, 4.8MB; 11305A Controller; 11273B Interface Kit; 12869A Cartridge)	10,950	—[3]
Opt. 101	Installation	—	
	PERIPHERALS (order Option 30)		
9862A	Plotter (requires plotter control ROM)	2,995	17.50
9863A	Paper Tape Reader (requires extended I/O ROM)	1,850	17.08
9864A	Digitizer (requires extended I/O ROM)	5,140	30.00
9865A	External Tape Cassette	1,885	11.00
9866A	Thermal Page Printer	3,145	18.33
9868A	I/O Expander	1,060	6.17
9869A	Calculator Card Reader (requires extended I/O ROM)	3,575	19.58
9870A	Card Reader	580	3.42
9871A	Character Impact Printer	3,400	19.83/34.00[2]
98021A	Forms Handling Mechanism for 9871A	200	N/A
9881A	Calculator Line Printer Subsystem	7,990	N/A
Opt. 001	128-Character Set	500	N/A
Opt. 101	Installation	—	—
9882A	CRT Subsystem	4,675	27.25
Opt. 001	5120 Total Bytes of Memory	125	.75
Opt. 002	Delete 11296B ROM	-525	24.17
11285A	Data Communications Package (includes 11284A Interface Cables & 11296B Interface Control ROM)	1,575	9.17
9883A	High Speed Paper Tape Reader (requires Extended I/O ROM)	2,275	12.42
9884A	Paper Tape Punch (requires extended I/O ROM)	3,080	29.00
	SPECIAL-PURPOSE INTERFACE CARDS		
11202A	8-Bit Parallel I/O Interface Card	225	1.33
11203A	BCD Input Interface Card	330	1.92

PRICE DATA (CONTD)

Description		Purchase Price (maint. not incl) $	Monthly Maint. $
11205A	Serial Interface Card	435	2.50
11206A	Modem Interface Card	435	2.50
11282A	Incremental Plotter Interface Card	815	4.75
11284A	Data Communications Interface Cards	1,050	6.17
11287A	Line Printer Interface	315	1.83
11336A	9871A/9830A Interface Card (included in 9871A Opt. 30)	200	—
	SUPPLIES & ACCESSORIES		
11268A	System Desk	790	—
11304A	Mass Memory Cart	485	—
12869A	Memory Cartridge	125	—

N/C No change
N/A Not applicable
1. Maintenance prices are for a one way, 0-100 mile distance maintenance call
2. Less than 1000 printing hours per year/1000 or more printing hours per year
3. 9867B Mass Memory Drive - 97.75
   11273B Interface Kit - 7.00
   11305A Controller - 15.17
   12869A Cartridge - NC

Description **9830 Software Packages**		Purchase Price $
	COMMERCIAL	
09830-73001	9830A Payroll Pac	150
09830-73011	Real Estate Pac Vol. 1	80
09830-73005	Real Estate Pac Vol. 2	200
09830-73007	Real Estate Pac Vol. 3	175
09830-73009	Real Estate Pac Vol. 4	150
09830-73013	Real Estate Pac Vol. 5	150
09830-73015	Real Estate Pac Vol. 6	800
09830-73020	Accounting Systems/Accounts Payable Pac	500
09830-73025	Accounting Systems/Accounts Receivable-Billing Pac	500
09830-73032	Accounting Systems/Inventory 5000	600
09830-73035	Mass Memory Payroll Pac	300
09830-73037	Consultant's Cost Accounting Pac	250
09830-73039	Consultant's Cost Accounting Pac Vol. 2	250
09830-73041	Cassette Ledger System Vol. 1	500
09830-73051	Expense/Budget Monitor Program	55
09830-73055	Job Cost Accounting	350
09830-73060	Mass Memory General Ledger Pac Vol. 1	500
09830-73065	HP-9830 Actuarial Pac	250
09830-73070	Order Invoicing Vol. 1	300
09830-73080	Order Processing (see 09830-73070, 09830-73032, 09830-73025)	1,500
09830-73085	Financial Control and Information Pac (see 09830-73020, 09830-73025, 09830-73032, 09830-73035, 09830-73060)	1,500
09830-73101	Label Typing Program System	75
09830-73102	Page Editing Program	75
	EDUCATION	
11141-70000	Huntington I & II Education Programs	65
	ENGINEERING	
09830-71001	Magnetics Pac Vol. 1	130
09830-71026	Magnetics Pac Vol. 2	175
09830-71020	Time Series Analysis	100
09830-71101	State Variables Pac	175
09830-71103	BAMP 30	600
09830-71176	Digital Simulation Pac	250
09830-71191	Circuit Analysis Pac	100
09830-74210	Modified Moment Distribution	105
09830-74211	Modified Moment Distribution	105
09830-74220	Multi-Story Moment Distribution	155
09830-74221	Multi-Story Moment Distribution	155
09830-74222	Multi-Story Moment Distribution	155
09830-74225	Space Frame Analysis	1,500
09830-74230	Ring Frame Analysis	105
09830-74235	3-D Beam Analysis	105
09830-74240	Steel Beam Columns	155
09830-74250	Reinforced Concrete Column Design	260
09830-74255	Reinforced Concrete Beam Design	105
09830-74260	Prestressed Concrete Beam Design Vol. 1	350
09830-74500	HVAC Pac	150
09830-75001	Pipe Network Balancing	75
	MATHEMATICS	
09830-70001	Math Pac	105
	MEDICAL	
09830-75330	Radioimmunoassay Pac	200
09830-75340	Radioimmunoassay Vol. 2	200
09830-75350	Radiation Therapy	500

PRICE DATA (CONTD)

Description		Purchase Price $
	MISCELLANEOUS	
09830-76001	Plotter Pac	80
09830-76501	Data Base Routines	150
09830-76511	Batch Terminal Programs	50
11141-90001	Output Delay	50
11141-90002	Keyboard Digitizer	250
11141-90003	Log Axis Statement	50
11141-90004	Output Statement Dump	30
11141-90005	Utility Programs for Sorting	150
11141-90006	9830A Burst Read	150
11141-90007	Line Cross Reference	30
11141-90008	CMERGE	50
	NUMERICAL CONTROL	
09830-72050	Numerical Control Vol. 1	250
09830-72055	Numerical Control Vol. 2	250
09830-72065	Numerical Control Programming Manual	175
	STATISTICS	
09830-70801	Stat Pac Vol. 1	105
09830-70826	Stat Pac Vol. 2	80
09830-70828	Stat Pac Vol. 3—Cross Tabulation	100
09830-70851	Analysis of Variance	100
09830-73053	Two-Way Unbalanced AOV	100
09830-70855	Statistical Distributions Pac	50
09830-70857	Regression Analysis Pac	100
09830-70860	Nonparametrics	100
09830-70876	One-Sample Analysis Pac	100
09830-70878	Paired Sample Analysis	100
09830-70880	General Statistics	200
	SURVEYING	
09830-74010	Surveying Pac Vol. 1	500
09830-74020	Surveying Pac Vol. 2	200

*Requires one of these ROMS: 98212A, 98213A, 98214A

HONEYWELL INFORMATION SYSTEMS INC.

Series 60 Level 61 Model 40

OVERVIEW

The Honeywell Series 60 Level 61 Model 40 (61/40) is a keyboard-oriented disc processing computer for small businesses and the distributed processing operations of large companies and institutions. Designed and manufactured in France by Compagnie Honeywell-Bull, it was announced in most of Europe, French-speaking Africa, and Latin America on December 6, 1975 with initial deliveries due in the first quarter of 1976. Honeywell Information Systems has not yet decided if it will announce this system in North America, the UK, Italy and Asia.

Single Station Level 61 Model 40 prices range from FF 240,000 ($53,000) or FF 6,140 ($1,365) per month upward. It offers a 16K-byte CPU, 4.6M to 18.4M bytes of fixed/exchangeable disc backing storage, and a "diskette console" that incorporates its own 8K-byte microprocessor, input keyboard, 960-character CRT display, 40- or 120-cps or 100-lpm printer, and one or two IBM 3741-compatible diskette drives. The console operator can key batch input data directly to the diskette after programmed formatting and validation by the microprocessor, while the main CPU performs a single disc-to-disc or disc-to-printer file updating run. The GCOS 61/4 operating system allows the operator to interrupt these batch operations at any time to key in an on-line file inquiry to the main CPU, and to resume batch operations as soon as this has been answered. The system can also be used for on-line transaction processing, with each keyboard input record updating the main disc file immediately. User programs can be written in ANSI COBOL or FORTRAN IV, and a number of standard applications programs are also available.

Additional keyboards can be provided in either of two ways. Any number of Honeywell KDS 7255 key-to-diskette data entry stations can be added off-line at the computer site or data source points, and the IBM 3741-compatible diskettes recorded on these can then be processed in batch mode by the Level 61 Model 40. Alternatively, the 61/40 itself can be expanded into a Multi-Work Station system (MWS) by the addition of an 8K-byte communications processor. This controls two asynchronous 110- to 4,800-bps point-to-point communications lines. Each line can host one local or remote terminal. The terminal may be a Teletype ASR 33, GE TermiNet 300 or 1200 teleprinter, or 2,000-character screen CRT display terminal. The GCOS 61/4 Multi-Work Station (MWS) version can multiprogram one batch and two inquiry/response transaction processing programs initiated from each of the two terminals, or three inquiry/response and/or transaction processing programs controlled respectively by the system console and the two terminals. In addition to the COBOL and FORTRAN batch compilers, GCOS 61/4 MWS also offers a multiuser reentrant interpretive BASIC compiler for scientific/mathematical time-sharing. Multi-Work Station 61/40 systems are available in France from FF 9,300 ($2,065) per month and upward.

HEADQUARTERS

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The 61/40 communications processor can be expanded to 16K bytes and control a synchronous 600- to 4,800-bps communications line to a host EDP mainframe. This may be a Honeywell Series 60 Model 61/60 or Level 66, or 6000 series, IBM System/360 or 370, or Univac 1100 series system. See Table 1 for 61/40 specifications and those of the larger and fully compatible Series 60 Level 61 Model 60.

COMPATIBILITY

Series 60 Level 61 Model 60 provides a fully upward-compatible growth path for 61/40 users at the object program and source program levels. While its microprogrammed instruction set is currently smaller than that of the more recently designed 61/40, the additional 61/40 instructions are executed by supervisor software routines. Its FEP has no diskette drives for reading diskettes recorded off line on KDS 7255 data entry stations, but KDS 7255 stations can be connected on line as one or more of the 16 terminals that it can control.

Like all Level 61 systems, the new 61/40 is also upward source-program compatible at GCOS, JCL, COBOL, and FORTRAN levels with the larger Series 60 Levels 64 and 66. GCOS JCL statements need only be rewritten when users wish to take advantage of the more powerful GCOS 64 and 66 facilities.

The 61/40 diskette record formats are fully compatible with those of the Honeywell KDS 7255 and IBM 3741 data entry stations. The 61/40 can thus process diskettes recorded off line on either a KDS 7255 or an IBM 3741, or any other compatible system such as the LogAbax LX 3050 or LX 4500 and the Olivetti DE 525.

PERFORMANCE AND COMPETITIVE POSITION

The 61/40's entry-level price of FF 6,140 ($1,365) per month is some 20 percent lower than that of the smallest Honeywell Series 60 Level 61 Model 58 disc configuration. It offers, moreover, a larger main and backing disc memory, though a slower output printer. Batch data keyed in at the console keyboard are no longer recorded directly on the system disc, but go first to a diskette drive, from which they can be retrieved selectively for verification and/or amendment without competing for disc accesses with the

Table 1. Honeywell Series 60 Level 61: Specifications

MODEL	61/40	61/60
CENTRAL PROCESSOR		
Microprogrammed	Yes	Yes
No. of User Instructions	256	88 + extracodes
ROM: Capacity (bytes)	12K	10K
Cycle Time (ns)	350	350
Main Memory: Capacity (bytes)	16K	10K
Incl User Area	8.3K	8.3K
Cycle Time (ns)	1,200	1,200
Extension Memory (EMS) (bytes)	—	16K-64K
Cycle Time	—	1 millisec/288-byte sector
AUXILIARY STORAGE		
Discs: Capacity (bytes)	4.6M - 18.4M	5.76M - 92M
Access Time (millisecs)	44.5 - 52.5 avge	52.5 avge
Transfer Rate (bytes/sec)	312K	156K or 312K
Magnetic Tape: No. of Drives	—	2-4 drives opt
Transfer Rate	—	30K bytes/sec
INPUT/OUTPUT		
Front-End Processor: ROM Cap (bytes)	8K	—
RAM (bytes)	8K	8K - 16K
Keyboard	A/N std	A/N std
CRT Display (chars) Console	960 (12 x 80)	960 (12 x 80)
Serial Printer (cps)	40 or 120	—
Line Printer (lpm)	100	100, 200, 400, or 800
Cards (cpm)	—	100, 200, 300 rd, 40-cps pch
Paper Tape (cps)	—	125 rd, 105 pch
Diskettes	1-2 std	Via on-line KDS 7255 only
MT Cassettes	—	1-2
COMMUNICATIONS		
Comms Processor	Yes	Incl in IOP
RAM Capacity (bytes)	8K - 16K	—
No. of Lines: Asynchronous (line speed)	2 (110-4,800)	1-2 (110-4,800)
Synchronous (line speed)	1 opt (600-4,800)	1 opt (600-4,800 bps)
No. of Terminals/Async Line	1	1-8
Incl Teleprinters (cps)	10, 30, 120	10, 30, 120
CRT Displays (chars)	2,000	2,000
SOFTWARE		
Operating System	GCOS 61/4	GCOS 61/3
Multiprogramming	1-3 programs	1-16 programs
Assembler	No	Yes
Compilers	COBOL, FORTRAN, BASIC	COBOL, FORTRAN, BASIC
FIRST INSTALLATION	1st qtr 1976	4th qtr 1974

main batch processing program. By putting these key-to-diskette data entry operations under the control of a separate I/O microprocessor, the 61/40 ensures that no CPU program errors or hardware failures can interfere with key-to-diskette data entry operations. The intermediate diskette stage also allows additional input keyboard capacity to be provided simply by the installation of any number of off line KDS 7255 key-to-diskette data entry stations.

In all these respects, the 61/40's design follows very closely that of the IBM System/32 announced in Europe 8 months earlier. Yet at roughly equal disc capacity and printer speeds, the 61/40 costs 30 percent *more* than an IBM System/32, the prices being unbundled in both cases. The 61/40 does admittedly offer a larger console display screen (960 instead of 240 characters), faster diskette drives (useful when copying diskettes to the main disc), and a wider choice of programming languages: COBOL and FORTRAN instead of just RPG II. Above all, half or more of its on-line disc capacity is provided on exchangeable IBM 5444-type disc cartridges instead of IBM 32's wholly fixed disc storage: this makes it far easier and faster to take disc file dumps for security purposes, and allows users to have any amount of additional off-line disc file capacity for different runs.

CONFIGURATION GUIDE

Series 60 Level 61 Model 40 uses a similar multiple processor architecture to that of the Series 60 Level 61 Model 60, from which it has been developed. Each configuration is a confederation of two or three autonomous processing systems, each with its own processor and main memory: the CPU and its auxiliary disc storage, the "diskette console," and the optional communications control system.

Central Processor

Like all Level 61 processors, the 61/40 CPU is microprogrammed. A MOS/ROM read-only memory storing 4K 24-bit instructions and 350-nanosecond microstep execution cycle implements a 256-instruction set. This is a superset of the Series 60 Level 61 Model 58 (61/58) and Series 60 Level 61 Model 60 (61/60) 88 instruction set. The ROM also implements the I/O and interrupt handling routines.

Main memory is a MOS/RAM with a 16K-byte capacity and a 1.2-microsecond cycle time per byte. All 16K bytes are directly accessible for data retrieval and program execution, as main memory addresses are binary and not decimal as they are on the Models 61/58 and 61/60.

The CPU has an integrated disc adapter for controlling data exchanges with disc backing storage. All other data exchanges take place on a processor-to-processor basis with the microprocessors controlling the "diskette console" and/or the optional communications system.

Discs

The MSU 0100 mass storage unit can include one or two disc drives housed in drawers in the console pedestal. The first is always an IBM 5444-type drive holding a 2.3M- or 4.6M-byte fixed disc and a superimposed 2.3M- or 4.6M-byte exchangeable disc cartridge. The second drive may hold an exchangeable 4.6M-byte cartridge disc only, or a 4.6M-byte fixed and a 4.6M-byte exchangeable disc. Total on-line capacities thus range from 4.6M to 18.4M bytes in 4.6M-byte increments. Average access time is 44.5 milliseconds on the 4.6Mb system and 52.5 milliseconds on the others; the transfer rate is 312Kb/sec in all cases. Data and/or programs are held in fixed-length 288-byte sectors.

Diskette Console

The "diskette console" is a comprehensive I/O subsystem that comprises its own I/O processor, console keyboard, CRT display, single or dual diskette drive, and serial or line printer.

I/O Processor. This is an autonomous MOS/LSI microprocessor with 8K bytes of MOS/ROM implementing its own instruction set and I/O routines, and 8K bytes of MOS/RAM live buffer and working memory. It controls all slow-speed central site I/O including keyboard input formatting and validation, CRT display contents and formats, printed output, and the routing of keyboard input messages to the console's own diskette backing storage or direct to the CPU. Its keyboard formatting and validation programs are upward-compatible with those of the KDS 7255 key-to-diskette data entry station described in another report, and loaded from diskette 128-byte sectors.

Keyboard. The alphanumeric console keyboard in typewriter layout with separate numeric keypad is the prime input device for both batch and real-time transaction data, and on-line file inquiries. Function keys allow the operator to define the character of each input record, and whether it is to be routed to diskette backing storage or direct to the CPU. The operator can interrupt a batch data entry operation at any time to key in an on-line file inquiry, and then resume batch data entry at the point at which it was interrupted.

Display. The console display has a 960-character capacity grouped as 12 lines of 80 characters, and a 94-character set including upper- and lowercase alphabetics. Its contents are entirely under I/O processor control, but this accepts keyed instructions from the console operator. On receipt of a system message for display from the CPU, the IOP will sound a buzzer to warn the operator and will display the message only when the operator presses a key instructing it to do so. This allows the operator to complete the current input record.

Printer. The console printer may be a 40-cps or 120-cps serial matrix printer with 132 print positions per line, or a 100-lpm line printer with 96 or 128 print positions per line. All offer a 64-character set.

Diskette Drives. A diskette console can incorporate one or two diskette drives. Each drive can hold one 77-track floppy disc at a time, on which input programs and data records are recorded in IBM 3741-compatible 128-byte physical sectors on 73 tracks with 26 sectors per

track. Standard diskette formatting and sector search programs are fully upward-compatible with those of the IBM 3741 and Honeywell KDS 7255 key-to-diskette data entry stations. A company wishing to decentralize some processing to a source data entry point can thus replace an IBM 3741 or Honeywell KDS 7255 with a Honeywell Series 60 Level 61 Model 40 at any time without altering any of its input formatting and validation programs. It can also use a 61/40 diskette drive to read diskettes recorded off line on a KDS 7255 or IBM 3741 or other compatible system.

On single diskette drive systems, each diskette will normally be copied to the main disc store as soon as it has been recorded and/or verified. The diskette drives, high transfer rate of 20K bytes/sec allows this copying operation to be completed in under 1 minute. On two diskette drive systems, one drive can be used directly as an input file by a batch processing program while the other is used by the console keyboard input program.

DATA COMMUNICATIONS

The optional data communications controller is another MOS/LSI microprocessor with an 8K- or 16K-byte MOS/RAM memory. It controls two asynchronous local and/or remote point-to-point communications lines with 110- to 4,800-bps transfer rates. One teleprinter or TTY-compatible display terminal can be connected to each line.

The 16K-byte communications processors also control a 600- to 4,800-bps synchronous line leading to a host computer system. Line control procedure programs are available for on-line communications with the Honeywell Series 60 Level 61 Model 60 and Level 66, the 6000 series, the IBM System/360 or 370, and the Univac 1100 series.

Terminals. The terminals connected to the asynchronous lines may be Teletype ASR 33, GE TermiNet 300 or 1200 teleprinters, or Honeywell DTU 7170 CRT display terminals with 2,000-character (25 by 80) screens. These can run in echoplexed character start/stop or message buffered mode, and have autonomous screen editing facilities.

SOFTWARE

The GCOS Level 61/4 operating system is available in both single program and multiprogramming versions. The single program version can control a single batch or real-time disc file updating program at a time, but can interrupt this and roll it out to disc at any time to bring in an on-line file inquiry program to handle an inquiry sent by the diskette console. When the inquiry has been answered, it rolls the main program back in and resumes it at the point at which it was interrupted.

The multiprogramming version can multiprogram three foreground transaction processing or time-sharing programs controlled from the console keyboard and each of the two on-line terminals simultaneously; or two terminal-oriented transaction processing or inquiry programs with one background batch processing program. Each program is segmented into 288-byte pages, which are loaded individually from the disc held virtual memory into real main memory only as they are addressed.

Languages. Both GCOS 61/4 versions offer ANSI COBOL and FORTRAN IV batch compilers. The multiprogramming version offers also a multiuser reentrant interpretive BASIC compiler.

MAINTENANCE

CII-Honeywell-Bull has a dense sales and service network throughout Europe, especially in France following the recent integration of Honeywell and CII sales and service facilities. Service personnel usually arrive within 2 hours of a telephone call, except for installations remote from the nearest population center.

PRICE DATA

Model No.	Description	Monthly Rental FF	Purchase Price FF	Monthly Maintenance FF
	Basic Single Station System comprising CPU, 4K-wd ROM, 16K-byte RAM			
MSU 0100	Single disc drive, 2.3M + 2.3M-bytes, console with IOP, kybd, 960-char display, diskette drive (one)			
PRU 0020	Serial Printer, 40 cps	6,140	239,905	3,417
	Basic Multi-Station System, comprising CPU, discs, console, diskette, printer as above, as well as communications microprocessor, 8K bytes, 2 asynchronous communications lines	8,520	334,047	4,692
TN 300	TermiNet 300 terminal (each)	391	NA	NA
DTU 7071	CRT Display terminal, 2,000 chars (each)	530	NA	NA
	Fully Expanded Multi-Station System, comprising CPU, 4K-wd ROM, 16K-byte RAM			
MSU 0100	Dual disc drive, 2 x (4.6M + 4.6M bytes) console with IOP, kybd, 960-char display, diskette drives (two)			
PRU 0120	Line printer, 100 lpm, communications microprocessor, 16K bytes, 2 asynchronous communications lines, 1 synchronous communications line to host system			
DTU 7071	CRT Display Terminals (two)	13,000	485,000	NA

HONEYWELL

Series 60, Level 61

OVERVIEW

Honeywell first introduced Series 60, Level 61 in Europe. The company's two models were the batch processing 61/58 and the transaction processing 61/60 — both keyboard-oriented, virtual memory, small business computers designed and manufactured by Compagnie Honeywell-Bull SA in France. Later in 1974, Honeywell announced Level 61 in North America and then introduced another "model," a stripped-down 61/60 priced in the same range as the 61/58.

The peripherals available for Level 61 vary depending on location. European customers seem to have a wider choice. Table 1 lists system specifications and indicates what peripherals are available and where.

The small Model 61/58 is a batch processing system with direct keyboard input of variable transactions. It is available in card configurations from 5,000 French francs ($1,250) rental per month upwards, and in disc configurations from 8,316 French francs ($2,079) rental per month upwards. The three disc subsystems offer 4.6 million to 92 million bytes of on-line backing storage. Up to four local and/or remote teletypewriter and/or CRT display terminals can be connected to Model 61/58 disc systems. This model is used primarily for on-line source data entry, but it can also be used for simple file inquiries using up to 10 keys or criteria to reference individual file records.

The larger System 61/60 is a full-fledged, real-time, transaction processing system. It uses a front-end processor to control up to 16 synchronous or asynchronous communications lines (110 to 4,800 bit-per-second) for local and/or remote teletypewriter and/or display terminals. The terminals can be used for direct data entry, file inquiries, real-time transaction processing, or conversational time sharing. Both the new Model 61/58 and the older Series 50, Model 58 disc configurations can be upgraded in the field to full System 61/60 specifications by adding a front-end processor and the required terminals. System 61/60 rents for 15,000 French francs ($3,750) per month upwards.

The stripped-down 61/60 is configured with a slow printer and small disc capacity. It can be expanded to service only eight local or remote terminals instead of the 16 possible on the larger system.

Both the 61/58 and 61/60 disc systems run under the GCOS 61 operating system. Its job control language (JCL) is a fully compatible subset of the GCOS JCL used on all other Series 60 levels and on the Honeywell 6000 Series. Three COBOL compilers are available for commercial batch and real-time programming. The COBOL compilers, as well as the batch FORTRAN IV compiler, are also fully compatible subsets of the COBOL and FORTRAN compilers available at other Series 60 levels. An assembler is offered for Model 61/58 card and disc systems, and a BASIC compiler is offered for System 61/60 conversational time sharing. Applications packages include the AGAP distributive trades sales management system, FACTOR industrial stock control system, and PERT critical path planning package.

COMPATIBILITY

Within the Honeywell Series 60, Models 61/58 and 61/60 are fully upward compatible at all levels. A Model

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Table 1. Honeywell Series 60, Level 61: Configuration Guide

SYSTEM COMPONENTS	Model 61/58 Card	Model 61/58 Disc	Model 61/58 MWS/B	Stripped 61/60	System 61/60 MWS/TP	System 61/60 MWS/TP+B
CENTRAL PROCESSOR						
ROM Capacity, 350 nsec (Kbytes)	5-7.5	7.5	7.5	10.0	10.0	10.0
MOS/LSI Main Store, 1.2 μsec (Kbytes)	5-10	5-10	10.0	10.0	10.0	10.0
MOS/LSI EMS, 1 msec/page (Kbytes)	0-64(1)	0-64	0-64	0-64	0-64	0-64
FRONT-END PROCESSOR	NA	NA	NA	Std	Std	Std
MOS/LSI Main Stor, 1.6 μsec (Kbytes)	NA	NA	NA	8-16	8-16	8-16
Twin MT Cassette Drive, 750 bps	NA	NA	NA	1	1	1
CONSOLES	1	1	1	1	1-2	2
Card Reader Console	Std	Std	Std	Opt	Opt	Std
FEP Console	NA	NA	NA	Std	Std	Std
Alphanumeric Keys	46	46	46	41	41	41+46
Numeric Keys	13	13	13	11	11	11+13
Functional Keys	2	2	2	5	5	5+2
Display (char positions)	6-10	6-10	6-10	960	960	960
DISC SYSTEMS available in Europe	NA	1 std	1 std	1 std	1 std	1 std
DSS 070: 100 cyl 2.3Mb, 312 Kbytes	NA	2-4	2-4	—	NA	NA
200 cyl 4.6Mb, 312 Kbytes	NA	2-4	2-4	—	3-4	3-4
DSS 110: 200 cyl 2.3Mb, 156 Kbytes	NA	2-4	2-4	—	NA	NA
DSS 162: 200 cyl 5.6Mb, 156 Kbytes	NA	2-4	2-4	—	2-4	2-4
DSS 178: 200 cyl 2.3Mb, 312 Kbytes	NA	2-4	2-4	—	2-4	2-4
DISC SYSTEMS available in North America						
MSU0310, 46MB (2 spindles) expandable to 92MB	Opt	Opt	Opt	Opt	Std	Std
MSS1500, 3.456MB (2 spindles) expandable to 23MB	Std	Std	Std	Std	Opt	Opt
INPUT/OUTPUT DEVICES						
Card Reader 80-col (100/200/300 cpm)	Std	Std	Std	Opt	Opt	Std
Card Punch 80-col (40 col/sec)	Std	Opt	Opt	Opt	Opt	Opt
Paper Tape Reader (125 cps)	Opt	Opt	Opt	Opt	Opt	Opt
Paper Tape Punch (105 cps)	Opt	Opt	Opt	Opt	Opt	Opt
Magnetic Tape Drives (30 Kbs)	NA	0-4	0-4	Opt	0-4	0-4
LINE PRINTERS available in Europe						
Line Printer, 96-128 Print Positions (100, 200, 400, or 800 lpm)	Std	1-2	1-2	—	Opt	1-2
LINE PRINTERS available in North America						
PRU0110, 100 lpm, 96 print positions with 200 lpm, 128 print positions optional	Std	Std	Std	Std	NA	NA
PRU0301, 300 lpm, 132 print positions with 450 or 650-lpm options	Opt	Opt	Opt	NA	Std	Std
DATA COMMUNICATIONS						
Single-Line Controller (SLC) Synchronous (600-4,800 bps)	Opt	Opt	Opt	NA	NA	NA
FEP Synchronous Adapter (1 line, 600-4,800 bps)	NA	NA	NA	Std	Std	Std
Multi-Line Controller (MLC) (4 async lines, 110-1,200 bps)	NA	NA	Std	NA	NA	NA
FEP Multi-Workstation Adapter (8 lines async/sync 110-4,800 bps)	NA	NA	NA	1-2	1-2	1-2
Number of Key-Terminals/System chosen from among:	NA	NA	1-4	1-8	1-16	1-16
Teletype ASR 33 (10 cps)	NA	NA	Opt	Opt	Opt	Opt
Kode 33 RT/TS (10 cps)	NA	NA	Opt	Opt	Opt	Opt
GE TermiNet 300 (10/15/30 cps)	NA	NA	Opt	Opt	Opt	Opt
GE TermiNet 1,200 (120 cps)	NA	NA	Opt	Opt	Opt	Opt
DTS 7200 Display (25 lines, 72 char, async, TTY-compatible)	NA	NA	Opt	Opt	Opt	Opt
DTS 7513 Display (25 lines, 80 char, sync, message buffer, 2,000 char)	NA	NA	NA	Opt	Opt	Opt
SOFTWARE						
GCOS 61 Operating System, Level with Facilities for	NA	61.1	61.2	61.3	61.3	61.3
On-Line Data Entry/Batch Dual Prog	NA	Opt	Opt	NA	NA	Opt
On-Line File Enquiry	NA	NA	Opt	Opt	Opt	Opt
Real-Time File Enquiry/Update	NA	NA	NA	Opt	Opt	Opt
Multiprogramming (16 programs)	NA	NA	NA	Opt	Opt	Opt
LANGUAGE COMPILERS						
GESAL Assembler	Opt	Opt	Opt	NA	NA	NA
Mini-COBOL	Opt	Opt	Opt	Opt	Opt	Opt
ANSI COBOL 68	NA	Opt	Opt	NA	NA	Opt
ANSI COBOL 74	NA	NA	NA	Opt	Opt	Opt
BASIC	NA	NA	NA	Opt	Opt	Opt
FORTRAN IV	NA	Opt	Opt	NA	NA	Opt
APPLICATIONS PACKAGES						
AGAP Retail/Wholesale Management	NA	Opt	Opt	NA	NA	Opt
FACTOR Industrial Inventory Control	NA	Opt	Opt	Opt	Opt	Opt
PERT	NA	Opt	Opt	Opt	Opt	Opt

Notes:

MWS	Multi-Workstation System.
MWS/B	MWS designed for batch processing with distributed source data entry.
MWS/TP	MWS designed for multiterminal real-time transaction processing.
MWS/TP+B	MWS designed for a combination of batch processing and multiterminal real-time transaction processing.
EMS	Extended Main Store; an EMS can be fitted to Model 61/58 CPUs equipped with at least 7.5K bytes of ROM and 10K bytes of main store.
Opt	Device optionally available on this system.
NA	Device not available on this system.
—	Not applicable to system.

61/58 can be upgraded in the field to full System 61/60 specifications by adding a front-end processor (FEP).

Both Level 61 models are source-program upward compatible with the higher Series 60 levels. Programs written in COBOL or FORTRAN and incorporating GCOS 61 JCL statements need only be recompiled without alteration to run on Levels 61 (COBOL only), 64, or 66. Disc data bases may have to be recreated to take advantage of the more advanced data management facilities available at higher Series 60 levels.

For Series 50, Model 58, the Models 61/58 and 61/60 are fully compatible at all levels, including GESAL assembler and machine code levels. Models 50/58 and 61/58 have virtually identical specifications and can execute each other's programs on each other's files without modification. More than 2,000 Model 58 configurations, including 300 multi-workstation systems, were installed or on order at 600 user sites when Series 60, Level 61 was announced in April 1974. These Model 58 systems can be used as backing systems and sources of applications experience by Model 61/58 users. Model 58 achieved a particularly strong penetration in the distributive trades, engineering assembly, and local government.

Both Series 50, Model 58 and Model 61/58 configurations can be upgraded in the field to full System 61/60 specifications by the addition of a front-end processor (FEP) and the required teletypewriter and/or display terminals.

For Series 100, 200, 400, and 2000, Level 61 COBOL and FORTRAN compilers are compatible with those of the older Series compilers, but GCOS JCL statements are not compatible. All source programs must be adapted to the appropriate operating system before they can be recompiled and transferred. Extensive changes are also required in disc data base formats.

For Series 6000, Level 61 is fully upward compatible at GCOS JCL statement, BASIC, COBOL, and FORTRAN source program levels running under GCOS. Programs need only be recompiled without alternation.

For IBM System/360 and 370, Honeywell Series 60, Level 61 uses the same 8-bit byte data format as the IBM Systems/3, 360, and 370. This feature makes exchange of data via magnetic tape or data communications line straightforward. Source programs can only be exchanged, however, if written in a compatible subset of both Honeywell and IBM COBOL or FORTRAN definitions. In all cases, operating system JCL statements must be modified.

For other manufacturers' systems, the same considerations apply to exchange of data and/or programs with other byte-oriented computer systems, such as the Burroughs B 1700 and B 2700/B 3700/B 4700 Series, NCR Century, Philips P1000, Siemens System/4004, and Univac 9000 Series.

Communications procedures have been written allowing Series 60, Level 61 systems to exchange data on a processor-to-processor basis and/or be used as intelligent RJE terminals to the following computer systems:

- Other Series 60, Level 61 systems.
- Series 60, Levels 64 and 66.
- Series 50, Model 58.
- Honeywell Series 200, 400, 2000 and 6000.
- IBM Systems/360 and 370.

In exchanging data and jobs with IBM Systems/360 and 370, Level 61 systems use BSC (binary synchronous communications) procedures and emulate IBM 2780 data communications terminals.

PERFORMANCE AND COMPETITIVE POSITION

Honeywell's Series 60, Level 61 is available in three basic types of configuration: 61/58 card systems, 61/58 disc systems, and 61/60 multiterminal disc transaction processing systems.

Model 61/58 card systems are designed to update a file of 80-column cards on the basis of console keyboard transaction inputs and to print output documents simultaneously. Available for rental from 5,000 French francs ($1,250) per month upwards, they offer a choice of card readers (100, 200, and 300 cards per minute) for file input, and printers for (100, 200, 400, and 800 lines per minute) report and business document output. Updated file cards are punched at 40 columns per second (20 to 100 cards per minute); the processing speed is essentially determined by the speed of the keyboard transaction input.

Competing keyboard-oriented card processing systems include Burroughs L2000 to L7000, Kienzle 5600, LogAbax LX 4200, Nixdorf System 820, Philips P352, and Ruf/Hohner 5000 and 6000.

Model 61/58 disc systems add from 4.6 to 92 million bytes of on-line disc capacity to the 61/58 card systems. Available for rental from 8,316 French francs ($2,079) per month upwards, they offer dual programming facilities between on-line key-to-disc data entry in random transaction order and either a disc sorting or a batch processing program with concurrent printed output. The console keyboard is the prime input mechanism for variable transactions; it can be complemented by up to four local and/or remote data entry stations, which can be either typewriter terminals (10 or 30 characters per second) or CRT display terminals (1,800-character screen). In addition to direct batch data entry, these systems can also be used for on-line file inquiries, which the system handles on a roll-in/roll-out basis that interrupts the batch processing program.

Competing keyboard-oriented disc processing systems include Burroughs B 700, BCL Molecular 6M and 18,

DEC Datasystem 300, IBM System/3 Model 6, ICL 2903, Kienzle 6100, LogAbax LX 4200, MAI Basic Four, and Nixdorf System 880. In France, other competitors include the Informatek Matek 1026, Marme GMG 5000, and Synelec SYN 9; in the United Kingdom, also the MBM 7000 and Melcom MCS 1600.

Model 61/60 multiterminal disc systems add an 8K-to 16K-byte front-end processor (FEP) to Model 61/58 or older Model 58 disc systems. The FEP takes over all communications line handling and message buffering tasks; it can handle up to 16 synchronous or asynchronous lines (110 to 4,800 bits per second) leading to local and/or remote teletypewriter and/or CRT display terminals. These systems may be used for direct data entry and on-line file inquiries concurrently with central site batch processing. Alternatively, they may be used for full-fledged, terminal-oriented, real-time, transaction processing and file up-dating, as well as for conversational time sharing. Each terminal can call for and interact with a different program, and each can access the indexed sequential, disc-held, data base records on any of up to 10 alternative keys or criteria.

Available for rental from 15,000 French francs ($3,750) per month upwards, Model 61/60 competes against Allied Business Systems' MULTIBUS, AIA ADAM, Burroughs B 1726, CTL Modular One TPS, DEC Datasystem 500, Datasaab 6501, IBM System/3 Model 10, ICL 2903, Marme GMG 5000, MBM 7000, Melcom MCS 1600, and Nixdorf System 880/65.

Honeywell's published prices for all Level 61 systems compare favorably with those of competing Burroughs, IBM, and ICL systems; at first sight, they appear high compared with those of other listed small business manufacturers because Honeywell's prices are bundled. They include a large selection of high-level language compilers and applications packages that enable users to be largely self-sufficient in applications programming. Most less-expensive competing card and disc processing systems offer only assembly languages; thus, they require turnkey programming by the manufacturer at additional cost.

Entry-level Model 61/58 users will be attracted by the applications experience gained by the 600 users of the 2,000 Model 58 systems installed or on order since Model 61/58 is fully compatible at all levels. This applications experience is especially strong in engineering assembly, distributive trades, utilities, and local government. Installed Model 58s include 300 multiterminal configurations with remote source data entry.

Small and medium-size businesses that expect data processing requirements to grow rapidly will be reassured by the "top cover" which Honeywell offers on the higher Series 60 levels. These models have GCOS job control languages (JCL) and COBOL and FORTRAN compilers that are fully compatible supersets of the Level 61 languages. Users can thus transfer their Level 61 COBOL and FORTRAN programs to higher Series 60 levels without alteration; only source code recompilation and disc data base recreation will be required to take advantage of the more powerful systems architecture and data management facilities.

Source code compatibility between Level 61 and the higher Series 60 levels will also attract large companies to use Level 61 systems for their decentralized processing in remote offices and factories, especially if their central processing system is a Honeywell Series 60 or 6000. Even IBM System/360 or 370 users will be attracted by Level 61 for their decentralized processing because both Models 61/58 and 61/60 can communicate on-line with IBM systems, emulating IBM 2780 BSC procedures.

Level 61 has inherited from the Series 50, Model 58 the peculiar design feature that CPU main stores cannot be larger than 10K bytes. This capacity compares with maximum main store sizes ranging from 32K and 256K bytes on competing batch and transaction processing small business computers. This restriction will not limit in any way the sizes of the programs that users may write for their Level 61 systems. Honeywell pioneered virtual memory paging techniques for small business disc systems as far back as 1969. Thus, GCOS 61, like Model 58 DOS, allows users to treat CPU main store and backing disc store as a single virtual memory. They can write programs of any size, and GCOS will segment them automatically into 288-byte pages. Each page is called from disc into CPU main store only as it is addressed during execution; it is automatically displaced to make room for other pages when it has not been addressed for some time.

Page swapping does slow down processing, but this situation hardly matters as long as the limiting factor on processing throughput is the speed of manual keyboard input of transaction data. Even the addition of up to four local and/or remote source data entry terminals on Model 58 multi-workstation systems has not pushed the system to its processing throughput limit; the additional keyboard terminals are restricted to source data entry and occasional on-line file inquiries. When direct page swapping to/from backing disc store becomes a limiting factor on throughput, Model 58 and Level 61 systems can be fitted with 16K and 64K bytes of immediate access "extended main store" (EMS). The transfer of a 288-byte page from EMS to CPU main store takes only 1 millisecond.

Real-time transaction processing for up to 16 teletypewriter and display terminals will impose much heavier demands on the new System 61/60, but this problem appears to have been foreseen by the system's designers. All communications line handling procedures, checks and error recovery routines, as well as message buffering have been delegated to a front-end processor (FEP) with its own 8K-, 12K-, or 16K-byte main memory. This FEP will hand complete transaction messages to the CPU for

processing. The FEP is restricted to a maximum combined throughput on all connected lines of 15,000 bits per second; thus, it will be able to transfer, at most, a 20-byte message every 11 milliseconds or a 50-byte message every 27 milliseconds in either direction. During these time intervals, the CPU can transfer up to 10 or 20 program and/or data pages from EMS to main store, allowing up to 2,880 bytes of program per 20-byte message and up to 7,000 bytes of program per 50-byte message without slowing down the system. Much will depend, however, on the frequency of access to disc files by individual terminal transactions and the complexity of the transaction processing programs, as well as on the length of the transaction messages themselves. Only when the first System 61/60s are delivered at the beginning of 1975 will it be possible to assess with accuracy the maximum practical limit of transaction processing terminals for different task mixes before CPU thrashing occurs.

CONFIGURATION GUIDE

Series 60, Level 61 systems are offered in four basic configurations: 61/58 card system, 61/58 disc system, System 61/60 transaction processing system, and System 61/60 transaction/batch processing system. Each basic configuration has certain standard components and can be expanded by the addition of optional features and/or peripherals.

Model 61/58. All Model 61/58 systems use a card reader console into which all the main standard system components are integrated: central processor (built into the pedestal); alphanumeric, numeric, and functional input keyboards; 6- or 10-digit numeric display (of most recent numbers entered on numeric keyboard); card reader; and line printer. Three card reader models and four line printer models are available.

The Model 61/58 card system is completed by the addition of a card punch (40 columns per second). Model 61/58 disc systems are completed by the addition of two or four-disc drives chosen from among three available models. Both 61/58 systems have the following optional features: a paper tape reader and/or punch and a single-line communications controller for processor-to-processor communications with another Honeywell computer system or an IBM System/3, 360, or 370. The 61/58 disc system can also support up to four magnetic tape drives, and a multiline communications controller (MLC) for up to four asynchronous lines (110 to 1,200 bits per second) for teletypewriter and/or display terminals.

The 61/58 system must have the full 10K bytes of main store to support the MLC. A 61/58 disc system with an MLC and one to four teletypewriter and/or CRT terminals is known as a 61/58 MWS (multi-workstation system).

System 61/60. System 61/60 uses the same CPU as Model 61/58, but the 61/60 also includes a front-end processor (FEP) to interface to all data communications lines. The FEP is housed in a console that also houses the alphanumeric, numeric, and functional keyboards for operator instructions, a full 960-character CRT display for system status messages, and a twin magnetic tape cassette drive for system program loading and system dumps.

The FEP console has all the features required for controlling the system; the card reader console is not required on System 61/60 transaction processing systems, where all input and output will utilize up to 16 local and/or remote teletypewriter and display terminals. Mixed 61/60 transaction and batch processing systems, however, require a card reader console to house the card reader and line printer needed for input and output of central site batch data.

A System 61/60 transaction processing system can be field-upgraded to a mixed transaction/batch processing system by the addition of a card reader console with card reader and line printer.

A Model 61/58 or Series 50 Model 58 disc system can be field upgraded to a System 61/60 mixed transaction/batch processor by the addition of an FEP. If the Model 58 or 61/58 was already a multi-workstation system and/or an RJE terminal, both the synchronous and asynchronous communications lines must be transferred to the appropriate adapters on the FEP. The SLC and/or MLC previously used cannot interface to FEP. Table 1 lists the standard and optional components of each Level 61 system.

SOFTWARE

Honeywell offers a wider variety of compilers on Level 61 than on Level 62. As with peripherals, there seem to be differences between Europe and North America as to which languages are available. European users can use FORTRAN IV as well as Mini-COBOL, ANS COBOL, and BASIC. Assembler language GESAL is also offered for the batch systems. North American users are not offered FORTRAN IV or GESAL. For all users, ANS COBOL 68 is available for both the 61/58 and 61/60; ANS COBOL 74 is only on the 61/60.

Applications packages are available for financial management systems, inventory reporting, bill of materials, material requirements planning, hospital accounting, and student scheduling.

COMMUNICATIONS

For Model 61/58, a single-line controller allows synchronous communications with other Honeywell or IBM computers at speeds up to 2,000 baud using voice-grade lines, or up to 9,600 baud using leased lines. A Multiline Controller enables asynchronous communications with up to four terminals at speeds up to 2,400 baud (directly connected) or 1,200 baud (remotely connected).

The front-end processor unit, standard on both the stripped and regular versions of the Model 61/60, has both a multiport asynchronous adapter and a synchronous channel adapter. Asynchronous transmission is at three possible speeds, which are selected between 110 and 4,800 baud, through up to eight buffered channels to terminals in ASCII code. Synchronous transmission is over two-wire switched or two- or four-wire dedicated lines to the host computer at speeds up to 4,800 baud. Standard features of the sync channel adapter are selective auto answer for automatic connection to the host computer, error detection, and automatic cyclic redundancy checking.

Model 61/60 allows simultaneous use of up to eight terminals and one batch program with the conversational users having priority. Honeywell engineers can upgrade a 61/58 to a 61/60 at a user's site.

PRICE DATA

Identity	Monthly Rental (5-yr) (Excluding Maint.) $	Purchase Price $	Monthly Maint. With MiniCOBOL $
BASIC CONFIGURATION			
Model 61/58 batch system with 5,120 bytes of main memory; card console unit with 100 card-per-minute reader, 10-position display, alphanumeric keyboard and numeric keyboard; removable-disc mass storage subsystem with 3.46-million-byte capacity; 100 line-per-minute printer, and MiniCOBOL compiler	1,405	66,590	447
Model 61/58 multiworkstation with 10,240 bytes of main memory; card console unit with 100 card-per-minute card reader, 10-position display, alphanumeric keyboard and numeric keyboard; removable-disc mass storage subsystem with 5.76-million-byte capacity; multiline controller; capability to attach one remote terminal and MiniCOBOL compiler	1,937	91,400	561
Model 61/60 stripped-down transaction processing system with 10,240 bytes of main memory; 8,192-byte front-end communications processor with keyboard control display screen, two magnetic tape cassettes for storage and editing of information, 100 line-per-minute printer, and 3.46 million bytes of disc capacity	1,794	82,780	520
Model 61/60 transaction processing system with 10,240 bytes of main memory; front-end processor unit; removable-disc mass storage subsystem with 46-million-byte capacity; 300 line-per-minute printer, capability to attach five remote keyboard terminals and MiniCOBOL compiler	3,135	138,715	706

HONEYWELL INFORMATION SYSTEMS

Series 60 Level 62

OVERVIEW

Honeywell Series 60 Level 62 is a batch-oriented, multiprogramming small business system with capabilities for interactive processing. Also known by the name of Liberator/3, Series 60 Level 62 comprises two upward-compatible models, 62/40 and 62/60. Together with the Series 60 Level 61, Level 62 represents Honeywell's current offering to the small- and medium-sized business user.

While in the past Honeywell has placed the bulk of its marketing emphasis on the Level 62 as an upgrade system for older Honeywell machines (Honeywell-Bull Gamma 10 and G-100 Series), it has now become more active in the competitive replacement market, targeting users of IBM's System/3, NCR's Century Series, and Univac's Series 90.

Level 62/40 can be configured with 64K (standard) to 128KB of MOS memory, from 23 to 87MB of on-line disc storage, and up to nine data communications lines. A basic 62/40 configuration includes integrated I/O control for peripherals, data communications, and the system console.

Level 62/60 can be configured with 64 (standard) to 256K bytes of MOS memory, from 23 to 480MB of on-line disc storage, and up to nine data communications lines. Like the 62/40, the 62/60 includes integrated I/O control for peripherals, data communications, and the system console.

Level 62 has traditionally been a card-oriented machine requiring a card reader to load job control language (JCL), data, and programs. While most Level 62 users still operate in a card-dependent environment, Honeywell has introduced an option that allows programs and data to be loaded from tape cassette, magnetic tape, the system console, or terminals. This move by Honeywell follows the general trend away from card-oriented operations.

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The data communications controller allows up to four communications lines to be physically integrated into the mainframe of either model. Point-to-point or multipoint connection is established using the proper hardware attachments available for synchronous and asynchronous lines. In this way, teletypewriter and/or CRT display terminals can be connected to the controller. Level 62 will also support the BSC1 or BSC2 communications protocol for connection to larger host processors in the IBM 2780 mode or for communications with IBM 3741 Models 2 or 4 diskette terminals. A second communications controller for up to five additional lines is optionally available.

The Level 62 operating system, GCOS 62 (General Comprehensive Operating Supervisor) has batch multiprogramming capabilities limited only, Honeywell claims, by the amount of main memory available. It provides dynamic memory management facilities and disc management techniques that are compatible with the facilities offered on the medium- and large-scale Honeywell systems, Series 60 Levels 64 and 66. A choice of relative, indexed, and sequential file organizations is provided for disc files.

Under GCOS the following languages are supported: ANSI COBOL 74, RPG II, and FORTRAN. Honeywell has added extensions to COBOL to allow it to be used for real-time transaction processing programming.

Series 60 Level 62 computers were designed by Honeywell Information Systems Italia S. p. A., and are manufactured for worldwide distribution at its plant in Caluso, Italy. They are marketed worldwide by Honeywell's local companies. Table 1 lists system specifications and configuration guidelines.

Table 1. Honeywell Series 60 Level 62: Configuration Guide

System Components	Model 62/40	Model 62/60
Central Processor		
Read-Only Store (ROS) Capacity	Up to 240,000 bits	Up to 240,000 bits
Cycle Time (nsec)	175/ROS word	175/ROS word
No. of Instructions	141(1)	141(1)
Registers: General	16(2)	16(2)
Base	8	8
Index	8(2)	8(2)
Main Memory		
Min Capacity (bytes)	64	64
Increment (bytes)	8 or 16	16
Max Capacity (bytes)	128	256
Reserved for firmware and GCOS operating system	28,672	28,672
Cycle Time (μsec)	1.00/2 bytes	1.00/2 bytes
I/O Processor		
Peak Throughput (bps)	837,000(3)	837,000(3)
Max No. of Channels	6	6
Multiplexor Channels	—	1
Subchannels/Multiplexor	—	4
Peripheral Simultaneity	6	6
Discs (no. of subsystems)	1 std	1 std
Chosen from among: (no. drives/subs)		
MSU0112: 5.8Mb fixed/ 5.8Mb removable, 312KB, 40 ms avg seek (MSU0113: 5.8MB removable cartridge) (MSU0116: 5.8MB fixed + 5.8MB removable)	1-4	0-4
MSU0330: 80MB, 30 ms avg seek, removable		2-6
MSU0310: 29.2MB, 312KB, 38 ms avg. seek	0-4	2-6
MSU0360: 58.4MB, 312KB, 30 ms avg seek	0-2	2-6
Max On-Line Capacity (bytes)	87,600,000 116,800,000 (Europe)	480,000,000 292,000,000 (Europe)
System Console		
Keyboard	64 keys	64 keys
Serial Printer	30 cps	30 cps
Magnetic Tape Cassette, (700 bps)	1-2	1-2
I/O Devices		
Card Reader (300,* 500,* 600, or 1,050 cpm)	X	X
Line Printer (400, 600, 800, 1,200, 1,600 lpm); (200*, 300* lpm)	1 std	1 std
80-Col Card Punch (120 cpm)	X	X
96-Col Card Reader (300 cpm)	X	X
96-Col Multifunction Unit (500 or 1,000 cpm; 120 cpm punch or print)	X	X
Paper Tape Reader (600 or 1,000 cps)	Not available in U.S.	
Paper Tape Punch (110 cps)	Not available in U.S.	
Magnetic Tape Drives, 30 or 60KB)	2	2, 3, or 4 (2, 4, or 6 in Europe)
Data Communications		
No. of Lines	0-9	0-9
Line Speeds (bps)	110-9,600	110-9,600
Terminals		
Teletype 33, 35 (10 cps)	X	X
Teletype 37, 38 (15 cps)	X	X
GE Terminet 300 (10/15/ 30 cps)	X	X
VIP 7700 Display (2,024 chars, buffer sync)	X	X
3741 Diskette Terminal	X	X
Software		
GCOS 62 Operating System	Std	Std
Batch Multiprogramming	X	X
Data Communications	X	X
Output Writer	X	X
Languages		
COBOL 74	X	X
RPG 2	X	X
FORTRAN	X	X

Notes:
(1) 24 additional floating-point instructions optionally available.
(2) The 16 general registers include 8 index registers.
(3) 1.5MB with MSU0330.
X Optional device or feature.
* Not available in North America.

COMPATIBILITY

Honeywell Series 60 Level 62 was designed primarily for users upgrading from smaller and/or older computer systems. Therefore, it has an extensive range of software conversion aids to make transition easy for users. All Level 62 processing systems are fully compatible with each other at all levels; Model 62/40 systems can be upgraded in the field to full Model 62/60 specifications.

The programming languages for Level 62 systems are upward-source-code-compatible with other Series 60 levels. The Level 62 ANSI COBOL 74 is a superset of COBOL available at Level 61 and a subset of COBOL 74 available at Levels 64 and 66. COBOL source programs can be transferred among Series 60 levels without alteration through recompilation.

For Honeywell Series 200 and 2000, conversion aids are provided for translating COBOL to Level 62 COBOL, Easycoder to Level 62 COBOL, and Series 200/0 files to Level 62 formats.

For Honeywell G-58 systems, Honeywell offers the following software conversion aids:

- G-58 to Level 62 program conversion aids.
- Two-pass G-58 to Level 62 disc file converter with intermediate nine-track magnetic tape file (magnetic tape is not offered on G-58 systems in North America).

For Honeywell G-100 users, Honeywell offers the following conversion aids:

- G-100 assembler (APS) translator to Level 62 COBOL.
- Two-pass G-100 to Level 62 disc file converter with intermediate storage on seven- or nine-track magnetic tape.
- Code conversion generator for cards.

The language translator runs on any G-100 system with 24K of main memory and two or three discs, depending on size.

For Honeywell-Bull Gamma 10 systems (not offered in North America), Honeywell offers the following software conversion aids:

- Object code program translator with Level 62 object code as output; facilities are available for adding Level 62 GCOS JCL statements if required.
- File conversion from Gamma 10 card files to Level 62 discs or magnetic tape.
- Card sort simulator.
- Card collator simulator.

For IBM System/3 Models 8, 10, 12, and 15 users, Honeywell offers the Liberator/3 capability.

Level 62 RPG is syntactically and semantically compatible with IBM System/3 RPG II and includes more sophistication with the same repertoire of source instructions. Compilation efficiency is aided by the fact that Level 62 machine code is considerably more powerful than that of IBM System/3.

Level 62 offers a larger character set than System/3 and different disc file formats. System/3 disc files are converted by reading the System/3 packs on the Level 62 and rewriting them on another drive to take advantage of the more efficient Level 62 format. The user has the choice of the specific Level 62 format and organization.

Former System/3 users may continue their former mode of card processing with the 96-column Multifunction Unit on Level 62. Alternatively, a software simulator is available for the System/3 96-column MFCU, allowing the System/3 user to switch to a compact 96-column card reader when moving to Level 62.

For IBM System/360 Model 20 users, Honeywell offers the following software conversion aids:

- 360/20 RPG to Level 62 RPG source program translator.
- Two-pass 360/20 to Level 62 disc file converter with intermediate storage on seven- or nine-track magnetic tape.
- File conversion for 360/20 multifile management via tapes.
- Replacement of 360/20 80-column MFCM with Level 62 96-column Multifunction Unit or simulation of MFCM on disc.
- Compatible card utilities (GANGPUNCH; REPRODUCE and COLLATE).

The 360/20 to Level 62 RPG translator produces a printed program conversion report and a Level 62 RPG source program on a disc library. The MFCM simulation includes the complete functionality of the 360/20 and provides a transparent interface to data management for the Level 62 96-column Multifunction Unit.

In addition, a conversion guide is provided for the translation of 360/20 control language to Level 62 JCL.

For NCR Century Series users, Honeywell offers a NEAT/3 to Level 62 COBOL source program translator, together with a two-pass disc file converter via tapes.

For Univac 9000 Series users, Honeywell offers a two-pass disc file converter to Level 62 disc formats. Specific program conversion aids are unnecessary because the 9000 Series ANSI Basic COBOL is a compatible subset of Level 62 ANSI COBOL 74, and the Univac 9000 Series RPG follows IBM 360/20 RPG definitions closely. Thus, COBOL source programs need only to be recompiled, and Univac 9000 Series users can use the 360 RPG to Level 62 RPG translator to obtain Level 62 RPG source code.

PERFORMANCE AND COMPETITIVE POSITION

Honeywell Series 60 Level 62 is aimed at small business users upgrading from older Honeywell systems and from the competitive replacement market. Honeywell has always served its own customer base of small Series 200, G-58, G-100, and Gamma 10 users with conversion aids to the Level 61 and 62. Recently, however, Honeywell has stepped up its raids on competitors and strengthened its commitment to the small business market. Enhancements to the Level 62, especially in the areas of increased memory size and new mass storage peripherals as well as price cuts, target enhancements made to competitive systems including IBM's System/3 family (Models 12, 15, and 15D), Burroughs B 1700 Series, Univac's Series 90 Model 90/30, and NCR's Century Series.

Honeywell, like its competitors, is offering its users the opportunity to convert card-based systems to cardless systems. While Honeywell does offer an attractive selection of its own terminals for data entry, it does offer the ability to attach the popular IBM 3741 diskette data entry system.

Honeywell's drawing card in the upper end of the small business market will be the GCOS multiprogramming system. GCOS provides variable-length multiprogramming with automatic allocation of memory and peripheral resources. The number of concurrent programs is dependent only on program size and the amount of main memory available.

Also notable on the Level 62 are comprehensive error checking and prevention features. The ability to configure around failed components and isolate failures to the chip level will do much to increase user availability.

USER REACTIONS

Level 62 users are from all walks of life, but application programs proved similar. The users interviewed employ the 62/40 and 62/60 for accounting functions (accounts payable/receivable, payroll, general ledger), but each has additional application programs tailored to his particular needs. Honeywell's service and maintenance are considered very satisfactory by all of the users.

Airline. This Midwestern airline decided to switch to the 62/40 when its IBM System/3 proved too small to handle an increased workload. The standard 62/40 configuration is adequate for its applications, and conversion from the System/3 was facilitated by Honeywell's Liberator/3 conversion package. Honeywell did the major portion of the work connected with the conversion; the user commented that Liberator/3 is not quite as fast as Honeywell claims, but the conversion was fairly easy and has proved satisfactory.

The 62/40 is operated by the airline's computer staff and is employed for accounts payable/receivable, air route accounts, and air freight accounts. At the time of the interview, they had configured their computer with an 80-column card reader, two cassettes, the smaller disc, a 400-lpm printer, and 64KB of memory. Plans for the future include conversion to a greater capacity disc drive because the company has experienced recording problems with the smaller sized disc, and conversion to a cardless environment. Operating without cards, the user will configure the system with a Sycor CRT operating offline. This user has not made use of the Level 62's multiprogramming capabilities.

The airline is very pleased with the service Honeywell provides. When the computer was first installed, there were some bugs in the system; Honeywell responded quickly and eventually solved the problems. This user reports that service continues to be prompt as well as satisfactory. Honeywell has always proved willing to help in the programming that was developed by the airline.

Chamber of Commerce. This large city's Chamber of Commerce uses its 62/40 for accounting purposes. In addition, a number of mailing lists and membership notices are generated from the 62/40.

This user converted from a Honeywell 200/105 in October 1975. Honeywell aided in the process so that conversion was relatively painless. The actual programming is done by the user's computer staff.

Presently, a minimum configuration is used: 80- and 96-column card readers, a tape cassette, and the MSU0330 mass storage units. Conversion to a cardless environment is part of the user's plan; the deciding factors in this decision are savings in cost and the increased storage space.

Downtime has been minimal and Honeywell's service is satisfactory.

Local Government. The Honeywell 62/60 is being utilized for a wide variety of applications including payroll, water billing, general ledger, special assessments, applications for business licenses, police and detective statistical reporting, and fire incident reporting.

The city replaced its Honeywell G-58, performing the conversion process itself. This user reports that conversion went smoothly. The city decided to remain with Honeywell for three major reasons: it was possible to carry over some of the old programs; financially, Honeywell proved the best alternative; and the city was extremely pleased with the service and maintenance Honeywell had provided in the past.

The city has configured its 62/60 with 96KB of memory, two disc drives (with plans to attach a third), a 400-lpm printer, and a 600-cpm card reader. When the communications interface is attached, the user plans to attach Honeywell 7700 VIP terminals on-line.

All programming is done by a computer staff; they utilize the multiprogramming capabilities of the 62/60 and at this time run two jobs simultaneously. When the communications interface is attached, the user plans to run three jobs simultaneously.

Manufacturer. In this case, the Honeywell 62/60 is being used for commercial applications such as accounts receivable/payable and inventory control. Conversion from a Honeywell 2000/2020 was not without problems, but Honeywell eventually ironed out the difficulties and the system has been operating smoothly. Honeywell has continued to aid the company in its development of programs.

This company has configured the 62/60 with five MSU0113 disc drives, an 800-lpm line printer, 600-cpm card reader, two nine-track tapes, and four Honeywell 7700 VIP terminals.

The user also takes advantage of the 62/60's multiprogramming capabilities and runs three jobs simultaneously about 90% of the time. The user claims that the computer handles this load quite easily.

CONFIGURATION GUIDE

The 62/40 and the 62/60 comprise a central processor, MOS main memory, and integrated I/O control (six ports) for peripherals, communications, and the operator's console.

62/40. The minimum main memory of the 62/40 is 64, 536KB, expandable to 128KB. Standard with the 62/40 is a data communications controller, system console, keyboard, 30-cps printer, and console cassette. Required for the operation of the system, yet not standard equipment, are two mass storage units (expandable to four), a printer, and a card reader.

A variety of optional devices can also be attached to the 62/40, including two to four magnetic tape drives and a second console cassette. Four communications lines can be attached via the standard communications controller; a second integrated communications controller can be added, attaching five more communications lines.

62/60. Minimum main memory for the 62/60 is 64KB of MOS memory, expandable to 256KB. Included in the basic 62/60 is a communications controller, system console, keyboard, 30-cps printer, and console cassette. Required for the operation of the system, yet not standard with the system, are two mass storage units (expandable to six), a printer, and a card reader.

Optional devices for the 62/60 include two to four magnetic tape drives and an additional console cassette. Four additional communications lines can be attached via the communications controller; an optional integrated communications controller connecting five additional lines can be added to the system.

The 62/60 offers an optional port 6 configuration, the port expander unit. Utilizing this unit, two console cassettes, card devices, and/or printers can be addressed.

European Models. In Europe, the configuration for the Level 62 varies slightly from the North American configuration in that:

- Main memory for the 62/60 can only be expanded to 350MB.
- Two MSU0360 disc drives with 58.4MB each can be substituted for the MSU0112/0113.
- The 60KB tape drive subsystem is not available on the 62/40.
- A 200- and 300-lpm line printer is also available.
- The magnetic subsystem can be expanded to six clustered drives with two-drive increments (rather than the four drives possible on the North American models).

MAINFRAME

Both Level 62 models are comprised of a single unit housing the system console (30-cps serial printer, a keyboard, and tape cassette subsystem) and central processor which can contain main memory, main memory control, read-only store (ROS), a command generator, processor logic unit, and I/O control.

Central Processor

Level 62/40 and 62/60 processors use ROS (access time of 170 nanoseconds for a 16-bit word) and firmware for frequently performed operations including I/O control, error recovery, and instruction execution.

The processor logic unit and the I/O control, both contained in the processor, are driven by microprogram control. The central processor facilities are employed by the I/O control for arithmetic and logic operations, and for connection and dialogue with the peripheral subsystems. Data can be transferred simultaneously among the six I/O ports, but it is transferred concurrently with instruction execution.

Main Memory

Main memory for the 62/40 can be increased from a minimum of 64KB of MOS memory to a maximum of 128KB. The memory is increased in increments of 8KB or 16KB, the 8K increments use 1K-bit MOS memory, while the 16K increments use 4K-bit memory. This higher density memory makes possible the use of a high-speed disc controller.

The 62/60 has a minimum main memory of 64KB that is expandable in 16KB increments to a maximum of 262,144 bytes.

The main memory is directly addressable; the minimum addressable unit is the byte, and two bytes are accessed during each memory cycle.

I/O CONTROL

The 62/40 and 62/60 have six ports that are capable of transferring data simultaneously among each other and concurrently with instruction execution. Each line can be dedicated to a single terminal in a point-to-point network, or it can communicate with up to 32 terminals in a poll-and-select environment. I/O operations are simultaneous on all channels under I/O processor control. Data communications transfers on port 5 to/from the console keyboard/printer and the four communications lines to/from terminals are multiplexed.

Port 1 attaches two to four mass storage units (discs) and the system's printer is controlled by port 2. Either port 3 or 4 can be used to connect a 96-column card reader at 300 cpm, an 80-column card reader, or an 80-column card punch. An industry-compatible magnetic tape subsystem can be connected to port 3 or 4. On the 62/40, this subsystem can include two tape drives; on the 62/60, this can be expanded to four drives. An optional second integrated data communications controller, which provides for attachment of up to five more lines, can also be connected to either port 3 or port 4.

The standard integrated data communications controller is attached to port 5; this unit controls the operator console. Four data communications lines can be addressed through this data communications controller. These lines are capable of connecting local and/or remote teletypewriters, and/or CRT display terminals. Each line can be dedicated to a single terminal in a point-to-point network, or it can communicate with up to 32 terminals in a poll-and-select environment.

Port 6 controls a standard console cassette; a second console cassette can be attached as an option.

The Model 62/60 can attach a port expander unit at port 6; this unit allows four more lines to be addressed. These lines can support a maximum of two cassettes, card devices, and/or a printer.

PERIPHERALS

Both the 62/40 and 62/60 attach a wide variety of peripherals via six I/O ports. The majority of peripheral devices can be attached to both models.

Mass Storage Equipment. A range of mass storage units is available for use with the 62/40 and 62/60. These units are attached to Port 1.

As standard, Level 62 supports a single cabinet with two drawers. The top half of the cabinet is a unit that has one 5.8MB removable disc cartridge and one 5.8MB fixed disc. These discs share a common spindle and use the same access mechanism. The bottom half of the cabinet must hold one of two units — the MSU0113 or MSU0116. The former consists of one 5.8MB removable disc cartridge; the latter has a 5.8MB fixed disc and a 5.8MB removable disc. Total cabinet capacity is 23.2MB.

Two to four MSU0310 disc drives (28.2MB each) may be substituted for the MSU0112/0113.

Two large-capacity, high-performance discs (MSU0330 with 80MB each) may be ordered in lieu of the MSU0112/0113 or MSU0310. This unit cannot be used in combination with other mass storage units.

Magnetic Tape Units. The MTU0120/0121/0111 tape units offer a variety of track-handling capabilities (seven or nine tracks) and densities (200, 556, 800, or 1,600 bpi). All three tape units have a read/write speed of 18.75 ips and are able to transfer a maximum of 30,000 bps. The minimum configuration is one MTU0120 primary tape unit and one MYU0121 secondary unit. One or two MTU0111 units can be added as an option.

Tape units with faster throughput (MTU0220/0221/0211) are also offered. They can be either seven- or nine-track and 200, 556, 800, or 1,600 bpi. The read/write speed is 37.5 ips, and a maximum of 60,000 bps is transferred. The minimum configuration comprises one MTU0220 primary tape unit and one MTU0221 secondary tape unit. As an option, one or two MTU0211 tape units can be added.

Terminals. One terminal is standard equipment on both models. Honeywell offers its own Series 7700 Visual Information Projection terminal. Other options include:

- Teletype Models 33/35/37/38.
- GE Terminet 300.
- IBM 3741 Model 2 or Model 4.

Tape Cassette Subsystem. A tape cassette handler is a standard feature of the Level 62; a second handler can be attached as an option. These cassettes are attached via port 6 and have transfer rates of 700 bps.

A cassette subsystem is standard with the port expander unit that is attached to the 62/60.

Card Readers/Punches. Four 80-column card readers can be attached to the 62/40 and the 62/60; readers that operate at speeds of 300, 500, 600, and 1,050 cpm are available. An 80-column card punch operating at 100 cpm is an option.

Two 96-column Multifunction Units can also be attached to both the 62/40 and the 62/60. The basic functions of these units include reading, punching, printing, and stacker selection. Under program control, these functions expand to include sorting, collating, merging, interpreting, and reproducing. These Multifunction Units use 96-column cards, and punch 120 cpm. The CCU0506 reads 500 cpm; the CCU1006 reads 1,000 cpm.

Printers. Printers are attached to the 62/40 via port 2; the 62/60 attaches printers via the port expander unit attached to port 6 in addition to the printer attached to port 2.

A range of line printers is available; these are models PRU0400/0600/0800, which print at speeds of 400, 600, and 800 lpm, respectively. The 120 standard print positions can be expanded to 132.

The Model 62/60 can attach higher speed belt printers. The PRU1200 prints at a speed of 1,200 lpm for continuous single-spaced line operation; it can reach a peak speed of 1,500 lpm using a limited character set. The PRU1600 prints at speeds of 1,600 lpm for continuous single-spaced line operation with a 48-character set. Peak speed capability is up to 1,900 lpm using a limited character set. Both printers have 136 print positions, but an extended print option allows 160 print positions per line.

DATA COMMUNICATIONS

The integrated communications subsystem can accommodate nine lines (either synchronous or asynchronous) providing direct and remote capabilities. Maximum total throughput is 2,400 cps. Maximum throughput of each line is 1,200 cps (using one synchronous line at 9,600 baud). Transmission is half- or full-duplex over switched or private lines as well as direct-connect via two-way alternate transmission.

Under Release 2 of GCOS, Level 62 can support both synchronous and asynchronous terminals.

With Release 3 of GCOS (late 1976), Level 62 will provide bisynchronous IBM 2780-type capabilities acting as a satellite to a larger host processor.

The GCOS communications system is composed of a nucleus and driver modules; these elements are present in memory only when communications facilities are to be used. The GCOS communications system controls the following network functions: line discipline, terminal device handling, control character editing, message queuing, error handling and recovery, and synchronization of multiple simultaneous data transmission activities.

Synchronization of logical I/O requests with physical communications activities, interfacing between application programs and driver modules, and communications processing are all terminal-device-independent functions controlled by the nucleus.

A user can employ either synchronous or asynchronous transmission modes; this is possible due to the modular design of the communications system. The terminal device-dependent driver modules send and receive messages, perform the abling and disabling of lines and terminals, handle line interrupts, and are responsible for initiating automatic retries when an error occurs.

SOFTWARE

Level 62 operates under Honeywell's own operating system, General Comprehensive Operating Supervisor (GCOS). This is a flexible operating system that provides multiprogramming, memory management, and fail-soft capabilities. GCOS supports the COBOL-74 compiler, an industry-compatible RPG compiler, and a FORTRAN IV compiler.

Minimum system requirements for GCOS are: Series 60 Level 62 central processor with console; 65,536 bytes of main memory; two disc units; one printer.

Operating System. GCOS takes full advantage of Level 62 hardware capabilities. Hardware features include an independent I/O controller and hardware register protection for the memory areas assigned to various activities and system programs.

GCOS controls the processing of activities (which may consist of several jobs) in a multiprogramming environment. All jobs within an activity, unless specified, otherwise by the user, must be processed sequentially. GCOS maintains a run queue; it selects a ready-to-run job from this queue when an existing job is interrupted. Jobs needing I/O operations and supervisor services can be suspended, allowing job processing and I/O operations to overlap. By means of multiprogramming, hardware and software capabilities are fully utilized.

GCOS data management frees the user from physical I/O operations by controlling files, volumes, and physical blocks of data. Its flexibility allows device independence capabilities to be an integral part of data management software. This flexibility extends to file organization. Three methods of file organization are available to the user — sequential, indexed, and relative. Queued partitioned and queued linked file organization are available for system use only. GCOS also handles label checking, file security, buffer control, and the blocking and deblocking of data. The major control functions of network handling are assigned by the communications supervisor operating under the GCOS Communications System.

Languages

Along with standard Level 62 programming languages, Honeywell offers language conversion aids designed to help the user convert to the Level 62 operating environment. Conversion aids are offered for: System/3 RPG programs and disc files; System/360 Model 20 RPG; System/360 Model 20 files; Honeywell Series 200/2000 files and COBOL; and Honeywell Series 100 programs and files.

COBOL. Level 62 COBOL supports the American National Standards Institute COBOL-74 standard features. In addition, it supports the Honeywell extensions to the communications capabilities. COBOL source language and libraries are accepted as input by the compiler; data descriptions and user-supplied standard routines can be copied into any COBOL source program.

FORTRAN. Level 62 FORTRAN IV is compatible with the proposed American National Standards Institute Level 1 FORTRAN standard. It also provides a number of compatible extensions to the standard. Level 62 FORTRAN supports sequential and relative files and sequential processing of indexed files.

RPG. The RPG language offered with the Level 62 automatically reads, identifies, selects, and matches input records; performs calculations; and generates formatted output. This is all done under the direction of the user.

TYPICAL PRICES

Model Number	Description	Purchase Price $	Monthly Maint. $
CPS2401	62/40 CPU with 57KB memory	49,500	162
CPS2402	Same as 2401 except with 65KB memory	51,950	165
CMM2430	First 8KB memory increment	1,960	2
CMM2431	Additional 8KB memory increments	1,960	2
CMA2430	Addressing capability for each 8KB memory increment	490	1
CMM2440	First through fourth 16KB memory increment	3,840	4
CMA2440	Addressing capability for each 16KB memory increment	960	2
CPS2600	62/60 CPU with 65KB memory	75,410	243
CMM2641	First 16KB memory increment	3,840	4
CMM2640	Additional 16KB memory increments for expansion beyond 80Kb	3,840	4
CMA2640	Addressing capability for each 16KB memory increment	960	2
	Mass Storage		
MSU0112	Fixed/removable disc unit; 11.6MB	15,710	107
MSU0113	Same as 0112 except 5.8MB	9,720	36
CPA2002	Addressing capability for MSU0112 & 0113	950	2
MSU0310	Removable disc unit; 29MB	13,040	59
CPA2009	Addressing capability for MS30310	8,935	57
MSU0330	Removable disc unit; 80MB	15,700	65
CPA2027	Addressing capability for up to 2 MSU0330s	12,690	56
CPA2028	Addressing capability for 2 additional MSU0330s	1,140	4
MTU0120	First magnetic tape unit; 18.75 ips	7,870	44
MTU0121	Second magnetic tape unit; 18.75 ips	6,500	35
MTU0111	Third & fourth magnetic tape units (62/60 only); 18.75 ips	6,500	35
MTU0220	First magnetic tape unit; 37.5 ips	9,980	59
MTU0221	Second magnetic tape unit; 37.5 ips	8,160	48
MTA0100	Addressing capability for all magnetic tape units	21,050	113
	Peripherals		
PRU0400	Printer; 400 lpm	26,680	177
PRU0600	Printer; 600 lpm	34,780	215
PRU0800	Printer; 800 lpm	37,720	229
CPA2002	Addressing capability for PRU0400, 0600, & 0800	5,090	9
PRU1200	Printer; 1,200 lpm	44,420	310
PRU1600	Printer; 1,600 lpm	64,940	431
CPA2010	Addressing capability for PRU1200 & 1600	8,975	29
CRU0300	Card reader; 300 cpm, 80 cols	5,985	26
CRU0500	Card reader; 500 cpm, 80 cols	7,560	32
CPA2011	Addressing capability for CRU0300 & 0500	2,875	7
CRU0600	Card reader; 600 cpm, 80 cols	18,200	68
CRU1050	Card reader; 1050 cpm, 80 cols	19,240	108
CPA2012	Addressing capability for CRU0600 & 1050	3,170	8
CRF0003	51-col option for card readers	1,980	6
CRU0306	Card reader; 300 cpm, 96 cols	6,600	39
CPA2016	Addressing capability for CRU0306	950	3
PCU0120	Card punch; 100–400 cpm	17,470	70
CPA2214	Addressing capability for PCU0120	3,890	10
	Data Communications		
DCC2401	Additional 5 async or 4 sync lines beyond 4 lines on Integrated Data Communications Controller; includes addressing for 1 async line	2,200	5
DCA2001	Addressing capability for 2 async lines	2,640	19
DCA2002	Addressing capability for 2 sync lines	2,640	19
	Software		
SBC0005	Communications software for sync terminals		131
SBC0006	Same as 0005 except for async terminals		131
SBC0007	Software for bisync communications; IBM 2780 mode (CPU to CPU)		131
SBC0008	Same as SBC0007 except for IBM 3741 terminal mode		10
SBL0002	RPG compiler		11
SBL0005	ANS-74 COBOL compiler		87
SBL0007	FORTRAN		113
SBS0200	GCOS Level 62 BASIC supervisor		N/C

IBM CORP.

System/3 Model 4

In January 1976, IBM announced the newest and smallest member of the System/3 family. The Model 4, designated as an online work station system for distributed computing, permits the attachment of up to five local work stations or a cluster of up to 32 remote work stations via an optional binary synchronous communications (BSCA) adapter. While the System/3 family has, up to this point, been composed of models for general-purpose small business computing, the Model 4 is probably the first member of the family that has been designated as a specific kind of system (i.e., work station) for interactive transaction and management-oriented processing.

As a standalone work station system, the Model 4 can distribute processing power to several user locations in the local office environment. As a remote job entry system to another System/3, 360, or 370, the Model 4 acts as a major processing link in a distributed processing network. In either case, the System/3 Model 4's most distinguishing characteristic is its work station concept, which allows up to five local 3270-type devices (mix of CRTs and printers) to operate in an online mode.

IBM believes that the Model 4 will be well suited for such applications as: data entry and creating data files, inquiry into existing data files, and file update. Using the IBM 3270 Series Information Display terminals, IBM's principal CRT product, operators can interface directly to the system, thus eliminating the need for intermediate keypunching and data handling.

The Model 4, which will be delivered in June 1976, is comprised of 64K bytes (one size only) of MOSFET memory, a 115-cps matrix printer, a keyboard console, either 4.9MBytes or 9.8M-Bytes of disc storage, and a 3277 Model, Display Station for displaying operating system messages. Up to five of the following local work stations (located up to 2,000 feet from the Model 4 processor) may be attached to the Model 4: 3277 Display Station Model 1 or 2, 3284 Printer Model 1 or 2, 3286 Printer Model 1 or 2, and 3288 Line Printer Model 2. Communications capabilities up to 50,000 bps are provided by an optional binary synchronous communications adapter.

WHY THE MODEL 4 ?

The System/3 Model 4 has been introduced to fill a gap in the market that has been left by current General Systems Division (GSD) offerings. It is aimed at the small business user who has the need for limited online capabilities at a price and level of sophistication that is scaled down to fall in line with the interactive small business systems currently offered by other mainframe and independent manufacturers.

Will it impact the sales of the System/32? Although price-wise typical System/32 and Model 4 configurations fall within a dollar range of each other, their market orientations are different. The System/32 is primarily a batch machine designed to operate with a single CRT and turnkey application packages (either IBM's Industry Application Packages [IAPs] or packages supplied by independent software houses). Also, the System/32 can make use of the 3741 Data Station in an offline mode (or online via the bi-sync communications adapter) to prepare data for high-speed batch input. This is in contrast with the Model 4's interactive transaction-oriented nature.

Will the Model 4 dull the competitive edge of the Model 8? Theoretically, it shouldn't. According to IBM, the two systems do not compete

HEADQUARTERS

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in the same market. Price-wise, the two systems are far apart — 64K bytes of main memory on the Model 8 is priced at $39,610, compared to $19,150 for 64K bytes of main memory on the Model 4. Also, the Model 8 has a larger range of configuration possibilities than the Model 4. It supports a high-speed line printer, magnetic tape, and 3741 Data Stations, as well as BASIC ASSEMBLER, ANSI COBOL, and FORTRAN IV. Its greater flexibility makes it the better choice for general-purpose commercial processing.

And what of the System/3 Model 6? Officially, it is dead. The Model 6s that are in the IBM warehouse are being made into Model 4s, and IBM is making no show of pretense about that fact. The Model 4's console, discs, console printer, and system control program (with the exception of CCP and CCP/disc sort for the Model 4, and the 3741 Data Station feature for the Model 4) are identical to those of the Model 6. Memory technology on the two systems — MOSFET for the Model 4 and monolithic for the Model 6 — is different, but, according to one IBM spokesman, it is not difficult to change one to the other.

At the time of writing, a large percentage of the orders for the Model 4 were coming from current Model 6 users. The Model 4 offers more main memory for less money than the Model 6 (16K bytes of main memory, which is the maximum on the Model 6, costs $30,520), and the Model 4 allows up to four online users to access the system simultaneously while the Model 6 allowed only one online user.

The Competition

The Model 4 is a system which offers workstation and System/3 capabilities at a price lower than any other model in the System/3 family. It is at the same time designed to be competitive with the rash of small business systems that have hit the market within the past several years — mostly in response to the System/32. In order to be competitive with IBM, other mainframe manufacturers and independent manufacturers priced themselves attractively lower than IBM and offered capabilities that topped those of the System/32. Seeing that the System/32 could only host one user, most of the competitors designed their systems to offer online capabilities for multiple users. As the small business system market becomes increasingly aggressive and as more interest is shown in distributed processing capabilities, systems that allow processing power to be placed at user sites (usually in the form of a CRT terminal) are receiving a large portion of the users' attention.

The Model 4 will find itself competing with a large variety of small business and intelligent terminal systems. In the small business system market, these will include: Basic/Four, Burroughs B 704, Digital Equipment Datasystem 350 Series, NCR Century 8200 Series, Microdata Reality, Honeywell Series 60 Level 61 Model 60 (61/60), and Qantel 1300 Series. Each of these systems offers characteristics and capabilities which distinguish it from the rest of the pack. Much of the choice between systems depends on user needs. The Model 4's advantages in this market are its IBM birthright, its IBM terminals, and its well-proven System/3 operating system.

The intelligent terminal manufacturers are offering increasingly sophisticated terminal systems specifically designed to host multiple terminal users and meet the needs of users building distributed processing systems. The Model 4 will meet competition from the following intelligent terminal systems: Datapoint 1100 (as well as the Datapoint 2200 and 5500) and the Datashare plan for distributed processing, Four-Phase Systems IV/40 and IV/70 and the NP/80 Network Processor for hierarchical network processing, Raytheon PTS/1200, and even IBM's own 3790 Communication System.

CONFIGURATION GUIDE

The basic Model 4 configuration consists of the following devices:

- 5404 Processing Unit (64K bytes MOSFET memory) with a keyboard console.
- 5447 Disc Storage and Control. Model A1 is 5MB and has an average access time of 126 ms, and Model A2 is 10MB and has an average access time of 126 ms.
- 5213 Model 3 Printer with a print speed of 115 cps and bi-directional printing.
- 3277 Display Station Model 1 (without keyboard) for displaying CCP messages. As a standard feature, the 3277 Model 1 and two additional 3270 Model 1 devices (3277 Model 1, 3284 Model 1, 3286 Model 1) can be attached as local work stations.
- Local work stations can be any of the following devices:
  3277 Display Station Model 1, 480 characters.
  3277 Display Station Model 2, 1,920 characters.
  3284 Printer Model 1 or 2, 40 cps.
  3286 Printer Model 1 or 2, 66 cps.
  3288 Line Printer Model 2, 120 lpm.

Optional features for the Model 4 include:

- 4704 Display Increment for attachment of three additional 3270 devices in any combinations.
- 4705 3270 Model 2 Attachment for connection of 3270 Model 2 local devices (3277-2, 3284-2, 3286-2, 3288-2).
- 7081 Serial I/O Channel for special-purpose peripheral devices such as an optical mark reader and magnetic character reader.
- 2074 Binary Synchronous Communications Adapter (BSCA) provides communications rates of 600 to 5,000 bps over point-to-point (non-switched) data lines in EBCDIC or ASCII code.

MAINFRAME

The mainframe contains main storage, a keyboard console and maintenance console (identical to the one on System/3 Model 6), facilities for addressing main storage, facilities for the arithmetic and logical processing of data, and controlling I/O devices.

The Model 4 uses Monolithic Systems Technology (MST) for logical circuitry, and Metal Oxide Semiconductor Field Effect Transistor (MOSFET) for memory. The basic addressable unit is an 8-bit byte with a ninth bit for parity checking. Data is coded in EBCDIC. Main cycle time is 1.52 microseconds. The "cycle steal" technique is used for instruction execution and I/O handling.

Only one 5404 Model A 18 (65,536 bytes) processing unit can be attached to a Model 4. Local work stations are attached directly to the processing unit. One 3277 Model 1 (for CCP messages) and two other Model 1 work stations are standard. An optional display increment is needed for the attachment of one to three additional local Model 1 work stations. Model 2 work stations also require an optional attachment. The optional binary synchronous communications adapter is housed in the processing unit and also operates in the cycle steal method.

PERIPHERALS

Via the serial I/O channel, the System/3 Model 4 can attach any of the peripherals available to the System/3 family. See report 140.4239.030 in your AUERBACH service for a full listing of these devices. The standard peripherals and work stations available for the Model 4 are listed below.

Slow-Speed and High-Speed Peripherals

A character printer and removable disc storage are standard with the Model 4.

Printer. The 5213 Model 3 printer prints at a nominal print rate of 115 cps. It has 132 print positions and six lines per inch vertical spacing. Bi-directional printing and an adjustable forms tractor are standard features of the printer.

Disc. The 5447 disc storage and control comes in two models. Model A1 stores approximately 5 MB and consists of one removable disc and one fixed disc. Model A2 stores approximately 10 MB and consists of one removable disc and three fixed discs. The removable disc of the 5447 is the 5440 disc cartridge, which is the disc used on the 5444 Disc Storage Drive. The 5444 is used with the other System/3 models, thus allowing data and programs to be interchanged among System/3s using the 5440 disc.

Each disc for the 5447 has a capacity of 2.45MB and an average access time of 126 milliseconds. Each disc can store up to 50 data files.

Work Stations

The Model 4 can support up to five local work stations and one remote work station.

3277 Display Station Model 1. This terminal is required for displaying operator messages from the CCP. It is used without its keyboard.

Local Work Stations. Local work stations may be any of the following devices.

- 3277 Display Station Model 1 and Model 2 are CRT displays with 480 characters (Model 1) or 1,920 characters (Model 2) in 21 lines of 40 characters or 24 lines of 80 characters respectively. An optional keyboard may be attached.
- 3284 Printer Model 1 or 2 provides print speeds of 40 cps.
- 3286 Printer Model 1 or 2 provides print speeds of 66 cps.
- 3288 Line Printer Model 2 provides print speeds of 120 lpm.

Remote Work Stations. Remote work stations are supported via the 2074 BSCA; they may be selected from the following devices.

- 3270 Information Display System (via 3271 Control Unit).
- 3275 Display Station Model 2.
- 3741 Data Station Model 2.
- 3741 Programmable Work Station Model 4.
- 3735 Programmable Buffered Terminal Model 1.

DATA COMMUNICATIONS

Using the binary synchronous communications adapter (BSCA), the System/3 Model 4 can communicate with any of the following devices or systems.

- Another System/3 equipped with BSCA.
- System/32 equipped with BSCA.
- System/360 Model 20 equipped with BSCA.
- System/360 Model 22 and larger.
- System/370.
- 2770 Data Communications System.
- 2780 Data Transmission Terminal.
- 3741 Data Station Model 2 or 3741 Programmable Work Station Model 4.
- System/7 equipped with BSCA.

Transmission rates of 600 to 50,000 bps are supported over point-to-point (non-switched) data lines; either EBCDIC or ASCII code can be chosen.

SOFTWARE

Software support for the Model 4 is divided into two general categories:

- System Control Programs (SCP).
- Program Products.

SCP

The SCP schedules and supervises programs, completes the input and output operations requested by programs, and maintains disc files and libraries. The following SCP programs are available for the Model 4.

- Disc System Management — The disc system management program consists of a supervisor, scheduler, operation control language, and data management. The supervisor uses 3.25K bytes of memory. Disc data management supports sequential, indexed, and direct disc files; Model 4 disc files are compatible with those used on other System/3s.
- Disc Utility Programs — Under disc system management, the following utilities are executed: library maintenance program, copy/dump program, file delete, file and volume label display, disc initialization, and alternate track assignment and rebuild.
- Communications Control Program (CCP) — The Model 4 CCP is functionally identical to the System/3 Model 10 CCP, except for the differing operator interfaces. CCP is pre-generated and is available to the user in minimum and maximum versions. The minimum version of CCP supports local 3270 (3277, 3275, 3284, 3286, 3288) devices, BSCA, and one to four user programs (tasks). It requires approximately 26K bytes of main storage. Only EBCDIC code is supported. The maximum version of CCP supports 3270 devices, as well as 3735 and 3741 devices, and one to four user programs (tasks). It requires approximately 32K bytes of main storage. Either EBCDIC or ASCII code is supported. The CCP's functions include terminal monitoring, program fetch, resource management, concurrent program execution, and disc file access management.
- Overlay Linkage Editor — While the overlay linkage editor is an optional SCP feature, it is required for generating display formats using the CCP format generation routines, generating printer formats using the CCP format generation routines, and generating sort object modules. The overlay linkage editor is used when the CCP is not in operation.
- Multi-leaving Remote Job Entry Work Station (MRJE/WS) Program — Using the optional MRJE/WS program, the Model 4 can be used as work station for the submission of jobs to a System/370 operating under HASP II, ASP, JES under OS/VS2, or JES2/JES3 under OS/VS2. Input to the System/370 can be from a keyboard console or disc.

Program Products

The following IBM-supplied program products are available for the Model 4.

- RPG II — RPG II object programs and sorts are executed under the CCP; however, RPG programs must be compiled while the CCP is not running. Two optional features, the RPG II telecommunications feature and the RPG II auto report feature, are also available.
- Disc Sort Program — The disc sort program allows any System/3 disc file organization to be sorted. The disc sort program cannot be used while the CCP is operating.
- CCP/Disc Sort — The CCP/disc sort program requires 12K bytes of main storage for generation and execution. It allows sort jobs to be executed under CCP control.
- Conversational Utility Programs — The conversational utility programs include keyboard source entry and keyboard data entry programs; both are disc-resident.

IBM — System/3 Model 12 and Recent Announcements

OVERVIEW

IBM's General Systems Division which handles the small business market made several significant announcements in July 1975.

- A new model of its System/3 line of small business computers-Model 12;
- a local display adapter for Models 8 and 15 which can support up to 12 or 30 local terminals;
- a magnetic tape subsystem on the Model 8;
- price reductions on the two older technology System/3 Models 6 and 10;
- price reductions on some features of Models 8 and 15;
- extended the Term Availability Plan to include System 3 Models 8, 12 and 15.

If the announcement of the System/3 Model 12 is viewed in conjunction with the earlier announcements for IBM's System/32 and System/3 Models 8 and 15, a new IBM marketing pattern emerges.

The System/32 will be IBM's single terminal entry level disc-based turnkey system that is supplied as a hardware/software package to suit individual customer's requirements.

The System/3 Model 8, which is also a disc based system, is IBM's entry level system for users with requirements for more processing power, a larger selection of peripherals and a foreseeable growth potential. It features more main memory, a Dual Program Feature, greater disc capacity and multiple local or remote terminals.

The System/3 Model 12 offers tremendously increased disc capacity (82M bytes for data areas) using the Winchester type discs rather than cartridge discs; a print spooler; faster line printers and thus has more powerful batch or on-line capabilities.

The System/3 Model 15 at the top of the line caters to the fully fledged on-line user with main memory expandable to 256K instead of 64K on the Model 12, multiprogramming capabilities provided by software rather than the hardware Dual Program Feature and additional support for telecommunications, especially local "clusters" of CRTs.

The outdated Models 6 and 10 will be sold off from inventory at reduced prices while existing 6 and 10 users will upgrade to the Model 12. Some Model 15 users who are not using their systems to full capacity may even downgrade to the Model 12.

The System/3 price-cuts must be viewed in the context of other price-cuts on the larger System/370 Models 115 and 125 (also by 15%). Some commentators regard the cuts as evidence that IBM is preparing to announce "something completely different" and needs extra cash to pay for extensive product development work. By extending the TAP leasing scheme from System/32 to the System/3 line IBM will probably improve its cash flow position as the ratio between purchase price and TAP or MAC payments seems now to encourage outright purchase rather than rental. On the other hand, all these moves may be seen as part of IBM's adjustment of the System/3 line to incorporate cheaper, more powerful central processor and I/O peripheral technology in order to remain competitive in the fiercely contested small business computer market.

COMPETITIVE POSITION

System/3's main competitors are Honeywell's Liberator/3 (Series 60 Level 62), the Burroughs B 1700 Series, ICL 2903, NCR Century Series and Univac 90/30. Hovering in the wings are the Lockheed System/3, the DEC DataSystems 300 and 500, Microdata Reality and Basic Four.

Our analysis of IBM's new prices confirms that IBM has sprinted to remain competitive. Whether IBM's price-cuts will spark the equivalent of a range war with its competitors remains to be seen. Certainly the new prices will tend to separate the sheep from the goats. The fierce little billy-goat Model 12 will butt head-on with Honeywell's Liberator/3.

We compared approximately equal system configurations from IBM, Honeywell, Burroughs and NCR. Table 1 shows the results. IBM is lower priced than all three of its main competitors. Both the B 1716 and NCR Century 101 represent the first models in their appropriate series to offer large disc capacity.

HEADQUARTERS

(U.S.A.)	(International)
IBM General Systems Division P.O. Box 2150 Atlanta GA 30301	IBM 821 United Nations Plaza New York NY 10017

Table 1. Price Comparison of System/3 Model 12 with Competing Systems

Description	Monthly Rental (Maintenance not incl) $	Purchase Price $
IBM System/3 Model 12		
32K main memory, 91M bytes of disc storage, Multifunction card unit (500 cpm), 600 lines per min.Line printer	3,458	131,435
Honeywell Series 60 Level 62		
57K main memory (32K not available), 90M bytes disc storage, Card Reader/Punch (600 cpm), 600 lines per min. Line Printer	4,343	188,105
NCR Century 101		
32K main memory, 60M bytes of disc storage, Card Reader (300 cpm) and Line Printer (600 lpm) as per Basic system	3,995	162,925
Burroughs B1716		
32K main memory, 87M bytes of disc storage (minimum), 750 lines per min. Line Printer, Card Reader (500 cpm)	4,168	158,521

SYSTEM/3 MODEL 12

The main reason for the introduction of the System/3 Model 12 appears to be that the price/performance gap between Models 8 and 10 and Model 15 was too wide both in terms of computing power and monthly rental. A user was confronted with a $1,500 to $2,000 monthly rental increase. Now the Model 12 can be ordered for only about $750 more.

Three Model 12 processors have been announced so far: B16 with 32K of main memory, B17 with 48K, B18 with 64K. In common with the other System/3 models the new processors all have a main cycle time of 1.52 microseconds and employ a cycle-steal technique. A minimum configuration of the Model 12 includes:

- 5412 B16 processor with 32K main memory
- 3340 Direct Access Storage Facility Model C2 housing two 3348 Data Modules
- either a 5203 or 1403 line printer
- either a 5424 Multifunction Card Unit or a 1442 Card Read Punch or a 3741 Data Station.

IBM estimates a typical Model 12 card system will have a purchase price of $125,936; a Monthly Availability Charge of $3,458 and a Term Availability Plan charge of $3,234. A typical Model 12 cardless system will have a purchase price of $127,506; a Monthly Availability Charge of $3,496 and a Term Availability Plan charge of $3,230.

Table 2 compares the models of the System/3 line. Delivery of the Model 12 is scheduled for June 1976.

Model 8 Enhancements

The Local Display Adapter (LDA) announced for Model 8 is the same as announced on Model 12. The LDA should bring performance improvements by reducing terminal response time as the limitations of teleprocessing data rates are not applicable to the LDA terminals. Up to twelve 3270 devices (3277s, 3284s, 3286s, 3288s) can be directly attached to the Model 8 in any combination at distances of up to 2,000 feet. The LDA is mutually exclusive with the Integrated Communications Adapter (ICA). First delivery is scheduled for January 1976.

A subfeature of the LDA is the ability to support up to four 3410/3411 magnetic tape drives on the Model 8 providing the same configuration capability as the Model 10 Disc system.

Model 15 Enhancement

Up to 30 local 3270 devices (3277s, 3284s, 3286s, 3288s) may be attached to the Model 15 via the newly announced Display Adapter (DA). As with the LDA on Model 8, response time should be improved as data rates will no longer be limited by telecommunication line rates. The DA will also poll the terminals, reducing the CPU overhead involved when the CPU has to handle that function.

DA Feature #4601 provides the hardware and micro-code to attach three 3270 terminals. It is mutually exclusive with the binary synchronous communications adapter (BSCA).

DA Feature #4602 provides additional attachment capacity for three more terminals. Up to nine of these may supplement the 4601 to give a maximum of 30 terminals. First delivery will be December 1976.

Price Reductions

IBM has reduced by approximately 15% the purchase price of the older core memory System/3 Models 6 and 10. These price reductions apply regardless of the model with which they are used so, since many of these features are used on Models 8, 12 and 15, these price cuts will impact the entire System/3 line.

IBM has also repackaged the 3340 disc system. Both the 3340-C2 announced for the Model 12 and the 3340-A2 announced earlier for the Model 15 house two drives but the purchase price of the C2 submodel is $8,412 less than the A2. Because of this and the lower costs of the Model 12 processors compared to the Model 15B's (which were needed to run the large discs), IBM has made acquisition of a greater disc capacity suitable for on-line systems more attainable by smaller users.

Term Availability Plan (TAP)

Under TAP a user undertakes to retain his machine for a base contract period of 36 months. Paying IBM a

Table 2. IBM System/3: Summary Configuration

SYSTEM	Model 6	Model 8	Model 10	Model 12	Model 15
CENTRAL PROCESSOR					
Models	5406; B2-B4	5408; A14, A16, A17, A18	5410; A2-A17	5412; B16-B18	5415; A17-A20, B17-20, C21-24
Memory (K bytes)	8K, 12K, 16K	16K, 32K, 48K, 64K	8K, 12K, 16K, 24K, 32K, 48K	32K, 48K, 64K	48K, 64K, 96K, 128K, 160K, 192K, 224K, 256K
DISC DRIVES					
Cartridge Max, M bytes	9.8	9.8	9.8	0.0	9.8
Models	5444* Mdls 1, 2, 3	5444 Mdls A1, A2, A3	5444* Mdls 1, 2, 3, A1, A2, A3	—	5444* Mdls A2, A3 (for 5415 A Mdls only)
Pack, Max, M bytes	—	—	40.96	81.92	81.92; 82 to 164
Models	—	—	5445* Mdls 1, 2, 3	3340 Mdl C2	5445* Mdls 1, 2, 3 (for 5415 A Mdls only); 3340 Mdls A2, B1, B2 (for 5415B Mdls only)
DISKETTE	3741 Mdls 1-4, data station	3741 Mdls 1-4, data stations	3741 Mdls 1-4, data stations	3741 Mdls 1-4, data stations	3741 Mdls 1-4, data stations
DISPLAY	2265 Mdl 2	3275 or 3271 with multiple 3277s & 3284/3286 printers	3277 or 3275, Mdls 1, 2	3271 or 3275, or 3277	3277 Mdl 1
PRINTERS					
Serial Printers	5213 Mdls 1, 2, 3 or 2222	5471	5471* Mdl 1	3284, 3286	3284* Mdl 1
Line Printers	—	5203 Mdls 1, 2, 3	5203* Mdls 1, 2, 3 or 1403 Mdls 2, N1	3288, 5203 Mds 1, 2, 3, or 1403 Mds 2, 5, N1	3284* Mdl 1, 1403* Mdls 2, 5, N1
CARD I/O					
96-Column	5496 Mdl 1	—	5424* Mdls A1, A2	5424 Mds A1, A2	5424* Mdls A1, A2
80-Column	129 Mdls 1, 2, 3	—	1442* Mdls 6, 7	1442 Mds 6, 7	1442* Mdls 6, 7 2560* Mdls A1, A2 2501* Mdls A1, A2
Optical Mark Sense	—	3881	3881 Mdl 1	3881 Mdl 1	3881 Mdl 1
MICR	1255 Mdls 1, 2, 3	1255 Mdls 1, 2, 3	1255 Mdls 1, 2, 3	1255 Mdls 1, 2, 3	1255 Mdls 1, 2, 3
BSC COMMUNICATIONS	2074	6202(1) and 2074	2074 (1st) 2084 (2nd)	2074 (1st) 2084 (2nd)	2074 (1st) 2084 (2nd)
MAGNETIC TAPE	—	—	3410/3415*, Mdls 1, 2, 3	3410/3411, Mdls 1, 2, 3	3410/3411*, Mdls 1, 2, 3
OTHER PERIPHERALS	2222 includes ledger card device		5475 data entry keyboard	—	—

Notes:
* Denotes special attachments required.
(1) Attaches to 4645 Integrated Communications Adapter, which supports 2 local lines and 1 remote line.

flat rate the user is not charged for second or third shift machine use. He has lease and purchase price protection through the first year of the term and, in addition, saves approximately 5% of what he would have paid under MAC (Monthly Availability Charge). The user may accrue up to 50% of the machine purchase price in the first 36 months and can extend TAP for an unlimited number of 1-year extensions or one extension of less than a year. However, he must pay a termination charge for discontinued machines, features or model downgrades.

COMPATIBILITY

Model 12 is upward compatible with the lower models of the System/3 line, Models 6, 8 and 10, with the exception that neither 5444/5445 disc storage or the 5475 Data Entry Keyboard is supported. All of the file organizations supported for Models 6, 8 and 10 are supported by Model 12. Programs written for Models 6, 8 and 10 must be recompiled to run Model 12 as there is only source language compatibility, not object program compatibility. Some macro instructions used in Model 10 assembler language programs may need modification before reassembling with the Model 12 Assembler. Data files from the Models 6, 8 and 10 must be transferred from the 5444 cartridge disc to the Winchester type discs at an IBM data center equipped with a System/3 Model 15 which can handle both types of disc. There are 19 of these in the conterminous United States. Under Model 12 System Control Program (SCP), a 5444 is equivalent

to a 5444 simulation area on the 3340. Model 12 source programs are upward compatible with the Model 15.

SOFTWARE

The major enhancements from System/3 Model 8 and 10 programming support are:

- Print spooling.
- 3340 direct-access device support.

Print Spooling

This function requires either the Dual Program Feature (DPF) or the 5471 printer-keyboard to be attached to the 5412 processing unit. Print data is written (spooled) to a print queue on the 3340 disc rather than printed directly. With the DPF installed, programs can generate printed output from both program levels at the same time.

Spooling increases the job throughput of the system as program execution is not affected by the speed of the system printer. The operator can control the subsequent printing by starting a special print job whenever it is convenient.

3340 Direct Access Device Support

Each 3348 Data Module (2 per 3340) is divided into a main data area (41M bytes) and four simulation and simulation backup areas (4.5M bytes). The system uses the 5444 simulation area in the same way it would use the 5444 disc drive. Each simulation area is large enough to hold the contents of one 5444 disc cartridge. All libraries of user programs, system programs, procedures, etc. are contained in the 5444 simulation areas. As there are two data modules in the 3340 drive there are eight 5444 simulation areas in total. The second group of four is used by the simulation area program $SCOPY.

A 3340 data module is interchangeable between the Model 12 and 15. Each model can access files created by the other. There is no 3340 data module interchange capability between System/3 and System/370, however.

All file organizations used with 5445 discs are supported for the 3340 main storage area except split cylinder files. Up to 1000 files can be contained on one 3340 data module.

In the 5444 simulation areas, only direct single volume files or consecutive single volume files can be used. User files are permitted in the 5444 simulation area to facilitate conversion from a lower System/3 Model but they should be copied to the 3340 main data area for application use.

COMMUNICATIONS

Local and remote communication can be handled in three different ways on the Model 12, each mutually exclusive of the others.

- Local Display Adapter (LDA)
- Integrated Communications Adapter (ICA)
- Binary synchronous Communications Adapter (BSCA)

Of these three only the LDA is a new announcement. The LDA provides the capability of supporting up to 12 local 3270 type terminals at distances that can be up to 2,000 feet from the Adapter. Data rates are higher with the LDA than with standard telecommunications disciplines (77,000 bytes/sec input — 50,000 bytes/sec output) and this should lead to faster response times.

The ICA permits one remote and two local communications lines to co-exist. A manual switch is used to select one of the communication lines for operation.

Either one or two BSCAs can provide synchronous transmission rates ranging from 600 bps to 50,000. Using the ICA or BSCA the Model 12 can communicate as a host or sub-host to the following:

- 2770 Data Communications System
- 2780 Data Transmission Terminal
- 2972/2980 General Banking Terminal System
- 3270 Information Display System
- 3735 Programmable Buffered Terminal
- 3741-2 or 4 Data Station
- System/3
- System/7
- System/32
- System/360
- System/370

Unlike the System/32 the System/3 Model 12 is not equipped to function with IBM's Advanced Function for Communications protocol SDLC and so does not meet the requirements of IBM's System Network Architecture (SNA). For a full discussion of SNA/SDLC see the AUERBACH Special Report No. 100.4239.196. System/3 is widely regarded as a computer series with a long life expectancy so it remains to be seen how IBM will move to include the highly popular small business line in its plans for the future.

PRICE DATA

Model	Monthly Rental (maintenance not incl) $ TAP	MAC	Purchase Price $	Maintenance $
Processor				
B16 (32K main memory)	1,265	1,328	50,465	215
B17 (48K main memory)	1,360	1,428	54,465	220
B18 (64K main memory)	1,455	1,528	58,465	225
Disc Storage				
3340-C2 DASF	696	818	27,580	72
Display Adapter (Model 15 only)				
4601	250	263	9,995	30
4602	35	37	1,405	1

OVERVIEW

IBM's System/3 is a line of small business computers that can satisfy the general-purpose EDP requirements of nearly all except the smallest of small computer users. The line runs the gamut from the Model 6, which is an interactive disc-based system with a minimum system only a few steps above programmable accounting machines, to the batch-oriented model 15 that in many ways can compete with the System/370 Model 115. The line as a whole, and particularly the Model 10, has proved to be one of IBM's most successful products. It is definitely the system against which all other small business systems compete in the marketplace.

The System/3 is probably the most popular single system that IBM has ever produced; over 25,000 systems have been installed. Part of its popularity lies in its surprisingly fast and efficient internal processing speeds and in the relatively low-cost power of the system. The versatility of the system makes it likely that it will have a longer life than IBM's larger computer series — satisfied System/3 users would frequently rather obtain multiple System/3s than move up to the 370 line although it remains to be seen whether this trend will continue when users expand to the limits of the Model 15 now available. Model 10 was announced in June 1969, Model 6 in October 1970, Model 15 in July 1973, and Model 8 in September 1974. All systems except Model 8 are delivered and currently in production. Model 8 is scheduled for delivery in June 1975.

Model 6

System/3 Model 6 is a small, general-purpose, commercial data processing and interactive, problem-solving system. A minimum Model 6 configuration consists of a central processor (the operator console-keyboard is part of the Model 6 CPU), a disc storage system (2.45 million bytes), and a serial printer. The system is aimed at the segment of the small business computer market that currently uses mixed data processing methods. Model 6 appeals to users with environments characterized by diverse applications now handled by manual methods, assisted by small calculators, bookkeeping machines, accounting machines or ledger card machines. These include novice users who require financial (bonds and lease analysis, rate of return) accounting; scientific or interactive processing; data input; and engineering and mathematical problem solution. The Model 6 is also intended for small businesses that subscribe to a time-sharing or service bureau system. In these settings, large data files and high-speed throughput aren't required. Rather, the prime criteria of the basic system design is to perform the wide range of tasks more effectively than by present methods.

Model 8

Model 8 is a disc-based system oriented toward batch processing but with facilities for on-line terminal applications and for remote communications via the Binary Synchronous Communications Adapter and an Integrated Communications Adapter. A minimum system includes CPU, 16K words of MOS memory, a printer, disc, and either a keyboard printer or a data station. The system can be expanded to include up to 64K words of memory, more disc, and a variety of peripherals including a 4-32 unit display subsystem. Model 8 peripherals are similar to Model 10 peripherals but lack the card I/O and I/O facilities available to all three of the other models. On the other hand, communications facilities are nearly comparable since two local and one remote medium-speed BSC terminal can be attached via ICA (although only one can be operative at any given moment), and an additional high-speed BSC adapter can also be attached. The communications and display subsystem capabilities, combined with the lower cost of the Model 8, make this system stronger in the intelligent terminal market against the clustered CRT terminal systems produced by several independents.

Model 10

Model 10 is a batch-oriented system that can be either card-based or disc-based. The two types of systems encompass different data storage media and data management techniques, each allowing a range of memory sizes running from 8K to 48K bytes and a variety of peripheral options. A minimum system in either case consists of CPU, 8K bytes of memory, printer, and card unit, with disc storage optional. Model 10 card-oriented systems appeal to present users of electromechanical punched card accounting systems; these users can keep the 80-column cards or switch to the more compact 96-column card handled by the multifunction card unit which can read, punch, interpret, sort, and collate cards. Model 10 can also serve as an upgrade for the Model 6 but not without severe growing pains. The versatility of the Model 10 system allows it to operate as a turnkey system for novice computer users or to perform the complex operations required by moderately experienced users.

Model 15

The Model 15 is currently the largest computer in IBM's System/3 series of small business computers. A

minimum system includes the CPU, 48K bytes of memory, cartridge disc, printer, card unit, and display. Two lines of submodels are specified depending on whether or not the CPU can attach the 3340 Direct Access Storage Facility. Memory capacity is 48K, 64K, 96K, or 128K bytes. The Model 15 has more facilities than the Model 10: some new processor instructions, larger memory, more on-line disc storage, and a multiprogramming operating system. It also uses the MOS memory technology of IBM's System/370 Models 115 and 125 and the new System/3 Model 8 instead of the core storage used in the System/3 Models 6 and 10. The Model 15 has basically the same communication offerings as the Model 10; a special option, however, can provide for up to eight communications lines instead of the limit of two that are currently available as standard with both the Model 10 and the Model 15. IBM is stressing the system's use in a teleprocessing and remote data entry capacity. Model 15 represents, at least temporarily, the upgrade that Model 10 users have been hoping for; it offers more main storage capacity at prices reasonably proportionate to those of the Model 10; it offers twice the on-line disc capacity (over 80 million bytes, compared to the 40 million bytes of the Model 10); and it also offers multiprogramming and spooling that were available only from independent vendors for the System/3 Model 10.

SYSTEM DIFFERENCES AND CONVERSION PROBLEMS

While it is possible to move up from one system to the next higher one because of the RPG II language common to all systems, this type of upward movement has many attendant problems. The processors for all systems are different and cannot be field-upgraded. Model 15 A series systems can be field upgraded to B series processors, and Model 8 A14, A16, and A17 processors can be upgraded to a larger Model 8 A Series processor. Model 6 can use a BASIC compiler/interpreter not available on the other three models, so programs in this language must be rewritten. Peripherals for the smaller systems are not always used on larger systems; for example, a Model 6 user must change printers when moving to Model 8 or 10; depending on the model, he might have to change it again when moving to a Model 10 or 15. Tapes and cartridge discs, however, can be transferred, and the RPG disc file structure is identical on all systems; thus, Model 6 can use the Models 8, 10, and 15 RPG II files, for example. This kind of compatibility does not extend to the new B series Model 15 processor completely, since the 3340 uses a different "pack" and the B series cannot be operated as a Model 10 disc system. Models 8, 10, and 15 share the capabilities of FORTRAN and COBOL compilers as well as RPG II. The Models 8 and 10 both use Model 10's SCP, so these two systems have the greatest degree of program compatibility. The Model 15 can run object programs under the Model 10 SCP, provided the I/O is the same and Model 10 SCP is used instead of the Model 15's multiprogramming operating system. Model 8 programs can also run on the 15 in Model 10 simulation mode. Model 15 users must recompile all Model 10 programs if they choose the new multiprogramming operating system, however. Table 1 presents the main differences among the models.

Table 1. IBM System/3: Differences Among Models

Characteristic	Model 6	Model 8	Model 10	Model 15
SYSTEM				
Orientation	Interactive	Batch & interactive	Batch	Batch
Disc-Based	Std	Std	Opt	Std
Multiprogramming	No	Yes, 2	No, 2 opt	Yes, 2 levels
Max Main Memory (K bytes)	16	64	48	128
Max Disc Memory (M bytes)	9.8	9.8	50.7	91.7, 164
PERIPHERALS				
Disk Pack Subsystem	No	No	Option	Option
Magnetic Tape	No	No	Option	Option
Card Equipment	Std	No	Std	Std
Line Printer	No	Yes	Option	Option
Communications	1-line option	2 local, 2 remote	2-line option	2-line option
Magnetic Stripe Ledger	Yes	Yes	No	No
OMR	No	Yes	Yes	Yes
Data Station Keyboard	No	Yes	Yes	No
LANGUAGES				
BASIC	Yes	No	No	No
RPG II	Yes	Yes	Yes	Yes
FORTRAN	No	Yes	Yes	Yes
COBOL	No	Yes	Yes	Yes
Assembler	No	Yes	Yes	Yes

System/3 users know they can go nowhere without conversion pains except to more 3s. The System/360 and 370 computers are incompatible with the 3s.

IBM System/360 Model 20 simulation is unavailable for the System/3 Model 15 from IBM; it is available from independent vendors for the Model 10. System/3 Model 15 users who are upgrading from System/360 Model 20 will have to convert their RPG II programs, if they stick with only IBM offerings. In perhaps a year or two, System/3 Model 15 users will be exactly where the Model 10 users were before the Model 15 announcement — nowhere to go except to more 3s without conversion pains. Of course IBM could continue its commitment to System/3 by announcing still another model to move up to. So far their approach has been to expand the Model 15 disc storage capacity and to add the Model 8 in the middle of the line instead, so it is difficult to predict what the company will do.

PERFORMANCE AND COMPETITIVE POSITION

Because of the wide range of capabilities available with the System/3, the product line competes with most small business systems on the market, except perhaps at the very lowest level.

The Model 6 provides competition for interactive systems like those made by Basic Four, Cascade Data, Honeywell, and Burroughs. In addition to these systems, which are mostly disc-based interactive systems in the $25,000-$30,000 range for comparable configurations, there are a number of intelligent terminals that can be expanded to compete with System/3 Model 6 and even System/3 Model 10. Many of these have developed software to support business processing. Four Phase, Datapoint, and Mohawk all have competing systems.

System/3 Model 6 does not support multiprogramming, so a user with several data entry stations or terminals operating concurrently can often combine this with capabilities close to those of System/3 Model 6 in an expanded intelligent terminal or a system like the Basic Four. In addition, the upper end of several lines of programmable accounting machines (Burroughs, Litton, Nixdorf) compete with the smaller Model 6 configurations.

The most important feature of the new Model 8 is its price, which is substantially lower than that of any other model in the System/3 line. The purchase price of the 5408 processor with 16K bytes of main memory is $26,100 as compared to $35,900 for a 16K-byte 5406 and $29,100 for a 16K-byte, disc-system 5410. The 5408 with 48K bytes of memory costs $34,100 as compared to $63,000 for a 48K-byte 5415 that supports the 5444 disk drives. The new 5415B Models that support the 3340 cost even more; the B17 48K-byte 5415 Model costs $92,000.

The 5408 price is still not low enough to make it price competitive with disc-based systems from other manufacturers, such as the DEC Datasystem 500, but it is low enough to replace some disc-oriented Model 10s that require only the 5444 disk drives.

System/3 Model 10 can range from configurations as small as those used for the Model 6 that is, smaller than the Model 8 to configurations of considerable power and capacity inherent in a system with 48K bytes of core and 50.7M bytes of disc storage. Model 10 is a batch system, finding competition among systems that compete with Model 6 but that can be adapted for batch processing (which includes most of them). Offerings by major manufacturers, such as the Honeywell 105 and 115, Burroughs B 1700 Series, and Univac 9200, also compete directly with System/3 Model 10. Model 10 does not compete with on-line multiterminal systems such as the DEC Datasystems 500; the new Model 8 is better than the 10 for this market.

The System/3 Model 15 finds its competition mostly among major manufacturers including Burroughs, Honeywell, and Univac, as well as IBM's own System/370 Model 115. Given around 96K bytes of core, the Burroughs B 1728, IBM 370/115, Honeywell 2030, and Univac 9200 can all be configured into systems of comparable price, within $1,000 of each other. Most of the non-IBM systems can be expanded to memory capacities considerably beyond IBM's.

One notable weakness of all System/3 models in the face of their competition is the limitations on communications capability. At every level the user can find processing power comparable to that of System/3 but with greater numbers of communications channels and frequently more variety in terminals. Many have emulators enabling them to communicate with systems from several vendors, which is handy for mixed shops. Many can be multiprogrammed, allowing several (local or remote) terminals to operate concurrently.

IBM's advantage, aside from the inherent efficiency and power of System/3 lies in the excellent service, software support, and stability that is one of IBM's claims to fame. Software for System/3 is particularly extensive; other manufacturers find this element of System/3's reputation particularly hard to beat. On the other hand, independent vendors and other mainframe manufacturers offer lower prices and other added attractions to maintain a competitive profile against the industry giant.

Most of the American-based companies market in Europe and Japan, and many are slowly making their way in other parts of the world. There they meet additional competition particularly from Europe where small business systems are very popular. A great deal of the competition comes at the interactive level, but Nixdorf, Philips, and ICL offer lines that compete with System/3 at all levels.

USER REACTIONS

A random sampling of System/3 users produced evidence of overall satisfaction with the systems. The Model

10 is the preponderant model in the field, and it is usually disc-oriented. Typical applications for both Model 6 and 10 are invoicing, accounts payable and receivable, payroll, general ledger, sales statistics and reports, inventory control, and order processing. The users interviewed included a major Eastern city's traffic court center, clothing manufacturers, a dairy, a wholesale food distributor, various piece goods manufacturers, a realty firm, a holding company, a furniture company, and a manufacturer of picture frames.

Most users programmed in RPG II and found the language well-suited to the business-type applications. One user said RPG II is not good for complex file handling, but the language is quite satisfactory for his use. A few users programmed in COBOL. One COBOL user felt there would be fewer conversion problems with the COBOL programs when the company eventually expands to an IBM 370 machine. Another COBOL programmer used the language because he was familiar with it.

Users commented on ease of programming and running the System/3. Reliability was an often-used word describing the System/3. Most users found the maintenance to be good to excellent, with a response from IBM within a couple of hours. A rural manufacturer of novelty items chose IBM because of its good service in non-metropolitan areas.

We asked the users why they picked the System/3. In response, many said they had IBM equipment in the past, often a 360/20, and did not want to change vendors when changing equipment. One user expressed fear of other products and bought IBM's reputation. Another hired a consultant to evaluate his data processing needs and was urged to buy IBM systems. A great number of users went the IBM route because of IBM's software, back-up support, and training. One user said that even though the IBM equipment is more expensive in the beginning, the lack of downtime, the software, and system backup make IBM cheaper in the end. Another user thought converting from IBM equipment to another manufacturer's computer was too expensive.

When looking for a computer system, the users interviewed had variously investigated the Burroughs B 1700, Univac 9200, 9300, and 90/30, GE 200, NCR Century Series, Honeywell equipment, and the Singer-Friden machines. Some users investigated no manufacturer other than IBM and accepted IBM's recommendation on the type of equipment needed.

Most users realize that even though their present system is satisfactory for their needs, they may face more demanding data processing situations in the future. System/3 users plan to change from card-based to disc-based system, add more disc storage and a faster printer, or increase the core memory. Some users also see the need for a larger system than the Model 10. Two users have ordered Model 15s and another plans to order one within a year. In deciding on a Model 15, these users did not investigate any other manufacturers. They had been pleased with their Model 10s, and they said the cost of conversion from one manufacturer's system to another was too great. When the Model 15 arrives, one user plans to add dealers' sales figures to the present sales analysis report. Another user is looking forward to the Model 15's dual programming.

The System/3 can use either the 80-column card or the shorter 96-column card. Users' opinions on the cards were divided. One user said the 96-column card costs less to buy and is more compact to store. Another user found the 80-column card superior to the 96-column card, because the 80-column card is the industry standard. A third user bought the Model 6 three years ago because it was the only small system available at that time that used no cards.

One manufacturer of System/3 peripherals used his Model 10 as a test vehicle for his product. He admitted to using and abusing the system. IBM had difficulty servicing the system since the system was kept in an unenclosed state.

One Model 6 user suggested IBM develop a power fail option in the event of an electrical failure. This user maintains a back-up file of all work processed each day for protection.

Amidst the praises for IBM and the System/3 were some dissatisfied customers. A general construction company needed a computing system to handle payroll, accounts payable and receivable, job costing, purchase orders, and management and control system for an apartment house the company owns. This user felt he was sold the IBM image and psychology. He objected to two major points with the IBM system. The first was salesmanship. The user was assured that anyone could run the Model 6. IBM underestimated the talent required for the system. IBM wrote a fair payroll package for them, costing $10,000. This package required 2½ days to process 100 payrolls. The user has since rewritten the programs. Four hundred payrolls are now processed in less than half a day. The second objection the user had was that the system is over-priced and that expansion is too expensive. The user felt that in 1970 the System/3 was a good product; today, he feels it is not a marketable system because of the competition from other systems. In reviewing his position with IBM, the user feels IBM underestimated the complexity of the company's needs. He feels IBM should have sold them a Model 10 initially. As a result of these complaints, the company is considering a Basic/Four system and DEC DATASYSTEM 300 or 500 as primary contenders for a replacement of their System/3. The company has also considered a Burroughs B 1700 and the NCR Century Series. The cost of conversion is the only factor against changing vendors.

A manufacturer of welding equipment bought independent memory for their Model 10 and has experienced maintenance problems with IBM because of this. The user feels he is being pushed into dumping the independent core memory and converting to all IBM equipment. He experienced difficulty with the memory on his system, but

he was not able to pinpoint whether the IBM memory, the independent memory, or the interaction of the two was causing erroneous error messages. The reaction of IBM to this intrusion of outside vendors was to blame any and all system problems on the independent memory. The user described a situation in which a moving part on a printer had snapped from wear, and IBM blamed the independent memory for the failure. The user is thinking of getting rid of the Model 10 and replacing it with a Univac 90/30, a Burroughs B 1700, or a Honeywell machine. (Again, conversion costs play a part in the decision.)The user is also considering taking the route that IBM wishes him to — remove the independent core memory and convert to all IBM memory.

CONFIGURATION GUIDE

Configurations for the System/3 vary considerably and as a consequence, the four models are neither field-upgradable nor completely compatible. For an overview of the product line, it is easier to deal with each system separately. Specific peripheral characteristics are also outlined later.

Configuring an IBM system involves paying particular attention to a variety of requirements, prerequisites, and limitations specified by the manufacturer. For example, use of RPG II Telecommunications feature on the Model 10 requires a 12,288-byte system. Attaching the binary synchronous communications (BSC) adapter or the 1255 MICR unit requires the processing unit expansion feature on the Model 6. Frequently, an adapter is required to attach a unit to the system, as well as an adapter for the system on the unit; this is true of the data recorders and MICR unit. On disc or tape subsystems, expansion may be the substitution of a higher density drive or a multiple-drive unit, instead of the simple addition of a slave unit.

This report does not present all the ins and outs of the configurations of these systems, but rather it presents the broad outline, minimum and maximum systems, plus indications of knotty configuration areas. It is almost axiomatic that the existence of independent peripheral manufacturers for System/3 peripherals will probably stimulate IBM to create more and more complicated attachments to discourage outside vendors — unless government pressure changes IBM's tendency in this regard. Table 2 presents a summary of the peripherals available on each system.

System/3 Model 6

A minimum configuration for the System/3 Model 6 includes a 5406 processor with 8K bytes of memory, a 5444 Disk Storage Drive with 2.45M bytes of storage, and either a 5213 or 2222 Printer.

A Model 6 system can be expanded to include 12K or 16K bytes of memory, and 4.9M, 7.35M, or 9.8M bytes of disc storage. A maximum of one printer, one card I/O device, either one diskette I/O device (the 3741 data entry station) or one binary synchronous communications adapter, one display unit, and one magnetic card reader can be attached. The card I/O device can be a Model 129 buffered 80-column card data recorder or the Model 5496 96-column card data recorder.

System/3 Model 8

The minimum System/3 Model 8 consists of a 5408 CPU with 16K (A14), 32K (A16), 48K (A17), or 64K (A18) bytes of MOSFET memory, 5203 Printer (100, 200, or 300 lines per minute), 5444 Disk Storage Drive, and either a 5471 Printer-Keyboard or a 3741 Data Station connected directly to the CPU.

The CPU can support the Dual Program option that allows two programs to be independently loaded and simultaneously executed. A Dual Feed Carriage Control option for the 5203 printer is required to attach a dual feed carriage. The 8642 Universal Character Set control is required if more than 48 characters are used on the 5203. Only one 5203 printer is allowed on each Model 8.

The initial 5444 disc system can be expanded in the same way a disc on Model 6 is expanded. Like all other System/3 models, the Model 8 has a diskette option, in the diskette facilities on the 3741 data entry station.

A 7081 Serial I/O Channel option is required to connect a 1255 magnetic character reader or a 3881 optical mark reader. Only one 7081 is allowed per system and it cannot be installed on a system with the 2074 BSCA option. A 3741 data station Models 1 or 2 requires an 8220 attachment and the 3265 I/O adapter for connection to the Model 8. The 3741 programmable data station Models 3 and 4 require the 8220 and the 3266 I/O adapter. The System/3 Model 8 does not support the Application Control Language (ACL) for Models 3 and 4.

The 4645 Integrated Communications Adapter (ICA) allows up to three interfaces, two local (8,000 or 2,400 bits per second) and one remote (the 6202 medium-speed BSC), but only one can be active at a time because a manual switch is used to select the interface.

The 2074 Binary Synchronous Communications Adapter (BSCA) also allows the Model 8 to communicate in BSC mode with other remote computers and remote terminals, functioning as the controller or as a tributary in a multipoint network or operating on a point-to-point switched or leased line. An integrated modem (1,200 bits per second) is available as a special feature. Only one 2074 is allowed per system and it cannot be installed on a Model 8 with the 7081 serial I/O channel.

The following optional features are available for the 2074: Auto Call; EIA Local Attachment for one 3271 control unit, one 3275 display station, or one 2972 remote communications controller; Internal Clock; Integrated Modem (1,200 bits per second); Station Selection (when

Model 8 acts as a tributary on a multipoint communication line); and Text Transparency (allows transmission of 8-bit byte binary data as well as EBCDIC).

The 3271 Control Unit provides for the attachment of four to 32 devices in increments of four devices. The devices can be a combination of 3277 Display Station Model 1 (480-character display) or Model 2 (1,920-character display), 3284 Printer Models 1 and 2, and 3286 Printer Models 1 and 2. The 3275 Display Station is a single CRT display of 480 or 1,920 characters. The 2972 Controller can attach up to fifteen 2790 area stations to the Model 8.

A 4110 attachment is used to connect the 5471 Printer-Keyboard to the Model 8. The 5471 is also used on the Model 10. It consists of a Selectric® typewriter and printer that operate independently under program control. The printer speed is 15.5 characters per second.

System/3 Model 10

The minimum configuration for a System/3 Model 10 includes a 5410 processor with 8K bytes of memory, 5203 or 1403 printer, 5422 Disk Storage Drive enclosure, and either a 5424 Multifunction Card Unit (96-column) or a 1442 Card Reader/Punch (80-column). The 5422 is required regardless of whether or not a 5444 Disk is included. Processor Models A2 through A7 use discs, while A12 through A17 do not use discs.

The minimum system can be expanded to include up to 9.8M bytes of disc cartridge storage in the same way the Model 6 is expanded. The System/3 Model 10 can connect the same drive as the Model 6 and, in addition, another series of faster drives with a number of high-performance features. In addition, a 2314-type of disc subsystem using 2316 packs allows up to 40.96M more bytes to be on-line: two 20.48M-byte drives or one 40.96M-byte drive. Like the Model 6, the Model 10 can also attach the 3741 data entry station which contains diskette drives.

Also Model 10 can attach a magnetic tape subsystem of up to four drives. Card equipment is entirely different on the two systems because Model 10 can't attach Models 5496 or 129 units, but it can attach Models 5424 (96-column) and 1442 (80-column); each is available for operation at several speeds. Printers available for the Model 10 are also faster: 5203 Line Printer or that old reliable 1403; here again, the printers for System/3 Model 6 cannot be used with Model 10. In addition, either a 5471 Printer-Keyboard or a 5475 Data Entry Keyboard can be attached.

Other special peripherals for the Model 10 are the 1255 MICR Reader and a 3881 Optical Mark Reader; note that these peripherals as well as the 5471 require disc subsystems and at least 12K bytes of memory. Another peripheral for the Model 10 that also requires a disc is a CRT display selected from several models. The CRT, like the diskette, uses a 4765 Local Communications Adapter that supplants the 2074 BSC Communications Adapter, but Model 10 allows attachment of a second 4765 which can in turn attach a Model 2084 BSC adapter, but not another diskette or CRT. If a 2074 is included in the system, a 2084 can be included without a 4765. This allows any combination of two items selected from the BSC adapter, the MICR Reader-Sorter, and the CRT, but only one unit of a kind per system except a system can support two BSC Adapters.

System/3 Model 15

The major differences between the Model 10 and the Model 15 as far as configuration is concerned is the larger main memory and disc storage available on the Model 15; less significant are some differences in the printers and card units available. A minimum Model 15 system consists of a 5415 processor with 48K bytes of memory, 1403 Printer, 5444 disc for A models or 3440 disc for B models, either 5424 or 2560 card unit, and 3277 CRT with keyboard.

A minimum system can be expanded to 64K, 96K, or 128K bytes of memory, and disc storage can be expanded on the A models to include a disc pack subsystem with a storage capacity of 81.92M bytes (two 40.96M-byte drives). The 3340 disc system used on B models can be expanded from a 82M-byte minimum system to 164M bytes maximum, but B models cannot attach the 80M-byte disc pack subsystem. The A models can be upgraded to B models in the field. Card I/O includes all models available to the Model 10 plus the 2560 and 2501 Card Units (80-column). The 5203 Printer, 5471 Printer and 5475 Data Entry Keyboard, are not available for the Model 15; instead the 3284 Serial Keyboard/Printer is provided. Other Model 10 peripherals, the 3410/3411 tape drives, 1255 MICR reader, 3881 mark sense reader, 3741 data entry station, and 2074/2084 BSC adapters can be attached to the Model 15. The same basic rules for Model 10 apply to Model 15 expansion over and above the basic configuration, but in a few cases different adapter models and slightly different procedures are required to attach corresponding models to the 5415 processor.

MAINFRAME

The System/3 is a small, single-processor business-oriented system. Most features of the mainframe architecture are similar for the three models. The mainframe contains the main storage and facilities for addressing main storage, for processing data arithmetically and logically, and for controlling the I/O units. The CPU utilizes monolithic systems technology (MST), for circuit logic. The cycle time is 1.5 microseconds, the same for all three machines.

The basic addressable unit is an 8-bit byte; a ninth bit is added for parity checking. Data is coded in EBCDIC. The card code is a 64-character set using 6 bits; the small card can store up to 96 columns of information.

System/3 uses a 16-bit address, which can address up to 64K bytes. The Model 15 uses an Address Translation Table (ATT) to address memory beyond 64K bytes. The ATT consists of 32 registers, which can address up to 128K bytes of storage. The Model 15 supervisor loads the appropriate values into the ATT registers, which are then used to convert the 16-bit addresses in a user program into the 17-bit addresses required to address all memory.

Model 15 features that differ from the Models 6, 8, and 10 are CPU storage protection; program check interrupt; eight levels of interrupt; a mask interrupt capability; privileged mode operation; and operation end interrupt. The main storage is Metal Oxide Semiconductor Field Effect Transistor (MOSFET), the same as that of the Model 8 and System/370 Models 115 and 125; Models 6 and 10 use core memory. Models 8 and 15 also use the same error correction and checking (ECC) as that used in System/370. The ECC corrects single bit errors and detects double bit errors with no loss of processor time.

All systems use a cycle-stealing technique for handling blocks of I/O data, providing overlap of I/O transfers with processing. Devices are connected to the computer via attachments, not by channels, with two exceptions. The 1255 MICR and 3881 OMR device require a serial I/O channel. Most peripherals, mass memory devices, and options are field installable.

Model 15 has a 2-byte wide data path feature to increase I/O transfer rate for discs. This reduces the number of processor cycles required to satisfy I/O requests, and these cycles can be used for other tasks. Another I/O enhancement is scan/read for discs (5445 only); this permits the system to retrieve the index from the disc in a single rotation instead of two.

PERIPHERALS

Peripheral devices can be selected from a variety of slow-speed, high-speed, and special peripheral offerings. Table 2 shows which devices can be attached to which System 3 model. Model 6 can attach up to six peripherals in addition to those in the minimum configuration while Models 8, 10, and 15 can attach up to 15 each.

Slow-Speed Peripherals

Printers, 80-column card units, and 96-column card units are available.

5424 Multi-Function Card Unit Model A1 or A2. Uses 96-column cards: A1 reads/punches/prints at 250/60/60 cards per minute; A2 reads/punches/prints at 500/120/120 cards per minute. For System 3/10 and 15 only.

1442 Card Read Punch Models 6 and 7. Uses 80-column cards: Model 6 reads at 300 cards per minute, punches at 80 columns per second; Model 7 reads at 400 cards per minute, punches at 160 columns/second. For System 3/10 and 15.

2560 Multi-Function Card Machine. Uses 80-column cards: Model A1 reads at 500 cards per minute, punches at 160 columns/second; can also collate, interpret, and print documents. For System 3/15 only.

1403 Printer Model 2, 5, or N1. 132 print positions; printing speed, respectively, is 600, 465, and 1,100 lines per minute. Model 5 for System 3/15 only, others for either System 3/10 or 15.

2501 Card Reader Model A1 or A2. Reads 80-column cards; 600 and 1,000 cards per minute, respectively. For System 3/15 only.

5213 Printer. 132 print positions, 85 or 115 characters per second, dot matrix; with pin-feed platen, vertical forms control tractor, or vertical forms control combined with bidirectional print. For System 3/6 only.

2222 Printer. 220 print positions and two sets of forms tractors, including ledger card device, with or without bidirectional print. For System 3/6 only.

5496 Data Recorder. 96-column cards; reads, punches, prints up to 22 cards per minute; keyboard, can be used off-line. For System/6 only.

129 Data Recorder. 80-column cards; buffered; reads 50 cards per minute; punches and/or prints 12 to 50 cards per minute; keyboard can be used off-line. For System 3/6 only.

5203 Line Printer. 96, 120, or 136 columns at 100, 200, or 300 lines per minute. Models 1 and 2 are chain printers, Model 3 is train printer; optional dual feed carriage. For System 3/8 or 10 only.

5475 Data Entry Keyboard. For dedicated on-line data recording using 5424 card unit and a system program. For System 3/10 only.

5471 Keyboard Printer. 15.5 card-per-second printing; requires 12K bytes memory and disc. For System 3/8 or 10 only.

3741 Data Station. 240-character CRT, keyboard (Model 1); Model 2 adds BSC (1,200/2,000/2,400 baud); Model 3 programmable in APL; Model 4 like Model 3 but with BSC added. For System/3 Models 6, 8, 10, and 15.

High-Speed Peripherals

Discs and magnetic tape drives are available. The tape and 3340 disc drives are those used on the System/370 models, but the cartridge discs are not.

Table 2. IBM System/3: Summary Configuration

SYSTEM	Model 6	Model 8	Model 10	Model 15
CENTRAL PROCESSOR				
Models	5406; B2-B4	5408; A14, A16, A17, A18	5410 A2-A17	5415; A17-A20, B17-20
Memory (K bytes)	8K, 12K, 16K	16K, 32K, 48K, 64K	8K, 12K, 16K, 24K, 32K, 48K	48K, 64K, 96K, 128K
DISC DRIVES				
Cartridge Max, M bytes	9.8	9.8	9.8	9.8
Models	5444* Mdls 1, 2,3	5444 Mdls A1, A2, A3	5444* Mdls 1, 2, 3, A1, A2, A3	5444* Mdls A2, A3 (for 5415 A Mdls only)
Pack, Max, M bytes	–	–	40.96	81.92; 82 to 164
Models	–	–	5445* Mdls 1, 2, 3	5445* Mdls 1, 2, 3 (for 5415 A Mdls only); 3340 Mdls A2, B1, B2 (for 5415B Mdls only)
DISKETTE	3741 Mdls 1-4, data station	3741, Mdl 1-4 data stations	3741 Mdls 1-4 data stations	3741 Mdls 1-4 data stations
DISPLAY	2265 Mdl 2	3275 or 3271 with multiple 3277s & 3284/3286 printers	3277 or 3275, Mdls 1, 2	3277 Mdl 1
PRINTERS				
Serial Printers	5213 Mdls 1, 2, 3, or 2222	5471	5471* Mdl 1	3284* Mdl 1
Line Printers	–	5203 Mdls 1, 2, 3	5203* Mdls 1, 2, 3, or 1403 Mdls 2, N1	3284* Mdl 1, 1403* Mdls 2, 5, N1
CARD I/O				
96-Column	5496 Mdl 1	–	5424* Mdls A1, A2	5424* Mdls A1, A2
80-Column	129 Mdls 1, 2, 3	–	1442* Mdls 6, 7	1442* Mdls 6, 7 2560* Mdls A1,A2 2501* Mdls A1, A2
Optical Mark Sense	–	3881	3881 Mdl 1	3881 Mdl 1
MICR	1255 Mdls 1, 2, 3	1255 Mdls 1, 2, 3,	1255 Mdls 1, 2, 3	1255 Mdls 1, 2, 3
BSC COMMUNICATIONS	2074	6202(1) and 2074	2074 (1st) 2084 (2nd)	2074 (1st), 2084 (2nd)
MAGNETIC TAPE	–	–	3410/3415* Mdls 1, 2, 3	3410/3411*, Mdls 1, 2, 3
OTHER PERIPHERALS	2222 includes ledger card device		5475 data entry keyboard	–

Notes:
* Denotes special attachments required.
(1) Attaches to 4645 Integrated Communications Adapter, which supports 2 local lines and 1 remote line.

5444 Disc Storage Drives. Combination unit with one removable and one nonremovable disc; 200 cylinders on each disc; 4.9 million bytes capacity per drive; usable with all processors. System 3/6 uses submodels 1, 2, and 3; System 3/15 uses A2, and A3; System 3/10 uses both sets of models plus an A1 model; System 3/8 uses the A1, A2, and A3 models.

5445 Disc Storage Drives, Models 1, 2, 3. Removable pack; 20.48M bytes capacity on Models 1 and 2, 40.96M on Model 3; 60-millisecond average access time; Model 2 is attached to Model 1, two Model 1 drives (and therefore two Model 2s) can be attached to System 3/10 and 15. One or two Models 3s or a combination of one Model 2 with a Model 3 can be attached to the System 3/15.

3340 Direct Access Storage Device. Uses 3348 data module with spindle, access arms, read/write heads, discs in sealed module; 41.04M bytes data and 9.83M bytes program support per module; 164M bytes data and 39M bytes program maximum/subsystem, 25 milliseconds average access, 885K bytes/second maximum transfer rate; for Model 15 B series processors only.

3410/3411 Magnetic Tape Unit and Control, Models 1, 2, 3. Recording density is 800 or 1,600 bits per inch; 7- or 9-track tape; transfer rates are 20K, 40K or 80K bytes per second; used with Systems 3/10 and 15 only.

3741 Diskette. I/O rates are 1,500 records per minute for reading and 1,000 records per minute for writing. These calculations are based on 128K-byte records, on a dedicated system without spooling, multiprogramming, or dual programming. The 3741 is double buffered. A direct attachment is available to connect the 3741 to the System/3. For Models 6, 10, and 15.

Special-Purpose Peripherals

A magnetic character reader and an optical mark reader can be attached via the optional Serial I/O Channel.

1255 Magnetic Character Reader, Models 1, 2, 3. Reads/sorts 6-inch documents at speeds of 500, 750, and 750 documents per minute. The units have 6, 6, and 12 stackers, respectively. Used with all System 3 models.

3881 Optical Mark Reader. Reads documents 3 by 3 inches to 9 by 12 inches with marks made by number 2 pencils or appropriately equipped printers; for Models 8, 10, and 15.

2265 Display. Screen capacity is 15 lines of 64 characters each, requires 12K-byte memory; it cannot be used with 2222; for System 3/6 only.

3275 Display Model 1, 2. Capacity is 480-character (Mod 1) or 1,920-character (Mod 2) display and keyboard; requires 4765 Local Communications Adapter; cannot be used with 2074. For Models 8, 10, and 15.

3277 Display Model 1, 2. Capacity of 480 characters (Model 1) or 1,920 characters (Model 2) for display; includes keyboard; requires 3271 Control Unit and 4765 Adapter. Cannot be used with 2074. For Models 8, 10, and 15.*

3271 Display Subsystem Controller. On Model 8. Attaches 4-32 devices in increments of four devices; devices can be 3277 Models 1 and 2, 3284 Printer Models 1 and 2, and 3286 Printer Models 1 and 2 in various combinations; for Models 8, 10, and 15.

DATA COMMUNICATIONS

One 2074 or two 2084 Binary Synchronous Communication Adapters (BSCA) provide synchronous transmission rates of 600 to 50,000 bits per second, on Models 10 and 15. Model 8 has a medium-speed BSC adapter (to 7,200 baud) attaching to an Integrated Communications adapter (two local lines, one remote) as well as the BSCA option. The BSCA adapters allow the System/3 to function as a processor terminal or a host or sub-host system.

The BSCA supports communication with System/3, System/7, Systems/360/370, 2770 Data Communication System, 2780 Data Transmission Terminal, 2972/2980 General Banking Terminal System, 3270 Display System, 3735 Programmable Buffered Terminal, and 3741-2 Data Station.

An EIA local feature permits attachment of one 3271 control unit or one 3275 display station without using a data communication line or modem. The 3271 can support a 4- to 32-unit display subsystem on Model 8.

The 4765 Local Communications Adapter (LCA) allows direct local attachment to a 3741 data station with a diskette. A 3271 control unit or a 3275 display station can also be attached locally via the LCA to provide single or clustered CRT display capability. The LCA excludes the first BSCA but not the second. Thus System 3/6 can use either communications or LCA devices but System 3/8, 10, and 15 can combine the two.

A special feature that will be priced separately and available only on specific request is the Multiple Line Terminal Adapter (MLTA) that provides attachment capability for IBM's low-speed start/stop terminals. Connection of one to eight communication lines with multiple terminals per line is possible. MLTA supports the 1050 Data Communication System, the 2740 Terminals, the 2741 Terminals, the CMCST (Communicating Magnetic Card Selectric Typewriter), and System/7, which is supported as a 2740-1.

SOFTWARE

IBM software is unbundled. The "System Control Programs" (SCP), which are operating systems, are available with the hardware at no charge, but language processors, utilities for optional and special-purpose peripheral devices and special features, and all application programs cost extra. The SCPs include disc-based systems for Systems 3/6 and 3/8, both disc-based and card-based systems for System 3/10, and a 2-level multiprogramming system for the System 3/15. The only language processors for System 3/6 are Basic and RPG II; Fortran, Cobol, assembly language, and RPG II are available for Systems 3/8, 10, and 15.

Operating Systems

With the exception of the Basic compiler-interpreter and some programs generated by the assembler, all programs run under control of the appropriate SCP. SCP

control functions differ somewhat for card and disc-based systems, but they have certain executive functions in common, similar utilities, and the same I/O drivers for the minimum configuration.

System 3/6

Programs within SCP include a Disc System Management program to maintain a disc-resident system for creating and executing programs. It permits selective loading of programs from disc; program execution is under control of an Operation Control Language(OCL), interpreter, which provides a limited set of statements for the user to communicate with SCP; I/O control; and roll-in/roll-out operations. Roll-in/roll-out lets the system suspend a program during its execution, place it on disc, and bring in an inquiry program. Upon completion of the inquiry, the suspended program is restarted from the point of interruption.

The disc utility permits the user to prepare and maintain disc files; it performs initialization, alternate track assignment and rebuilding, file and volume display, and file delete. An overlay linkage editor creates loadable programs from multiple relocatables modules. A copy-dump program and a library maintenance program are also included.

System 3/8 and 3/10 Disc-Based SCP. The Model 8/10 SCP contains all of the features of Model 6 SCP plus a number of important communications features. These include Remote Job Entry (RJE) work-station support, which permits a system equipped with BSCA and EBCDIC (Extended Binary Coded Decimal Interchange Code) text transparency to submit OS/360 jobs over communications facilities. The system must be a System/360 Model H40 (262,144 bytes of memory) or larger or a System/370. A BSCA multiline/multipoint feature provides communications support when used with System/3 macro feature. Program counters, used to gather performance information, are maintained on disc file. "Dual programming", allowing two programs to run in two partitions, can be included in an expanded version of the Disc System Management Program.

Also included in the Model 8/10 SCP is a macro feature for support of the assembler, system initialization program, device counter log-out, various magnetic tape utilities (Model 10 only), and utilities to support the 5445 Disc Pack Drive.

System 3/10 Card-Based SCP. Actually the card-based SCP is a subset of the disc-based system because all systems use card I/O. Almost all features of the disc-based SCP are included except disc-related routines, the overlay linkage editor, and several communications functions that need disc support.

System 3/15 SCP. The Model 15 SCP is similar to Model 8/10 SCP but features multiprogramming and spooling, plus it supports the additional peripherals available for the Model 15, particularly the extra discs. Three new commands — LOAD CPU, STORE CPU, and COMMAND CPU — are used to support the multiprogramming environment.

Multiprogramming allows two programs to run at the same time in two memory partitions. Partition 2 has priority over partition 1.

Spooling allows data in input or output queues to be stored on disc for reading, printing, or punching at a later time. This significantly faster way of handling I/O has been available from independent vendors for System 3/10, but it was not available from IBM.

The Model 8/10 SCP will run on the Model 15, but it will not take advantage of the new processor features or the new SCP instructions.

Communications Software. The Communications Control Programs (CCP) used with System 3 allow high-level language access to MLTA and BSCA attached terminals. This includes resource management to reduce contention between programs accessing the same files, concurrent program execution to allow multiple application programs within the available storage partition, and terminal monitoring to accept data and terminal commands. Concurrent program execution within a partition creates subpartitions that can handle multijob streams.

The CCP is available for Models 8, 10, and 15; it includes support for Cobol, Fortran; and RPG II. CCP requires no additional hardware over the minimum configuration except, of course, an MLTA or a BSCA and at least one terminal. The programs are slightly different for the models because of the differences in operator interface.

A Multi-Leaving Remote Job Entry Work Station (MRJE/WS) Program allows any System/3 to operate as an RJE terminal to a System/370 under OS.

Language Processors

Report Program Generator II (RPG II). RPG II, the language common to all System/3 models, is a programming language oriented towards generating reports. The language is output-oriented, because the primary concern is delivery of clear reports based on file or input data. RPG II uses preprinted specification sheets that permit the programmer to specify the form of the input data; the operation to be performed on the data; and the output format, including line layout, page and paragraph headings, and page numbering. It simplifies the programming task and enhances the novice's programming capability.

RPG II is available in both card-based and disc-based versions appropriate to the individual model.

Some additional features are available for RPG II:

- RPG Telecommunications feature — enables the system to transmit and receive synchronous data over communications lines; available in both card and disc versions.
- RPG II Auto Report feature — simplifies programming in RPG II by reducing much of the preparation and coding normally required to prepare users' applications programs; available in disc-based version only.
- Card RPG II Braille feature — supplies an option to list compilations and object programs in braille.

System 3/6 Only: BASIC. The BASIC language is a stand-alone interactive programming system, which uses a virtual memory concept to permit compilation and execution of programs that do not fit into available core storage. An optional feature of BASIC, DCALC, provides macros for such mathematical functions as addition, subtraction, multiplication, division, roots, and reciprocals; it thus can be used just like a calculator. Users who are unfamiliar with programming languages can use DCALC with ease.

BASIC includes a set of programs for system generation and disc pack use. The system disc stores system programs and user data files and provides for continuous execution of stacked jobs without requiring operator intervention.

System 3/6 Only: Stat/Basic. A comprehensive, interactive application program, Stat/Basic uses statistical techniques for analysis of numerical data. It consists of 40 procedures designed to aid the statistician, engineer, researcher, or business analyst by supplying him with the most commonly used statistical methods. Stat/Basic is used in association with an IBM System/360 system.

For System 3/8, 10, and 15 Only: BASIC ASSEMBLER, ANSI COBOL, FORTRAN IV.

BASIC ASSEMBLER. The ASSEMBLER is a symbolic programming language, machine-oriented for System/3; used to produce object programs. Some run under SCP, others are stand-alone programs.

System/3 Subset. ANSI COBOL. This subset of COBOL furnishes the user with the most widely accepted and used standard higher-level programming language. COBOL, which was originally designed for business applications, is available to Models 8, 10, and 15 systems.

System/3 Disc FORTRAN IV. The FORTRAN IV compiler provides a high-level programming language for the solution of scientific and mathematical problems; also available to Models 8, 10, and 15.

Program Products Other Than Language Processors

Program products vary with the configuration because many of the optional I/O drivers and support utilities fall into this category. A card-based Model 10 is a subset of the disc-based systems because both systems handle cards. Typical utilities include reproduce, interpret, 96-column list, MFCU sort/collate, data recording, verifying, and 80 to 96-column conversion. Disc-based systems include a disc sort facilitating sorting of sequential, indexed, and direct file formats in either ascending or descending sequence. The program provides six means of recognizing records.

Application Programming Systems

There are numerous application programming systems that are completely operational; the customer supplies information and parameters, and the systems are tailored to his needs. The required level of user programming effort depends on the specific application; it varies from none to forms design to writing RPG source programs. Customer responsibilities are delineated for each system.

A sample of the numerous application programs includes:

Hospital Accounts Receivable, Card-Based
Order Point Technique for Inventory Management
Card Bill of Material and Requirements Planning
Apparel Business Control
Hospital Patient Billing
Property and Liability Agency Accounting
Utility Billing System
Law Enforcement System
Unit Inventory Techniques
Bill of Material Processor
Optimum Blending
Appropriation Accounting
Citation Processing
Inventory and Requirements Planning
Job Analysis System/3
Business Analysis/Basic
Health Welfare and Pension Fund
System for Radio and Television
Shop Loading and Control
Health Welfare and Pension Fund

Application Customizer Service

IBM Application Customizer Service was developed for the small computer user. Small businesses are not financially able to invest in personnel to develop integrated programming systems for their applications. The Application Customizer Service allows each user to fill out a questionnaire relating to a particular application; the user specifies the content and layout of records and reports, identifies calculations required, and chooses processing procedures. Related jobs can be linked into an integrated family. The user punches cards from the questionnaire and sends them to an IBM Basic System Center where the cards are read as input to a System/360 Model 20. The Model 20 is programmed to run IBM's Application Customizer Program.

The 360/20 output supplies the user with all the necessary materials to prepare the computer program at his installation. The user must code the program, which is the easiest step in the process of generating it.

The Application Customizer Service is available for six major business application areas: order writing and invoicing (prebilling and post billing, automatic backordering, automatic selection of item prices or discounts), accounts receivable (open-item or balance forward method), inventory accounting (stock status reports), sales analysis (reports classified by item, product class, customer, or salesman), payroll (registers, paychecks, earning statements, etc.), and general ledger accounting (internal or client basis).

User Groups, Vendors, IBM Newsletter

User Groups. There are four independent organizations of IBM customers, supplying a wealth of information related to System/3. The user groups are: COMMON, NASU (National Association of System/3 Users), GUIDANCE, and GROUP/3. These organizations enable interchange of information, routines, programs, and programming packages among their members. Information services in the forms of newsletters or publications allow members to keep posted on available System/3 hardware and software (IBM and non-IBM).

Vendors. Many application programs are available from independent software houses. The programs can either be rented or purchased outright from the vendor.

IBM Newsletter. One of IBM's newsletters, the *Management Services Update*, announces new program products and user applications programs that apply to any of the IBM systems. System/3 applications have been receiving thorough coverage in order to demonstrate the utility of the system.

PRICE DATA

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	CENTRAL PROCESSORS AND WORKING STORAGE			
	IBM SYSTEM/3 MODEL 6			
5406	Processing Units with Keyboard (disc systems)			
5406-B2	8K	649	29,300	137
5406-B3	12K	777	35,200	143
5406-B4	16K	903	35,900	143
	Processor Options			
1550	Command Keys 9-16	21	990	1
5732	Processing Unit Expansion	37	1,750	7
7081	Serial I/O Channel	165	7,490	5
	IBM System/3 Model 8			
	Basic Processor (contains main storage and facilities for addressing main storage, arithmetic and logical processing of data, and controlling I/O units; includes housing for one or two 5444 disc drives)(1)	650	26,100	115
A14	16K Bytes	750	30,100	120
A16	32K Bytes	850	34,100	150
A17	48K Bytes	950	38,100	155
A18	64K Bytes			
	Processor Options			
3500	Dual Programming (capability to independently load and process 2 programs simultaneously)	127	5,830	1
7081	Serial I/O Channel	175	7,940	5
5732	Processing Unit Expansion	37	1,750	7
	IBM SYSTEM/3 MODEL 10			
5410	Processing Units (card systems)			
5410-A2	8K	361	16,400	42
5410-A3	12K	447	21,700	46
5410-A4	16K	611	22,400	46
5410-A5	24K	881	40,000	62
5410-A6	32K	1,145	40,700	62
5410-A7	48K	1,490	59,000	86
5410	Processing Units (disc systems)			
5410-A12	8K	508	23,000	92
5410-A13	12K	622	28,300	96
5410-A14	16K	754	29,100	96
5410-A15	24K	1,025	46,600	112
5410-A16	32K	1,285	47,300	112
5410-A17	49K	1,630	65,600	136

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	IBM SYSTEM/3 MODEL 10 (Contd.)			
	Processor Options			
3500	Dual Program	127	5,830	1
5501	Power Supply Expansion	55	2,290	1
5732	Processing Unit Expansion A	40	1,850	3
5733	Processing Unit Expansion B	21	816	1
5734	Processing Unit Expansion C	60	2,240	1
5735	Processing Unit Expansion D	21	816	1
7081	Serial I/O Channel	175	7,940	5
	IBM SYSTEM/3 MODEL 15			
5415	Processing Units			
-A17	48K	1,630	63,000	227
-A18	64K	1,740	67,000	232
-A19	96K	2,010	78,000	238
-A20	128K	2,225	86,000	248
B17	48K	2,310	92,000	235
B18	64K	2,410	96,000	240
B19	96K	2,660	107,000	245
B20	128K	2,860	115,000	255
	Processor Options			
5501	Power Supply Expansion	54	2,250	1
5733	Processing Unit Expansion 1	21	800	1
5734	Processing Unit Expansion 2	59	2,200	1
5735	Processing Unit Expansion 3	21	800	1
7081	Serial I/O Channel	172	7,790	7
	MASS STORAGE			
	Disk For Models 6 and 10			
5444-001	Disk Storage Drive	180	8,720	52
5444-002	Disk Storage Drive	297	10,400	52
5444-003	Disk Storage Drive	180	8,720	52
6378	Second Disk Attachment	50	2,420	5
	For Model 8 and 10 Only			
5444-A1	Disk Storage Drive	220	8,610	72
5444-A2	Disk Storage Drive	330	10,200	72
5444-A3	Disk Storage Drive	220	8,610	72
	For Model 10 Only			
4501	Higher Performance (1st disc attachment)	21	999	1
4502	Higher Performance (2nd disc attachment)	21	999	1
5422-001	Disk Enclosure	110	4,990	13
5440	Disk Cartridge (for all 5444 drives)	–	175	TM
5445-001	Disk Storage Drive	386	16,000	93
5445-002	Disk Storage Drive	368	15,300	88
3901	First 5445 Disk Attachment	551	20,400	36
3902	Second 5445 Disk Attachment	15	612	1
2316-001	Disk Pack	20	525	TM
	For Model 15 A Models Only			
	Disks			
5444-A2	Disk Storage Drive	330	10,200	72
5444-A3	Disk Storage Drive	220	8,610	72
5445-001	Disk Storage Drive	386	16,000	93
3901	First 5445 Attachment	540	20,000	36
3903	Second 5445 Attachment	81	3,000	1
5440	Disk Cartridge (for 5444-A2)		175	TM
5422	Disk Enclosure	100	4,900	12
	For Model 15 B Models Only			
3340 A2	Direct Access Storage Facility (1 control and 2 drives)	1,059	40,000	80
B1	One additional drive	592	22,000	43
B2	Two additional drives	747	28,000	69
	INPUT/OUTPUT			
	Punched Card (For Models 6 and 10)			
129-001	Card Data Recorder (reading 80-col cards at 50 cpm, and punching at 12-50 cpm; applies to all 129 models)	135	6,240	42
129-002	Card Data Recorder	151	6,990	46
129-003	Card Data Recorder	162	7,490	47
5486-001	Card Sorter	98	4,780	42
5486-002	Card Sorter	133	5,470	64
1225	Alphabetic Sorting	7	226	1
2370	Auxiliary Card Counter	10	525	3
7245	Sort Suppress/Digit Select	10	525	1

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	INPUT/OUTPUT (Contd.)			
	For Model 6 Only			
1020	Accumulate	20	999	3
1025	Additional Accumulate Program Levels	5	249	1
1201	Auxiliary Storage	8	399	1
3215	Direct Punch Control	6	300	1
3610	Expansion Feature	10	499	–
3950	Feed, Variable Length	25	1,240	6
4601	Interpret	15	561	2
5570	Production Statistics	10	499	1
6065	Reading Board Extension	–	20	–
7503	Card Input/Output Attachment	76	2,670	11
8705	Verifying Read Control	6	300	1
9671	Special Character Arrangement ASCII	150 S	80	–
9677	Special Character Arrangement EL	150 S	80	–
5496-001	Data Recorder	158	7,750	55
3210	Data Recorder Attachment	40	1,990	2
3666	8-Bit Read/Punch	30	1,470	2
7061/2	Self-Checking Number Mod 10/11	30	918	1
7501	System/3 Attachment	45	2,240	11
7801	3735 Attachment	45	2,240	5
7850	2772 Attachment	45	2,240	15
	For Models 10 and 15			
1442-006	Card Read Punch (300 cpm reading; 80 cpm punching)	286	15,260	61
1442-007	Card Read Punch (400 cpm reading; 160 cpm punching)	416	16,430	72
4130	1442-006/-007 Attachment	193	8,870	15
5424-A1	Multi-Function Card Unit (250 cpm)	314	10,200	153
5424-A2	Multi-Function Card Unit (500 cpm)	472	13,500	220
4100	MFCU Attachment 250/60/60	85	4,530	14
4101	MFCU Attachment 500/120/120	102	5,750	14
	For Model 15 Only			
2501-A1	Card Reader (600 cpm)	210	11,870	38
-A2	Card Reader (1,000 cpm)	276	12,080	54
3630	2501 Coupling	5	162	NC
8090	2501 Attachment	150	6,700	7
2560-A1	Multi-Function Card Machine	665	29,150	106
1575/6/7	Card Print (first/second/third 2 lines)	145	6,350	15
1580	Card Print Control	25	1,250	3
8100	2560 MFCM	150	6,300	16
	Magnetic Tape			
	For Models 10 and 15			
3411-001	Magnetic Tape Unit & Control	437	17,300	77
3411-002	Magnetic Tape Unit & Control	557	21,900	82
3411-003	Magnetic Tape Unit & Control	675	26,700	88
7951	3411 Magnetic Tape Attachment	160	4,800	10
	For Model 10 Only			
3410-001	Magnetic Tape Unit	199	7,850	50
3410-002	Magnetic Tape Unit	264	10,500	55
3410-003	Magnetic Tape Unit	330	13,000	61
3211	Single Density (1,600 bpi; phase encoded)	58	2,550	8
3221	Dual Density (800 or 1,600 bpi; NRZI; only for 002 and 003 models of 3410 and 3411)	86	3,670	30
6550	7-Track	86	3,670	14
7003	Attachment to System/3 (for 3411)	81	3,210	3
	Printers			
	For Model 6 Only			
5213-001	Printer (pin-feed platen)	173	6,320	53
5213-002	Printer (vertical forms control)	216	8,160	72
5213-003	Printer (vertical forms control)	270	8,360	82
3901/2/3	Printer Attachment (for 001/2/3)	71	3,490	19
3960	5213 Mdl 3 Enhanced Print Rate Attachment	122	4,890	21
4450	Forms Stand Stacker	–	51	–
2222-001	Printer (unidirectional)	378	16,800	115
2222-002	Printer (bidirectional)	416	17,000	126
7951/2	Printer Attachment (for 001/2)	71	3,490	19
	For Model 10 Only			
5203-001	Printer (100 lpm; 96 positions)	262	11,400	74
5203-002	Printer (200 lpm; 96 positions)	319	12,700	83
5203-003	Printer (300 lpm; 96 positions)	470	17,700	139
8642	Universal Character Set Control	15	487	1

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Printers (Contd.)			
	For Model 8 Only			
3970	5203 Printer Attachment for 100-lpm Printer	63	3,160	11
3971	5203 Printer Attachment for 200-lpm Printer	63	3,160	11
3972	5203 Printer Attachment for 300-lpm Printer	104	4,610	14
	For Model 10 Only			
3475	Dual Feed Carriage	85	3,960	22
3480	Dual Feed Carriage Control	26	1,310	1
3970/1	Printer Attachment (for 001/2)	59	3,160	10
3972	Printer Attachment (for 003)	96	4,610	13
4730	Additional Interchangeable Chain Cartridge	85	3,960	1
4740	Additional Interchangeable Chain Cartridge	119	2,960	36
5532	Additional Print Chain	–	975	–
5558	Additional Print Positions (24)	53	1,590	2
5559	Additional Print Positions (12)	26	795	NC
5560	Additional Print Positions (36)	79	3,380	2
8371	Type Subs (1st slug; chain)	15 S	5	–
8372	Type Subs (each additional; chain)	7 S	5	–
8373	Type Subs (1st slug; train)	20 S	15	–
8374	Type Subs (each additional; train)	15 S	15	–
8639	Universal Character Set Attachment	10	324	1
9950	Artwork per Character	–	100	–
9951	Matrix (per slug; 2 char)	–	150	–
9952	Set Up (for 2 char)	–	50	–
9953	Matrix (per slug; 3 char)	–	150	–
9954	Set Up (for 3 char)	–	50	–
5421-001	Printer Control Unit for 1403	286	12,900	29
1403-002	Printer (60 lpm)	810	30,210	188
1403-NI	Printer (1,100 lpm)	946	36,680	216
1376	Auxiliary Ribbon Feeding	78	2,745	17
1416	Interchangeable Train Cartridge (for NI)	98	2,960	TM
4140	Printer Attachment (for 002)	122	5,250	21
4150	Printer Attachment (for 003)	178	5,760	21
4740	Interchangeable Chain Cartridge Adapter	78	2,790	NC
5110	Multiple Character Set Feature (for 002)	10	410	2
5111	Multiple Character Set Feature (for NI)	10	410	2
5381	Numerical Print	235	8,055	10
5523	Preferred Character Set Feature	41	1,335	2
5532	Additional Print Chain	975	975	NC
6410/1	Selective Tape Listing (for N1/002)	198	7,220	11
6413	Selective Tape Listing Stacker	–	265	TM
6420	Selective Tape Listing (for NI only)	293	10,600	26
8371	Type Subs (first slug; chain)	15 S		–
8372	Type Subs (each additional slug; chain)	7 S		–
8640/1	Universal Character Set (for N1/002)	10	410	2
9950	Special Chain Artwork	–		–
9951	Matrix (per slug)	–		–
9952	Set Up (2-char slug)	–		–
	For Model 15 Only			
1403-002	Printer (600 lpm)	810	30,210	188
1403-005	Printer (465 lpm)	626	28,940	135
1403-NI	Printer (1,100 lpm)	946	36,680	216
4140	Printer Attachment (1403-002)	120	5,150	21
4135	Printer Attachment (1403-005)	110	4,700	21
4150	Printer Attachment (1403-NI)	175	5,650	21
5421	Printer Control Unit (for 1403)	260	12,740	26
	Magnetic Character Readers			
	For Models 6 and 10			
1255-001	Magnetic Character Reader (500 doc/min; 6 stackers)	870	39,400	231
1255-002	Magnetic Character Reader (750 doc/min; 6 stackers)	1,060	45,100	368
1255-003	Magnetic Character Reader (750 doc/min; 12 stackers)	1,400	61,400	484
1470	Balance List	73	3,320	7
3215	Dash Symbol Transmission	54 S	35	NC
4380	51-Column Card Sorting	16	734	NC
4520	High-Order Zero and Blank Selection	32	1,460	5
6303	System/3 Adapter	130	5,930	4
7060	Self-Checking Number	52	2,370	3
7850	2772 Adapter	47	2,130	3

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Displays			
	For Model 6 Only			
2265-001/002	Display Station	183	5,530	44
4766	Alphanumeric Keyboard (for -001)	31	918	5
7960	2265 Attachment for (-002)	76	3,740	2
	Keyboards			
	For Model 8 Only			
3741-001	Single Data Entry Station (240-char CRT)	159	6,000	39
-002	Same as 3741-001 except includes binary sync communications adapter; can be used as remote terminal transmitting at 1,200, 2,000, or 2,400 baud	194	7,250	50
-003	Programmable Work Station (executes programs written in APL)	253	8,600	59
-004	Same as 3741-003 except has binary sync communications capability	288	9,850	65
8220	3741 Attachment	205	8,200	17
5471-001	Printer-Keyboard	108	5,070	33
4110	Printer-Keyboard Attachment	58	3,020	5
	For Model 10 Only			
5471-001	Printer-Keyboard	117	5,070	35
4110	5471 Printer-Keyboard Attachment	54	3,020	5
5475-001	Data Entry Keyboard	45	2,420	8
4120	5475 Data Entry Keyboard Attachment	47	2,720	1
	Optical Mark Readers			
	For Model 10 Only			
3881-001	Optical Mark Reader	1,451	57,100	153
1471	BCD Read	60	2,390	2
3450	Document Counters	23	948	2
3801	Expanded Storage	60	2,390	1
6451	Serial Numbering	177	7,030	28
	DATA COMMUNICATIONS			
	For Models 6 and 10			
2074	Binary Synchronous Communications Adapter	292	13,200	72
4765	Local Communications Adapter	165	6,630	30
1315	Auto Call	43	1,990	1
4703	Internal Clock	27	1,240	1
7477	Station Selection	21	999	1
7850	Text Transparency	21	999	1
3872-001	Modem (2,400 bps)	91	3,030	26
3875-001	Modem (7,200 bps)	259	8,560	77
4872-001	Modem (4,800 bps; point-to-point)	–	4,549	20
	For Model 6 Only			
4872-003	Modem (4,800 bps; multipoint tributary)	–	4,947	23
	For Model 8 Only			
3872	Modem (2,400/1,200 bps)	86	3,030	24
3874	Modem (4,800/2,400 bps)	165	4,200	50
3875	Modem (7,200/3,600 bps)	224	8,560	71
4645	Integrated Communications Adapter	140	5,900	18
4801	Local Interface (8,000 bps)	25	1,020	1
4802	Local Interface (2,400 bps)	25	1,020	1
6202	Medium-Speed Sync Line	75	3,070	3
7851	Text Transparency	21	1,050	1
2074	Binary Sync Communications Adapter	308	12,500	72
1315	Auto Call	45	2,110	1
3601	EIA Local Attachment	27	1,020	1
4703	Internal Clock	28	1,320	1
4781	1,200-bps Integrated Modem (nonswitched)	16	535	4
4782	1,200-bps Integrated Modem (switched with auto answer)	21	714	6
5201	Modem Base	32	1,220	3
7477	Station Selection	22	1,050	1
7850	Text Transparency	22	1,050	1
	For Model 10 Only			
3601	SIA Local Attachment	27	1,020	1
4872-002	Modem (4,800 bps; multipoint tributary)	–	4,947	23
2084	Binary Synchronous Communications Adapter (2nd)	308	12,500	72
1325	Auto Call	45	2,110	1
3602	EIA Local Attachment	27	1,020	1

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
4723	Internal Clock	28	1,320	1
7487	Station Selection	22	1,050	1
7851	Text Transparency	22	1,050	1
	For Model 15 Only			
2074	Binary Synchronous Communications Adapter (1st)	302	12,300	70
1315	Auto Call	45	2,075	1
3601	SIA Local Attachment	27	1,000	1
4703	Internal Clock	28	1,295	1
7477	Station Selection	22	1,035	1
7850	Text Transparency	22	1,035	1
2084	Binary Synchronous Communications Adapter (2nd)	302	12,300	70
1325	Auto Call	45	2,075	1
3602	EIA Local Attachment	27	1,000	1
4723	Internal Clock	28	1,295	1
7487	Station Selection	22	1,035	1
7851	Text Transparency	22	1,035	1
4765	Local Communications Adapter	162	6,500	30
3741-002	Data Station	206	7,250	54
3271-002	Control Unit	194	7,340	13
3275-002	Display Station	156	6,630	14

Notes:
– Not Applicable
NC – No Charge TM Time and Material Basis

MODEL 15 ENHANCEMENTS

IBM has recently announced enhancements to its System/3 Model 15. Maximum memory size had doubled, a new software package is available, and the 3741 diskette data station now can be chosen as the sole method for data input and output.

EXPANDED MEMORY

Four new CPU models expand the System/3 Model 15's main storage capacity to a maximum of 256K bytes. The new 5415 Processing Unit models — C21, C22, C23 and C24 — provide 160K, 192K, 224K and 256K bytes of memory, respectively. Previous memory capacity on the Model 15 was 128K.

IBM expects that the C models will be ready in July 1975 for users who want to upgrade their Model 15s.

NEW SOFTWARE PACKAGE

A Model 15 software package for remote job entry has also been announced. The package — called the Multileaving Remote Job Entry Workstation (MRJE/WE) — allows the user to communicate with an IBM 360 or 370 running under ASP, HASP, OS/VS1 or OS/VS2.

The multileaving aspect of the package allows the Model 15 (A, B or C processing units) to improve the efficiency of line transmissions. With the MRJE/WS, line speed is not limited by the speed of I/O devices. A job stream prepared on tape or disc can be used with the MRJE/WS, or data from the MRJE can be dumped onto tape or disc for batch processing.

The remote job entry aspect of the package improves the efficiency of I/O communication. With the MRJE/WS a System/3 Model 15 will appear to the main operating system as another peripheral — card reader, card punch or printer.

The MRJE/WS will run under dual- or multiprogramming.

The new package will be ready for customer delivery in October 1975. It is supplied at no charge to IBM customers as part of their System Control Programming.

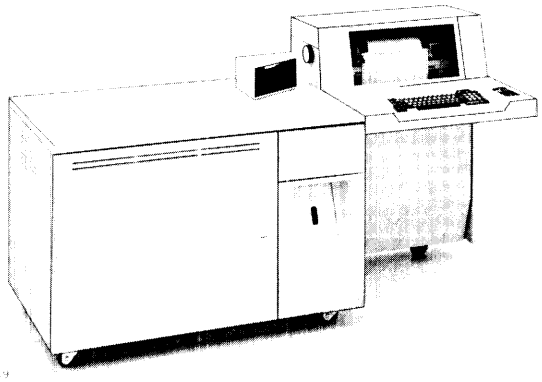
CHANNEL TERMINATOR FEATURE

The Model 15 (with B or C Processing Units) can now operate without card units. The 1601 Channel Terminator Feature eliminates the necessity for using the 1442 Card Read Punch, and 2560 Multi-Function Card Machine or the 5424 Multi-Function Card Unit on the Model 15. The Channel Terminator, while it does not preclude the attachment of an optional 2501 Card Reader, does make the 3741 diskette data station the only method for data input and output.

The Channel Terminator Feature will be ready for delivery in November 1975. Purchase price for the feature will be $2,335; monthly maintenance is $1. Rental is $48 per month.

PRICE DATA

Model Number	Monthly Rental $	Purchase Price $	Monthly Maint. $
C21	3,110	125,500	260
C22	3,310	133,500	265
C23	3,510	141,500	270
C24	3,710	149,500	280



OVERVIEW

The System/32, IBM's recent addition to the small business computer market, is an entry level system with some interesting and significant departures from the rest of IBM's computer lines. It is designed for first-time computer users, but instead of offering a totally customized system for those users who want a turnkey system, IBM has developed a series of "vertical" program packages for specific industries. These packages can be tailored or customized easily for 80 to 85 percent of the individual requirements at a very low cost, leaving the user to either program the rest using the RPG II compiler or contract with IBM or another vendor for the remaining 15 to 20 percent peculiar to the individual business.

The hardware packaging is both refreshing and ominous. The basic system consists of a processor with 16K words of memory, a 4.9 million-byte fixed disc, 240-character CRT, a 40-character-per-second printer, a keyboard, and a diskette drive. All are housed in a single desk-like unit. Upgrading the printer or changing disc capacity can be done in the field, but it is considered a model change. Options available to all models include additional memory to 24K or 32K bytes and communications features to permit either BSC or SDLC communications over switched networks. The refreshing element of the system is the simplicity of its presentation — no attachment interfaces and no attachments to figure out, configure, and price. The ominous element for plug-compatible manufacturers is the lack of external peripheral devices that can be profitably imitated.

Commercial software packages, called Industry Application Programs (IAPs) are available for five application areas: construction, wholesale food, wholesale paper and office products companies, hospitals, and membership organizations and associations. Each package consists of modules that will be tailored to a customer's application to handle such things as accounts receivable, accounts payable, payroll, inventory control, billing, and so on.

Data entry for the S/32 can be from the console or diskette. Diskettes are prepared off-line on a 3741 Model 1 or 2 Data Station or on another System/32. The total system cost can include the cost of the 3741 as well as the S/32. First System/32 deliveries were in February 1975, while the first IAP was delivered in March. Table 1 summarizes system specifications.

COMPETITIVE POSITION

The System/32 is a formidable competitor in the small business computer from two points of view: it moves IBM downwards into the small computer market, and it provides almost a turnkey package.

The penetration downward into the small business market has become increasingly important to the large computer mainframe manufacturers, because statistics show that the best customer is an old customer. Because of their investment in applications software, today's computer users are reluctant to switch from one computer vendor to another. Users are concerned that upgrade systems be software compatible with the system they are now using. An ever larger proportion of vendors' sales are to their own customers. Thus, it has become increasingly important for vendors to capture novices as they become first-time computer users.

Small businesses are relatively virgin territory for computer sales — primarily because there are so many of them, but also because the support requirements are large in comparison to hardware requirements. Thus, this market must be served locally either by a vendor with a very large service organization or by a local organization such as a software or systems house. Some minicomputer manufacturers with commercial configurations have gone to local distributors, who will service customers in their areas. This arrangement provides the level of software and hardware support needed by novice users without building prohibitively large software/service organizations.

A look at the service organizations of large computer manufacturers competing with IBM reveals some interesting statistics. Here is a list of some of the competing small-business computer/minicomputer manufacturers, and the approximate number of the service centers they maintain in the United States and Canada. These are mostly ball park figures rather than accurate counts, but they serve as a rough comparison of the size of the domestic service organizations.

Manufacturer	Service Centers
IBM	70 (coverage of entire USA via radio- or telephone-dispatched customer engineers)
Datapoint	50 (doubling in 1975)
NCR	300
Burroughs	200
Singer	143 (plus Canada)
Digital Equipment	50

Table 1. IBM System/32: Specifications

PROCESSOR	
Microprogrammed	Yes
Main Memory (K bytes)	16-32
Memory Type	MOSFET
Char Size, bits	8
Cycle Time, nsec	600
AUXILIARY STORAGE	
Disc	
Capacity, (M bytes)	5.0 or 9.1
Transfer Rate, (kc/sec)	889
Avg Access (msec)	70 or 72.5, respectively
I/O	
CRT	240 char (6 x 40)
Serial Printer, cps	40, 80
Line Printer, lpm	50, 100, 155
Cards	No
Paper Tape	No
Diskette	303K Char/diskette max
COMMUNICATIONS	Optional
Min-Max I/O Devices	1 printer; 1 CRT; keyboard; 1 fixed disc; 1 diskette drive
Packaging	All integral to basic system; field upgradable
SOFTWARE	
Operating System	SCP
Assembler	-
Compilers	RPG II
Applications	Modular "vertical" packages–tailored for construction companies; hospitals; membership organizations; wholesale paper; and food industries; other industries to be added
FIRST DELIVERY	February 1975

The large number of centers maintained by NCR, Singer, and Burroughs are probably a result of their small equipment business in cash registers, banking machines and other accounting equipment of various sorts, as well as for computer support. This large service organization makes them potentially strong competitors in the very smallest systems market.

As far as downward market penetration is concerned, System/32 addresses a smaller user than the System/3, largely because of its price. Some System/3 configurations can actually be smaller and slower as far as I/O is concerned — Models 6 and 8 both have 8K-byte versions. However, the cheapest Model 6 with the slowest printer available costs around $43,000, while a minimum configuration Model 8 with the slowest printer costs around $54,000. System/32 savings for the small businessman are further realized by the new Team Availability Plan (TAP) lease which provides a 36-month contract with a one-year guarantee of no raise in rates. A further guarantee insures no more than a 5 percent raise in rates in succeeding years, at a monthly rate lower than MAC. The biggest potential saving, however, lies in the "tailored" IAPs, which can range anywhere from $370 to $2,975 plus monthly license charges, depending on the industry or the package. Although IBM quotes an 80 to 85 percent "fit" to individual applications, some initial tests, in the construction industry for example, have shown even better percentages. Development of a fully customized application on System/3 can cost between $10,000 to $15,000. Thus, the IAPs make a substantial saving possible on System/32, even if the user must provide 20 percent of the software.

Software houses will have a chance to supplement IBM's offerings in special applications not yet covered by the industry giant. This will decrease as more IAPs are developed.

System/32 does not compete at the very lowest level of the small business market, however — at least not yet. Two types of systems can be significantly lower in price, and can act as entry level systems for upward — compatible small business systems. One is the intelligent terminal, such as those made by Datapoint and Four Phase. These are programmable and both hardware and software compatible with larger systems made by the same manufacturers. The other type of system is currently represented only by Wang 2200 and Hewlett-Packard 9830. These are "calculator/computers," which are small computers with advanced calculator-like arithmetic capabilities and a firm ware-implemented BASIC operating system. They cost in the neighborhood of $7,000 to $8,000 complete with memory, dual cassette drives, display, keyboard and printer, and can be expanded into medium-sized minicomputer configurations. The "entry-level" price for both of these systems enables them to capture an even smaller business (which will also require less speed and power) than those that can afford a System/32. Some of the smaller small business systems can also enter at a lower price level than can be reached by System/32 — the NCR 8200, for example — as can some of the programmable accounting machines like the Burroughs L series and NCR 299.

Major competitors of comparable price range and performance include the Burroughs B700 and B1710 and the NCR 8200. Specifications and sample prices for these are presented in Table 2. IBM's System/32 will prove formidable competition against comparable systems, not only because of the sheer size of IBM and their excellent reputation for software and service, but also because of the obvious care taken to study each of the industries covered by the Industry Application Packages. IBM representatives state that the system is quickly adopted by previously untrained personnel after a quick training course. Extensive and easy-to-use documentation has been prepared for each application area, as well as for the system as a whole.

IBM expects to sell more System/32s than they have System/3s. System/3 has been IBM's most popular system to date. Although System/32 is now fairly restricted as to speed (40 microsecond Add time) and expandability, IBM undoubtedly has planned the gradual unfolding of more capabilities and higher performance — the memory cycle time of 600 nanoseconds, for example, is quite fast.

CONFIGURATION GUIDE

The basic System/32 configuration consists of the CPU with 16K bytes of MOSFET memory; 600-nanosecond

Table 2. Comparison of IBM System/32 with Competitors

Characteristics	IBM System/32	Burroughs B 700	Burroughs B 1712	NCR 8200
Central Processor				
Microprogrammed	Yes	Yes	Yes	Yes
Memory				
Type	MOSFET	Core	MOS	–
Capacity (bytes)				
Min	16K	32K	16K	32K
Max	32K	48K	40K	48K
Cycle Time (nsec)	600	1,000	3,000/3 bytes	–
Disc Type				
Capacity (M bytes)	5/9.1	4.6/9.2	2.3/4.6/9.2(1)	4.9/9.8
Access Time avg (msec)	80.1/82.6	80	90	42.5
Char Printers	40/80	–	–	–
Speed (cps)				
Line Printer (132 cols)				
Speed (lpm)	50/100/155	90/180/400	90/300	125/300
Char Set	48/64	16/64/96	64/96	64/96
Price of a Configuration (with processor, 1 console, 32K-byte memory; 90-125 lpm printers, 4.6- to 5.0-byte disc)				
Purchase ($)	41,600	33,900	64,155	39,750
Monthly Rental ($)	1,082	858	1,735	1,285

(1) Also supports disc pack drives.

cycle time; disc storage; a read/write diskette unit; and an operator's console with display screen, keyboard, and printer. All system units are housed in the desk-sized 5320 unit.

The system units are all housed in the mainframe, and upgrades in printer speed or disc capacity are treated as changes in the system model number rather than the attachment of an alternative peripheral device. The basic 5-million byte disc can be upgraded to 9 million bytes, and the basic 40-character-per-second printer can be upgraded to 80 characters-per-second or to 50, 100, 155, lines per minute. The 10 system model numbers reflect the possible combinations of disc and printer performance as outlined in Table 3. All models can be upgraded in the field.

All models can increase memory capacity to 24K or 32K bytes, and can add either a Synchronous Data Link Control (SDLC) or a Binary Synchronous Communications Adapter (BSCA), with supporting options for either integrated modems or attachment to external modems. Switched network backup with or without auto answer features are also provided.

COMPATIBILITY

The System/32 is fairly compatible with the IBM System/3 at the RPG II source language level. Programs developed for System/32 can be recompiled and run on any System/3 model, provided the necessary changes are made to accommodate the differences in I/O devices. IBM has anticipated that users will want to move up from System/32 to System/3, and has documented the actual changes that need to be made to accommodate the differences in peripheral handling.

System/32 can attach either an 6301 SDLC control or a BSC adapter, and thus can be compatible with a wide variety of other IBM communication equipment. The SDLC control allows the system to communicate with System/370 Models 115, 125, 135, 145, 155H, 158, 158MP, 165H, 168, and 168MP via a 3704 or 3705 communications controller, operating under DOS/VS, OS/VS1, or OS/VS2 and NCP. The 2704 BSC Adapter allows the System/32 to communicate with the following systems:

- Another System/32 with a 2074,
- A System/3 with a 2074 or 2084,
- A System/360 equipped with a 2074,
- A 3741 Model 2 or 4 Data Entry Terminal,
- A System/7 equipped with a 2074, and
- A System/360 or /370 running under OS (BTAM or TCAM), DOS (BTAM), OS/VS1 (BTAM, TCAM, or VTAM), OS/VS2 (BTAM, TCAM, or VTAM), or DOS/VS (BTAM, TCAM, or VTAM), any of which are equipped with an Integrated Adapter, a 2701 Data Adapter, or a 3704/3705 Communications Controller with NCP or PEP.

MAINFRAME

The System/32 processor is 8-bit byte-oriented; it is microcoded and uses EBCDIC internal coding. I/O functions can be overlapped on all devices except the diskette. Memory consists of Metal Oxide Semiconductor Field Effect Transistor (MOSFET) modules with a 600 nanosecond cycle time.

The operator's console has a standard typewriter keyboard in addition to a 10-key numeric cluster and function keys for up to 24 commands. The visual display

Table 3. Differences Among IBM System/32 Submodels

Model Number	Disc Storage Capacity, M bytes	Printing Speed
A12	5.05	40 cps
A22	5.05	80 cps
B12	5.05	50 lpm
B22	5.05	100 lpm
B32	5.05	155 lpm
A13	9.17	40 cps
A23	9.17	80 cps
B13	9.17	50 lpm
B23	9.17	100 lpm
B33	9.17	155 lpm

screen uses a 64-character set and displays six lines with 40 characters per line. It is used for operator guidance, file inquiry, or other functions under program control.

Discs are available in two sizes. One stores 5M bytes and the other 9.1M. Access time ranges from 13 to 180 milliseconds (70 msec average) on the 5M-byte unit and from 14.2 to 167 (72.5 nsec average) on the 9.1M-byte drive; transfer rate is 889K bytes per second. Both are fixed discs with moving heads, recorded in 256-byte sectors.

The diskette is the same as that used with the 3741 data entry station. It can store variable-length physical records of one to 128 characters, allowing a single diskette to hold 1,898 physical records (242,944 bytes). An extended format feature can store up to 303K bytes per diskette by storing 512 byte sectors.

The console printer is a serial bidirectional 4 by 7 matrix printer available in two models that operate at 40 or 80 characters per second. Both serial and live printers handle up to six-part forms. Line printers print 132-column lines at 50, 100, or 155 lines per minute using a 48- or 64-character ASCII or EBCDIC set. Spacing is 10 characters per inch, six lines per inch. Form widths can range from 3.5 to 14.875 inches.

DATA COMMUNICATIONS

System/32 communications options allow SDLC or BSC communications over common carrier switched or nonswitched networks, or private networks at up to 7,200 baud, with or without Auto Answer options. The following modules are currently available:

6301 SDLC. In half-duplex mode; other SDLC units at transmission speeds up to 4,800-baud on the same data link must use the same clocking source, the same transmission code and the same data rate as System/32.

2074 BSC. Half-duplex mode, up to 7,200 baud; operates on a point-to-point line or as a tributary station on a multipoint line; because no software support is provided to operate as a control station on a multipoint line, other stations at each drop point of a data link must use same clocking source, data rate and transmission coding.

3701 EIA Interface. RS232C-compatible for attachment of external modem; requires 6301 or 2074 adapter; may require a 4703 Internal Clock if the external modem does not have one; cannot be used with 5500, 5501, 5600, 5602, or 5610 internal/external modems.

Integrated Modems. 5 models: 5500, 1,200 baud, nonswitched; 5501, 1,200 baud, switched, Auto Answer; 5600, 2,400 baud, nonswitched point-to-point; 5602, 2,400 baud, nonswitched multipoint tributary; 5610, 2,400 baud, switched, Auto Answer.

7951 Switched Network Backup. Used when 5600 or 5602 is used on nonswitched line; cannot be used with 6301 or 7952; attached to CBS-type common carrier.

7952 Switched Network Backup with Auto Answer. Like 7951, but with Auto Answer.

SOFTWARE

System/32 operates under the control of a System Control Program (SCP) that accepts simple statements in the Operation Control Language (OCL), and "Command" statements, which are essentially calls to subroutines. An RPG II compiler allows application programming in a high-level language. Important utilities include Sort, Data File Entry and Source Data Entry Programs.

The Industry Application Packages (IAPs) include programs for the construction, medical, membership, paper and food application areas. The programs for the construction, medical and membership markets are "tailored" from "maximum" models; that is, unneeded elements are deleted. Program packages for wholesale paper and food are handled more like the Application Customizer Service for the System/3 — the customer fills in parameters on forms, and the system is generated based on these parameters. The System/3 application customizer service, however, is not available to System/32 users.

Operating Systems

The System Control Program coordinates system functions with application programs, and it performs many routine tasks. Typical tasks include copying data from one diskette to another, maintaining operator communication via displayed messages, creating back-up copies, reorganizing the disc as needed to save space, and I/O support.

The Data File Utility (DFU) allows creation and editing disc files, while Source Data Utility (SDU) helps enter procedures and statements into the library. SDU can also interactively indicate errors in RPG II statements for on-line debugging.

The Operator Control Language (OCL). A special purpose operator interface uses a high level operator communication language that consists mainly of simple statements and calls or "Command Statements" to subroutines.

Report Program Generator II (RPG II). RPG II, a language also common to all System/3 models, is a programming language oriented towards generating reports. The language is output-oriented, because the primary concern is delivery of clear reports based on file or input data. RPG II uses preprinted specification sheets that permit the programmer to specify the form of the input data; the operation to be performed on the data; and the output format, including line layout, page and paragraph headings, and page numbering. It simplifies the programming task and enhances the novice's programming capability.

Some additional features are available for RPG II:

- RPG telecommunications feature — enables the system to transmit and receive synchronous data over communications lines; available in both card and disc versions.
- RPG II Auto Report feature — simplifies programming in RPG II by reducing much of the preparation and coding normally required to prepare users' applications programs; available in disc-based version only.

Industrial Application Programs (IAPs). IAP packages are engineered to fit 80 to 85 percent of a user's needs, although many users will find a higher percentage of "fit." The remaining percentage of a user's requirements can be obtained from IBM on a customized basis, from an outside vendor if the user prefers, or through his own in-house programming efforts. There is no need to maintain an in-house staff, however, because IBM can supply a complete turnkey system.

IAP packages include the following facilities:

- Construction Management Accounting System (CMAS) — includes Job Costing Accounts Payable, Payroll and General Ledger; assumes multi-company organization.
- Membership and Mailing List System — includes ability to create and maintain interrelated data bases for Membership Accounting Publications, Accounting, and Event Participation Accounting; provides automatic multiple file maintenance, with a single entry for updating multiple files.
- Hospital Financial Management System — includes Patient Billing, Accounts Receivable, Payroll, General Ledger/Accounts Payable, facility for summary bills on demand and a wide variety of daily reports.
- Profit and Asset Management System for Paper Merchants and Office Products Distributors — includes Billing, Accounts Receivable, Sales Analysis; a second version includes all of the above plus Inventory Control.

In general, a customer incorporates only the parts of the system needed for an application. This is especially true of the Membership Package, which includes software that can be adapted to a wide variety of uses.

PRICE DATA

A new Term Availability Plan (TAP) is available in addition to a monthly availability charge (MAC) 30-day lease. The system can also be purchased. TAP is a 3-year lease plan that provides a 5 percent reduction over MAC rates. For the first year, the rate cannot be raised; it can be raised by 5 percent in the second and third years. The basic system price includes CPU with 16K bytes of memory, operator's console, and the various printer/disc combinations as shown below.

PRICE DATA

PRINTER	System/32 Lease Rates, $ Disc Size				Purchase Price/ Monthly Maintenance, $ Disc Size	
	5M Bytes		9.1M Bytes		5M Bytes	9.1M Bytes
	MAC	TAP	MAC	TAP		
40 cps	809	770	898	855	33,100/165	36,100/175
80 cps	851	810	940	895	33,300/170	36,300/180
50 lpm	914	870	1,003	955	37,500/185	40,500/195
100 lpm	982	935	1,071	1,020	37,600/195	40,600/205
155 lpm	1,050	1,000	1,139	1,085	37,800/205	40,800/215

OPTIONS	MAC $	TAP $	Purchase Price $	Monthly Maintenance $
8K Memory Module	50	48	2,000	2.50
Bisync	95	90	3,600	10.00
Communications	116	110	4,400	15.00
SDLC				

PRICE DATA (Contd.)

3740 Data Entry Station	MAC $	TAP $	Purchase Price $	Monthly Maintenance $
3741 Model 1	168	–	6,000	42
3741 Model 2	206	–	7,250	54
3741 Model 3	268	–	8,600	63.50
3741 Model 4	306	–	9,850	70

SOFTWARE	Initial Charge $	Monthly License Charge $
Construction	470-2,330	20-100
Hospitals	370-2,000	18-98
Wholesale Food	2,975	140
Memberships	1,485	62
Wholesale Paper	2,500-2,975	120-140
RPG-II	NC	25
Utilities	NC	15

HEADQUARTERS

IBM Corporation
General Systems Division
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IBM CORP.

System/32 Report Update

The General Systems Division (GSD) of IBM has announced enhancements for its front-running small business computer, the System/32. The enhancements are not major; however, they extend the capabilities of the System/32 in the areas of disc storage and I/O offerings. Disc storage has been increased to 13.7MB from the current maximum of 9.1MB or 5.0MB. Also, the System/32 now supports 80- or 96-column punched-card input and output.

To round off the announcement, two new Industry Application Packages (IAP) have been introduced. One is for the lumber and building material trades, and one provides System/32 support for the new IBM 5230 Data Collection System. These packages are the most recent additions to the ever-growing number of application-oriented packages offered by IBM for the small business user.

FIVE NEW SUBMODELS

Five new submodels of the System/32 have been introduced to accommodate the 13.7MB disc. The new models and their respective print speeds and memory sizes are as follows:

- Model A14 — 40-cps printer, 13.7MB disc storage capacity, 16K bytes of main memory.
- Model A24 — 80-cps printer, 13.7MB disc storage capacity, 16K bytes of main memory.
- Model B14 — 50-lpm printer, 13.7MB disc storage capacity, 16K bytes of main memory.
- Model B24 — 100-lpm printer, 13.7MB disc storage capacity, 16K bytes of main memory.
- Model B34 — 155-lpm printer, 13.7MB disc storage capacity, 16K bytes of main memory.

Specifications for the new 13.7MB disc and the 5.0MB and 9.1MB discs are listed in Table 1.

PUNCHED—CARD INPUT/OUTPUT

The 80- or 96-column punched-card capability for the System/32 has been introduced primarily to accommodate System/32 users who wish to employ the new IBM 5230 Data Collection System (see report 292.4239.200 in your service for a full analysis of the 5230). The data recorder attachment feature (3200) permits the attachment of either a 129 Model 2 Card Data Reader (80-column) or a 5496 Model 1 Data Recorder (96-column). The 129 Model 2 reads up to 50 cards per minute and punches 12 to 50 cards per minute. The 129 Model 2 must be equipped with the 3741/5320 Attachment Feature (8201). The 5496 Model 1 reads, punches, or prints up to 21 cards per minute. The 5496 must be equipped with the 2772/3741/5320 Attachment Feature (7850).

Neither the 129 Data Recorder nor the 5496 Data Recorder allows reading and punching of the same card at a single pass. Also, neither the 129 nor the 5496 Data Recorders can operate simultaneously with the diskette, SDLC, or bi-sync communications.

A compare function maintains data integrity during the transfer of data between the data recorder and the System/32.

Programming support for any of the System/32 models using a data recorder will be in the form of the standard System/32 Systems Control Programming (SCP). Management of the SCP for the Data Recorder Attachment will be handled by a subroutine called from an RPGII program by using "SPECIAL" device support.

HEADQUARTERS

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Table 1. System/32 Disc Specifications

Description	5.0MB	9.1MB	13.7MB
Bytes/Sector	256	256	256
Sectors/Track	60	60	60
Tracks/Cylinder	2	2	3
Bytes/Cylinder	30,720	30,720	46,080
No. of Cylinders	164.5	298.5	299
Access Time (ms)			
Minimum	13.0	14.2	14.2
Average	70.0	72.5	72.5
Maximum	180.0	166.9	166.9
Average Latency Time (ms)	10.1	10.1	10.1

System/32 card capability will be available in November 1976.

TWO NEW IAPs

The new Lumber and Building Material Dealers Management Accounting System provides billing, accounts receivable, sales analysis, and inventory control for retail and wholesale lumber and building material businesses. This package, which is available immediately, features such capabilities as an automated estimate preparation procedure; lien expiration notification; pricing by different units of measure such as board foot, square foot, and lineal foot; and a new inventory control technique that provides a stock status review which is selectable by item, and a monthly stock status report.

Secondly, IBM 5230 Data Collection System Support Industry Application Package for the System/32 has been announced. This package, which will be available in June, is meant to be used in conjunction with the Manufacturing Management Accounting System (MMAS). The Data Collection System Support package presents data collected from the 5230 System to the MMAS application program running on the System/32, and produces input data that can be used for the inventory, payroll, production status, and costing modules of MMAS.

PRICE DATA

Description	MAC (incl maint) $	TAPMC (incl maint) $	Purchase Price (excl maint) $	Monthly Maint $
5320 System Unit				
Model A12	840	800	34,410	165
Model A13	932	888	37,530	175
Model A14	990	943	39,530	185
Model A22	883	841	34,620	170
Model A23	975	929	37,740	180
Model A24	1,033	984	39,740	190
Model B12	949	904	38,980	185
Model B13	1,042	992	42,100	195
Model B14	1,100	1,047	44,100	205
Model B22	1,021	972	39,080	195
Model B23	1,113	1,060	42,200	205
Model B24	1,171	1,115	44,200	215
Model B32	1,092	1,040	39,290	205
Model B33	1,184	1,128	42,410	215
Model B34	1,242	1,183	44,410	225

UPGRADE PURCHASE PRICES

FROM	TO A12 $	A13 $	A14 $	A22 $	A23 $	A24 $	B12 $	B13 $
A12		3,120	5,620	310	3,430	5,930	9,260	12,380
A13			2,500		310	2,810		9,260
A14						310		
A22					3,120	5,620	9,050	12,170
A23						2,500		9,050
A24								
B12								3,120

FROM	TO B14 $	B22 $	B23 $	B24 $	B32 $	B33 $	B34 $
A12	14,880	9,365	12,485	14,985	9,575	12,695	15,195
A13	11,760		9,365	11,365		9,575	12,075
A14	9,260			9,365			9,575
A22	14,670	9,155	12,275	14,775	9,365	12,485	14,985
A23	11,550		9,155	11,655		9,365	11,865
A24	9,050			9,155			9,365
B12	5,620	210	3,330	5,830	420	3,540	6,040
B13	2,500		210	2,710		420	2,920
B14				210			420
B22			3,120	5,620	420	3,540	6,040
B23				2,500		420	2,920
B24							420
B32						3,120	5,620
B33							2,500

FEATURES			
Data Recorder Attachment (3200)	68	65	2,525	6
Additional 8K bytes of main memory (1005)	51	49	2,075	2.50

IAPs	Initial Charge $	Monthly License Charge $
Lumber and Building Material Dealers Management Acct. System	3,120	147
IBM 5230 Data Collection System Support for System/32	500	26

IBM CORP.

System/32 Recent Announcements

SYSTEM/32 BROADENS ITS USER BASE

IBM has been keeping the General Systems Division (GSD) staff busy making enhancements and changes to its System/32. Already a small business computer with a surprisingly wide range of appeal and a wide spectrum of users, the System/32 is now able to target an even broader market. How has GSD managed its newest coup? Basically it moved the System/32 into two areas in which it had never competed — the word processing/data processing market and the minimal configuration (low-end) small business computer market.

WORD PROCESSING OPTION

The fully automated office of the future is becoming more of a present-day reality as data processing manufacturers begin making a commitment to the needs of the word processing market. Following the lead of Digital Equipment Corporation with its DS 310W data processing/word processing system, IBM has announced a word processing option to the System/32. Designed to accept input from either magnetic cards (recorded on IBM Mag Card Selectrics®)* or diskettes created on the IBM 3741 or 3742 Data Entry Station, the IBM Word Processor/32 provides the following capabilities:

- Sharing of system time data and between word processing and data processing tasks.
- Document and letter generation from stored and original data.
- Editing via the mag card typewriter or batch editing on the 3741 or 3742.
- Creation and maintenance of mass mailing lists.
- Information control sheets that are printed at the end of each task listing date, operator, author, department, and job, including year-to-date summary.

The Word Processor/32 requires a minimum System/32 configuration with 16K bytes of main memory, 5.0MB of disc, and a 50-lpm printer; System/32 Models B12, B13, B14, B22, B23, B24, B32, B33, and B34 meet these requirements. Word Processor/32 executes under System/32's System Control Program (SCP) Version 5 with word processing feature 6002. This feature provides the following:

- Printing support for super and subscript printing.
- User definition (through Operator Control Language (OCL) statements selected at job initiation time) of the keyboard's character set and its character arrangement.
- Application program request of data transfer between the System/32 and the 5321 Mag Card Unit (essentially, via the new 5321 unit any IBM mag card typewriters can be used as data entry stations to the System/32). The 5321 Mag Card Unit reads and records information using IBM Office Products Division (OPD) 50-track magnetic cards. Maximum reading rate is 20 seconds/card and maximum recording rate is 30 seconds/card. The input hopper holds up to 50 cards and the output stacker holds a maximum of 60 cards. The unit is cabled to a System/32 (#4900 attachment feature required).
- Additional data management support for the System/32 disc. It supports the storing of variable-length text data and the reuse of file space without reorganization. This is accomplished through the use of two files: an indexed sequential file that contains a table of available space and a linked direct access file that contains user data.
- A set of utilities for initializing and reorganizing user data stored on diskette.

*Selectric® is a Trademark of the IBM Corp.

New Models

The new low-end System/32 models are designed as marketing devices for lowering the entry-level price of the system and attracting new users to the IBM fold. In the final analysis, however, IBM has not lowered its prices significantly (for example, the new A01 has a purchase price of $33,560 compared with a purchase price of $34,410 for the older A12), and it is offering some systems packaged with a disc unit that will probably prove too small even for the smallest of applications.

New among the System/32 offerings are the 3.2MB disc and the 40-cps unidirectional printer. The new models are configured as follows:

	Printer	Disc (MB)	Main Memory (KB)
A01	40 cps uni	3.2	16
A02	40 cps uni	5.0	16
A03	40 cps uni	9.1	16
A04	40 cps uni	13.7	16
A11	40 cps bidi	3.2	16
A21	80 cps bidi	3.2	16
B11	50 lpm	3.2	16
B21	100 lpm	3.2	16
B31	155 lpm	3.2	16

PRICE DATA

IBM System/32

Model	MAC $ (Includes Maint.)	TAPMC $ (Includes Maint.)	TAPMC Upper Limit 2nd Yr $ (Includes Maint.)	TAPMC Upper Limit 3rd Yr $ (Includes Maint.)	Purchase Price $ (Maint. not Included)	Monthly Maint. $
A01*	714	680	714	748	33,560	160
A02*	788	750	788	825	34,160	160
A03*	880	838	880	922	37,280	170
A04*	938	893	938	982	39,280	180
A11*	766	730	766	803	33,810	165
A12	840	800	840	880	34,410	165
A13	932	888	932	977	37,530	175
A14	990	943	990	1,037	39,530	185
A21*	809	771	809	848	34,020	170
A22	883	841	883	925	34,620	170
A23	975	929	975	1,022	37,740	180
A24	1,033	984	1,033	1,082	39,740	190
B11*	875	834	875	917	38,380	185
B12	949	904	949	994	38,980	185
B13	1,042	992	1,042	1,091	42,100	195
B14	1,100	1,047	1,100	1,152	44,100	205
B21*	947	902	947	992	38,480	195
B22	1,021	972	1,021	1,069	39,080	195
B23	1,113	1,060	1,113	1,166	42,200	205
B24	1,171	1,115	1,171	1,227	44,200	215
B31*	1,018	970	1,018	1,067	38,690	205
B32	1,092	1,040	1,092	1,144	39,290	205
B33	1,184	1,128	1,184	1,241	42,410	215
B34	1,242	1,183	1,242	1,301	44,410	225

5320 MODEL UPGRADE PURCHASE PRICES

FROM	$ TO A02	A03	A04	A11	A12	A13	A14	A21	A22	A23	A24	B11
A01	600	3,720	6,220	600	1,200	4,320	6,820	910	1,510	4,630	7,130	9,860
A02		3,120	5,620		600	3,720	6,220		910	4,030	6,530	
A03			2,500			600	3,100			910	3,410	
A04							600				910	
A11					600	3,720	6,220	310	910	4,030	6,530	9,260
A12						3,120	5,620		310	3,430	5,930	
A13							2,500			310	2,810	
A14											310	
A21									600	3,720	6,220	9,050
A22										3,120	5,620	
A23											2,500	

FROM	$ TO B12	B13	B14	B21	B22	B23	B24	B31	B32	B33	B34
A01	10,460	13,580	16,080	10,070	10,565	13,685	16,185	9,575	10,775	13,895	16,395
A02	9,860	12,980	15,480		9,965	13,085	15,585		10,175	13,295	15,795
A03		9,860	12,360			9,965	12,765			10,175	12,675
A04			9,860				9,965				10,175
A11	9,860	12,980	15,480	9,365	9,965	13,085	15,585	9,575	10,175	13,295	15,795
A12	9,260	12,380	14,880		9,365	12,485	14,985		9,575	12,695	15,195
A13		9,260	11,760			9,365	11,865			9,575	12,075
A14			9,260				9,365				9,575
A21	9,650	12,770	15,270	9,155	9,755	12,875	15,375	9,365	9,965	13,085	15,585
A22	9,050	12,170	14,670		9,155	12,275	14,775		9,365	12,485	14,985
A23		9,050	11,550			9,155	11,655			9,365	11,865
A24			9,050				9,155				9,365
B11	600	3,270	6,220	210	810	3,930	6,430	420	1,020	4,140	6,640
B12		3,120	5,620		210	3,330	5,830		420	3,540	6,040
B13			2,500			210	2,710			420	2,920
B14							210				420
B21					600	3,720	6,220	420	1,020	4,140	6,640
B22						3,120	5,620		420	3,540	6,040
B23							2,500			420	2,920
B24											420
B31									600	3,720	6,220
B32										3,120	5,620
B33											2,500

PRICE DATA (Contd.)

Word Processing Options		MAC (Maint. not Included) $	ETPM (Maint. not Included) $	Purchase Price (Maint. not Included) $	Monthly Maint. $
5321	Mag Card Unit	255	217	10,200	55

*Indicates new System/32 Models

IBM CORP.

System/370 Models 115-0 and 115-2

SYSTEM/370 FAMILY ADDS ENTRY-LEVEL MODELS

The newest announcements from IBM are two new entry-level models for the System/370 family. The 115-0 and the 115-2, the two new models, were first released in Europe, the Middle East, and Africa in the middle of October by IBM World Trade, and shortly thereafter, on November 11, 1975, in the United States. The new units were developed at IBM's R&D center in West Germany and will be manufactured in Poughkeepsie, New York and Italy.

Model 115-0. The Model 115-0 is an enhanced version of the original Model 115. Besides the new name, IBM has added the following capabilities:

- The Model 115-0, and 115-2 can now be configured as cardless systems. The 115 will be able to be installed without a card reader or card punch if a diskette is substituted. Cardless configurations will be available in September of 1976.
- Field conversion facilities will be available for converting installed 115-0 systems to 115-2 systems in February 1976. The 115-2 is program compatible with the 115-0. No program changes will be required if I/O configuration does not change.
- As part of DOS/VS Release 32, a new optional Fast Channel Control Word (CCW) Translate Facility has been introduced for the 115-0 and the 115-2. It purports to improve I/O throughput by up to 11 percent; the facility is available immediately. Also available with DOS/VS Release 32 is DOS/VS Installment Enhancement Release (IER), which should reduce the amount of time needed to get the 115 (and 125) up and running under DOS/VS. DOS/VS IER is available immediately.
- The DOS/VS Entry Time Sharing System (ETSS), a field-developed program supporting from four to eight concurrent active terminals, offers expanded interactive capabilities for on-line applications. It supports a wide variety of languages (BASIC, COBOL, FORTRAN IV, PL/1, RPGII and Assembler); ETSS is available for the 115-0 and 115-2 immediately.

Model 115-2. The Model 115-2, which will be delivered in February 1976, features a new processor that is a look-alike for the old Model 125's processor. Its enhanced performance capabilities are designed to attract new entry-level users into the System/370 family.

- Main memory capacity for the 115-2 can now be expanded to a new maximum of 256K bytes. Maximum memory capacity for the 115-0 is 192K bytes.
- The instruction execution rate for the 115-2 has been increased 55 to 75 percent over the existing instruction rates for the Model 115.
- An improved multiplexor channel has been added that transfers data at the rate of 25K bytes per second in the byte mode. The rate for the 115-0's multiplexor channel remains 19K bytes in the byte mode. Both the 115-0 and 115-2 transfer data at the rate of 29K bytes per second in the burst mode.
- The 115-2 can add four more 3340 Direct Access Storage Drives (DASD) for a maximum on-line capacity of 558 million bytes. The maximum number of drives for the 115-0 remains four spindles with 279 million bytes of storage.
- The Model 115-2 can now share its 3340 Model A2 disc subsystem with any other System/370 CPU (except a Model 115-0 or 125-0). This is a String Switch feature which allows the Model 115 to be used as backup for a larger System/370.

See Table 1 for specifications for Models 115-0 and 115-2.

WHY THE NEW MODELS?

Why the 115-0 and 115-2? To date, the existing Model 115 has not been an effective entry-level model for the System/370 family. It has failed as a drawing card for potential new IBM users and it is often overlooked or passed by when users moving from older or smaller IBM systems are looking for a migration path.

With the introduction of enhanced processing potential for the Model 115-0 and 115-2, IBM is assuming a new competitive posture and will be aggressively seeking out users with old IBM machines. It has designated the 115-0 and the 115-2 as migration systems for the users of the

HEADQUARTERS

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Table 1. IBM System/370 Models 115-0 and 115-2: Specifications

PROCESSOR	Model 115-0	Model 115-2
Main Memory (K bytes)	64-196	64-256
Increment Size (K bytes)	32	32
Read/Write Cycle Time (ns.)	480	480
Bytes Fetched per Cycle	2	2
Type of Storage	MOSFET	MOSFET
Service Processor (SVP)	Yes	Yes
Machine Instruction Processor (MIP)	Yes	No
Instruction Processing Unit (IPU)	No	Yes
I/O ARCHITECTURE		
Integrated Attachments Adapters (IOPs)	Yes	Yes
3340 Direct Access Storage Drive	Std.	Std. (dedicated IOP)
No. of 3340 DASDs	2-4 drives	2-8 drives
String Switch (#8150) Feature	No	Yes
2560 Multi-Function Card Machine	Opt.	Opt.
5425 Multi-Function Card Unit	Opt.	Opt.
5203 Printer	Opt.	Opt.
3203 Printer	Opt.	Opt.
3410 Mag. Tape Unit	Opt.	Opt.
3411 Mag. Tape Unit & Control	Opt.	Opt.
MULTIPLEXOR CHANNEL		
Maximum No. of Channels	32	32
Shared	8	8
Unshared	24	24
Burst Mode (bytes)	29,000/sec.	29,000/sec.
Bytes Mode (bytes)	19,000/sec.	25,000/sec.
Field Conversion Capabilities	To 115-2	–

System/360 Models 20, 22, 25, and 30 as well as the System/3 and the 1130 System. In addition, it has been reported that capability-wise the 115-2 can give the System/360 Model 40 a run for its money. Who benefits from the 115's added potential? Undoubtedly IBM, and along the way, hopefully, the user. There are reportedly 17,000 to 18,000 System/360 users still firmly attached to their systems, but they are finding that they often can't make use of state-of-the-art advances in terminals and other communications offerings. For a rental price approximately equal to that of a System/360 Model 30 or Model 40 with 64K bytes of memory, the user can have a Model 115-2 that is significantly faster and offers a growth path into the rest of the System/370 family.

The enhancements and the added processing capabilities that go along with the new names for the Model 115 mark the beginning of a concentrated effort at giving a new shape and definition to the lower end of the System/370 family. News of new models designated 118, 128, 138, and 148 has been rumored, which would beef up IBM's medium-scale range of general-purpose machines.

GREAT EXPECTATIONS

The time is ripe for an entry-level System/370 model with capabilities that will prove tempting to the user who is on the move upward. IBM's most serious challengers for the medium-scale entry-level systems — Univac and Honeywell — offer in their individual product lines what the System/370 family has been lacking up until now — an entry-level model for those users who will eventually want to move upward.

The Univac Series 90 Model 90/30 claims to have processing power that is double that of the 115 (before enhancements), as well as a price edge over the 115 that may be enough to convince any user straddling the line between a Univac system and an IBM system to lean toward Univac. In addition, the Model 90/30 offers emulation for the System/360 Model 20. While there are a large number of 360/20 users who will upgrade to the System/370, an emulation path offered by another company may be weighed with equal consideration.

Honeywell Series 60 Level 64 Model 20 offers a main memory and storage facilities equal to those offered by the Model 115. Unlike Univac, Honeywell offers no IBM compatibility. Until GCOS Level 64 Set 1 has proven its capabilities as an operating system, Series 60 Level 64's competitive threat to the Model 115 is only in the area of price. The Model 115-2, although it brings with it additional capabilities, also drives the System/370 entry-level price up approximately 20 percent higher than current 115 prices.

WHAT TO EXPECT FROM THE 115-0

Without upgrading to the 115-2, current Model 115 users can expect real benefits from the new announcement. A new release of the DOS/VS operating system brings along with it new performance capabilities. Also, a field-developed software package aimed at on-line and time-sharing applications is optionally available for the 115 user. And, most significantly, IBM now offers the 115-0 user field conversion facilities to 115-2 processor specifications.

Fast CCW Translate Facility. Under the auspices of the DOS/VS Release 32, an optional Fast Control Channel Word (CCW) Translate Facility preserves a translated chain of CCWs for reuse without repetitive translation. Laboratory measurements have shown that on the average, I/O programs able to avail themselves of the new feature save 11 percent of processor time. In a multiprogramming environment, however, the effectiveness of the Fast CCW Translate Facility will be dependent upon individual applications.

The Fast CCW Translate Facility is not available for use with the following programs: BTAM, VTAM, POWER/VS, and SORT/VS. Also, it cannot be used on self-modifying or non-contiguous channel programs.

Cardless Configurations. A DOS/VS release scheduled for September 1976 will allow 115-0 and 115-2 models to be configured without card readers. Any Model 115 with a 3540 Diskette Input/Output Unit will not re-

quire a card reader as part of the minimum configuration. This will allow control card images, CE diagnostics, and Program Temporary Fixes (PTFs) to be read from a 3540 diskette reader instead of a 3504 card reader. For cardless Model 115-0 or 115-2 configurations the requirements are:

- 3115-0 or 3115-2 Model F or F2 processor with 64K bytes of memory.
- 3340/A2 DASD; 70 or 140 million bytes of on-line storage on two drives.
- A line printer.
- An input device, which may continue to be the 3504 card reader or the 3540 diskette reader.
- If no card reader is included in the configuration, at least one 3741 or 3742 Data Entry Station on the same site must be equipped with the Record Insert Feature 6123 (for 3741) or 6125 (for 3742) to support program maintenance requirements. By eliminating card reader equipment from a configuration that relies on diskettes for all data input, an approximate cost reduction of 4 percent will be effected.

Other Software Enhancements. Very close in time, but not directly related to the 115-0 and 115-2 announcements, IBM also introduced two software enhancements that will be optionally available to 115 users. They include an installation enhancement release called DOS/VS IER and a telecommunications software package called Extended Telecommunications Modules (EXTM) Version 2.

DOS/VS Installation Enhancement Release (IER) will be available in December 1975. It is meant to reduce the amount of time needed to implement DOS/VS for the first time. One spokesman from IBM estimated that by using DOS/VS IER a DOS/VS system could be up and running in 2 to 3 hours rather than the average 11 hours. DOS/VS IER will permit a DOS/VS SYSGEN to be accomplished in one batch partition.

The Extended Telecommunication Module (EXTM) Version 2 has been called a "poor man's VTAM (Virtual Telecommunications Access Method)" by some spokesmen at IBM. EXTM Version 2 cuts down the VTAM overhead and allows small System/370 configurations to support a telecommunications network. It operates under DOS/VS with CICS/DOS/VS Version 1.0.1 on System/370 Model 115 through 158, and requires at least 160K bytes of real storage. EXTM Version 2 permits the 3790 Communications System and the 3606 and 3608 Financial Services Terminals to be used with the 115 and the 125. EXTM Version 2 operates in a Systems Network Architecture (SNA) environment.

Field Conversion Facilities. Beginning in April 1976, installed 115-0s will be able to be field upgraded to 115-2s. The processor unit upgrade and special features upgrade will be available in June 1976. (See Table 2 for purchase prices for 115-0 and 115-2 model upgrades.)

Table 2. Conversion Prices for the Model 115-0 and Model 115-2

	New Models (purchase prices)			
From	FE	G	GE	GF
F	$7,900	$15,800	$23,700	$36,900
FE		7,900	15,800	29,000
G			7,900	21,000
GE				13,200

	New Models (purchase prices)					
From	F2	FE2	G2	GE2	GF2	H2
F	$38,100	$46,000	$53,900	$61,800	$69,700	$85,500
FE		38,100	46,000	53,900	61,800	77,600
G			38,100	46,000	53,900	69,700
GE				38,100	46,000	61,800
GF					32,800	48,600
F2		7,900	15,800	23,700	31,600	47,400
FE2			7,900	15,800	23,700	39,500
G2				7,900	15,800	31,600
GE2					7,900	23,700
GF2						15,800

DESIGN CHANGES FOR THE 115-2

IBM has introduced the 115-2 to close a price and performance gap that existed in the System/370 line. Pricewise, the 115-2 is 10 percent less than the Model 125, while delivering a performance that is tantamount to that of the 125. What IBM has done is to introduce a system that fits comfortably in the performance gap between the 115-0 and the medium-size processors, with a price tag low enough to attract comparison shoppers.

While IBM calls the 115-2 processor "new," it is, as we have already pointed out, strikingly similar to the old 125 processor. Therefore, the entry-level user has the benefit of improvements in internal performance and expanded memory and storage capacities with the 115-2.

Increased Memory Sizes and Improved Internal Performance. The 3115-2 Processing Unit adds a storage Model H2 that provides 262,144 bytes of storage. The maximum storage size for the 3115-2 processor unit is 262,144 bytes, and the maximum storage available for the 3115-0 processing unit is 196,608 bytes (Model GF).

Main memory cycle time is 480 nanoseconds for two bytes. This is the same as the memory cycle time on the 115-0.

Internal performance (instruction execution rate) on the 115-2 has been improved 55 percent to 75 percent over that of the 115-0. A comparison between the instruction timings for the Model 115 and the Model 125 appears in the IBM System/370 Model 115 Report in your AUERBACH Service. In many instances, the 115's instructions are approximately 55 percent to 75 percent slower than the 125's. It follows that the 115-2 processor offers instruction rates that match those of the 125 processor.

IBM explains the faster instruction rates for the 115-2 by pointing to the architectural changes made to the 115-2 processor. The three satellite processors used in the Model 115, the Machine Instruction Processor (MIP), the Service Processor (SVP), and the Input/Output Processors (IOPs) have been expanded to four separate processors in the 115-2. The MIP in the 115 has been replaced by an Instruction Processing Unit (IPU) and an Input/Output Processor (IOP) that is dedicated to controlling the 3340 DASF. This arrangement allows for one processor dedicated to program instructions and one processor dedicated to disc control — as in the Model 125.

Improved Multiplexor Channel. An Extended Byte Multiplexor Channel for the 115-2 increases the byte mode transfer rate from 19K bytes per second to 25K bytes per second. Speeds for the burst mode remain at 29K bytes per second. This byte multiplexor channel is functionally equivalent to the byte multiplexor channel on the System/360 Models 22, 25, 30, and 40. It provides a maximum of eight control unit positions and 32 subchannels — eight shared and 24 unshared.

Expanded Storage Capacity. With the 115-2, the attachment of up to eight 3340 DASD spindles is standard. The maximum number of spindles available with the 115-0 is four, and the maximum number of spindles available with the 125 is eight. The maximum amount of storage available for the 115-2 is now 560 million bytes.

String Switch Feature. The 3115-2 can now share one 3340 Model A2 DASD string with any System/370 except a 3115-0 or 3125-0. While DOS/VS supports the DASD string switch feature, it does not support the device reverse/release channel commands for program controlled sharing of attached DASD spindles. IBM points out that it is the user's responsibility to resolve conflicting references to shared files, but it will provide aid in the form of an operation and programming considerations manual, which will be available prior to the delivery of the feature.

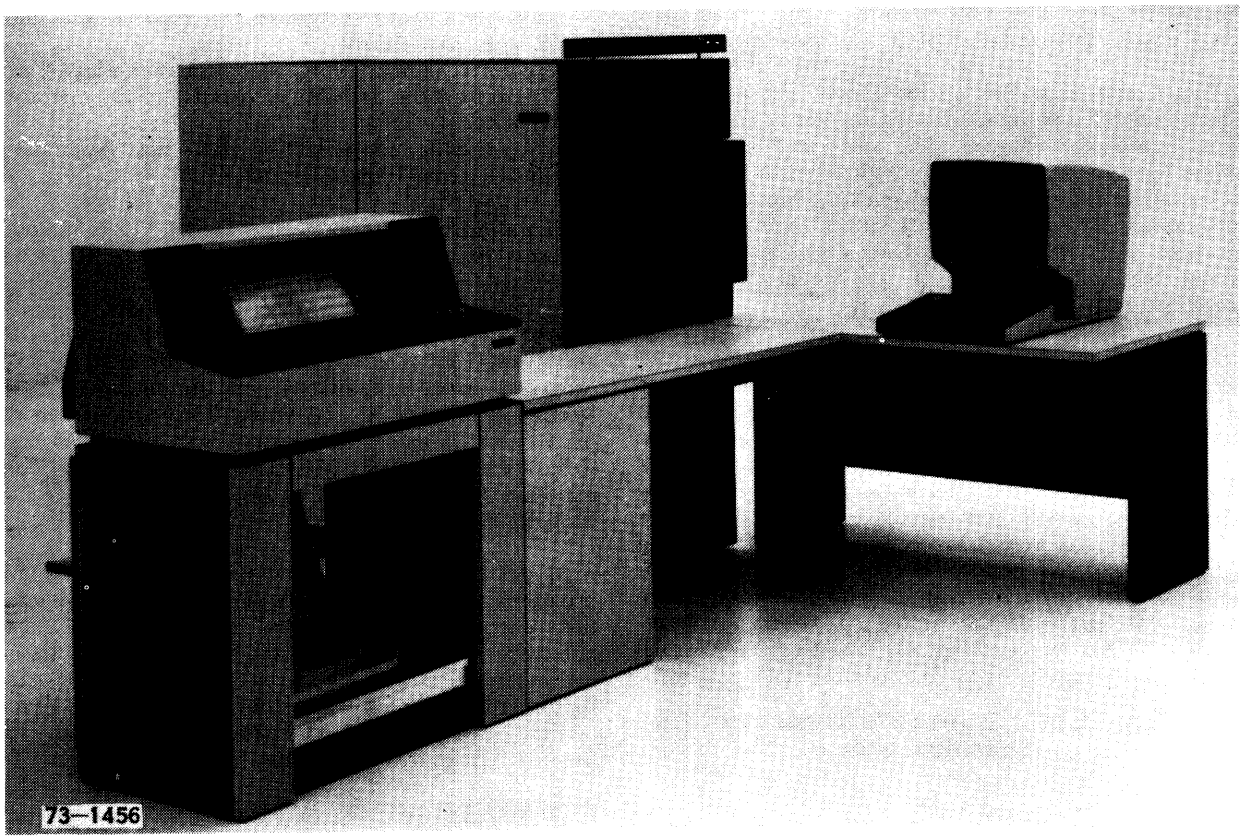
PRICE DATA

As of January 1, 1976, rental, maintenance, and service rates will increase by 4 to 5 percent for some IBM products. While some of the increases will affect products and services in the System/360 and System/370 families, the 115-0 and 115-2 prices that follow reflect the most current price data available from IBM.

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
3115	Central processor and working storage			
F	65,563 bytes	3235	122,150	294
FE	98,304 bytes	3460	130,050	299
G	131,072 bytes	3685	137,950	304
GE	163,840 bytes	3910	145,850	310
GF	196,608 bytes	4275	159,050	321
F2	65,563 bytes	4250	160,250	345
FE2	98,304 bytes	4475	168,150	350
G2	131,072 bytes	4700	176,050	355
GE2	163,840 bytes	4925	183,950	360
GF2	196,608 bytes	5150	191,850	365
H2*	262,144 bytes	5600	207,650	375

*Model H2 requires the special #3860 Expansion Base Feature.

IBM CORP.
System/370 Model 115



OVERVIEW

System/370 Model 115 is a small general-purpose computer marketed primarily for business applications. It is the entry-level model for IBM's System/370 family and is fully upward compatible with the other models of the series. The Model 115 is most often used as a standalone processing unit; however, it can also be used as a remote job entry workstation. Applications for the Model 115 include: on-line data entry, accounting and payroll functions, billing, and batch processing.

As one of the most recent additions to the System/370 product line (March 1973), the Model 115 was introduced to fill a gap in the System/370 product line. About the same time as the Model 115 announcement, IBM also announced the System/3 Model 15, the highest end of the System/3 line. The two announcements intimated a bridge (one without real conversion aids) between the high end of the System/3 and the low end of the System/370. However, the formation by IBM of a separate division to market System/3 and like products appears now to preclude any attempts to bridge the differences between the System/3 and System/370 lines.

The Model 115 offers many of the features available with the other members of the System/370 family. Especially notable is the DOS/VS operating system that is used by all but the largest models of the System/370 line. The Model 115 is architecturally very similar to the System/370 Model 125; like the 125, its standard features include an operator's console (with CRT) and a distributed architecture that allows for independent arithmetic and logic processing, I/O processing, and diagnostic and maintenance processing.

Each processing unit has its own Reloadable Control Storage (RCS), which houses the microprograms for its control. The processing units are designated as the

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Machine Instruction Processor (MIP), the Input/Output Processors (IOPs), and the Service Processor (SVP). MOSFET (Metal Oxide Semiconductor Field-Effect Transistor) technology is used for main memory and RCS. Model 115 also uses IBM 3340 Direct Access Storage Facility. The 3340 features a fixed-head disc, which eases implementation of the DOS/VS software.

Data communications on the Model 115 is handled via an integrated communications adapter or an optional byte multiplexor channel. The integrated attachment allows five synchronous lines or eight asynchronous lines to be attached; the byte multiplexor channel has 32 subchannels. Model 115 can use IBM's communications protocol, SDLC (Synchronous Data Link Control) but it is not required. See Table 1 for Model 115 system specifications.

IBM's recent purchase price cuts, amounting to 15 percent on the Model 115 CPU and 10 percent on some of its associated peripherals, have brought to light that the Model 115 user base is not up to IBM's expectations. The price cut move may be the bait with which IBM will lure new users into the fold, as well as the method by which the firm will maintain its established customer base. Because the Model 115 is an entry-level system, it will be a surprise if the price cuts encourage any users or potential users of the system to purchase rather than lease. Most users of the Model 115 are already established IBM users, and they see the 115 as an intermediate step before moving up to a medium-scale system.

Table 1. IBM System/370 Model 115: Specifications

Characteristics	Model 115
Central Processor	
Model No.	3115
Main Storage	
Min Capacity (bytes)	65,536
Max Capacity (bytes)	196,608
Increment Size (bytes)	32,768
Read/Write Cycle Time (nsec)	480
Bytes per Cycle	2
Type of Storage	MOSFET
I/O Architecture	
Integrated Attachments/ Adapters (IOPs)	
3340 Direct Access Storage Facility	Std
2560 Multi-Function Card Machine	Opt
5425 Multi-Function Card Unit	Opt
5203 Printer	Opt
3203 Printer	Opt
3410 Mag. Tape Unit	Opt
3411 Mag. Tape Unit & Control	Opt
Multiplexor Channel	Opt
Max No. of Channels	32
Shared	8
Unshared	24
Burst Mode (bytes)	29,000/sec
Bytes Mode (bytes)	19,000/sec

COMPATIBILITY

Three types of compatibility were established as design criteria for all models of System/370:

- Inherent object code and data structure compatibility with other System/370 models and most System/360 models.
- Featured compatibility, standard or optional, permitting emulation of other computers and operating systems.
- Plug-to-plug compatibility with most System/360 and System/370 peripherals.

As an entry-level system, the Model 115 is intended for users upgrading from System/360 Models 20, 22, and 25; System/3 Models 6, 10, and 12; and the 1130 (however, no compatibility bridges are offered). Compatibility features are however offered for the older IBM 1401/1440/1460 Data Processing Systems. Most DOS programs from System/360s can run under DOS/VS. System/360 Model 22 and Model 25 programs can run on Model 115 using the optional System/360 I/O compatibility and the IBM 2311-1 (disc storage drive) compatibility features; Model 115 can emulate System/360 Model 20.

Model 115 compatibility with System/3 is limited to programs written in RPG II and COBOL. IBM terms this "entry-level compatibility"; however, it should be noted that Model 115 offers the System/3 user little improvement in performance over existing Model 15 capabilities. In addition to these limitations, the Model 115 and the System/3 record and handle data differently and use different addressing schemes.

COMPETITIVE POSITION

In theory System/370 Model 115 competes with the upper end of the small business market: the Burroughs B 1700, the Univac Series 90 Model 90/30, the NCR Century series, and IBM's own System/3 Model 15. However, Model 115 users are almost exclusively previous IBM System/360 Model 20, 22, or 25 users. They usually upgrade from the System/360 to the Model 115 without even considering a competitive system, because conversion from System/360 Model 20, 22, or 25 is encouraged with complete conversion aids.

USER REACTIONS

All the users we spoke with had upgraded to the Model 115 from System/360 Models 22 or 25. Conversion from the System/360 to the System/370 Model 115 went smoothly in all cases; there were no problems, and there was no need to reprogram existing programs.

The Model 115 is being used for standard business applications, namely, payroll, accounts receivable, accounts payable, billing, and order entry. Some of the users are connecting on-line CRT terminals as well as

doing batch processing. Each user found the Model 115 capable of doing much more than expected.

Insurance. An insurance company is using the Model 115 for rating and writing insurance policies and billing. Presently three on-line CRTs are used for policy entry, and there are plans to add two more CRTs. Response time has been good, except toward the busy end of the day when response time drags out; the company thought it would be able to remedy this problem.

The company's Model 115 has a 96K memory; half of that capacity is used by the supervisor program and in the other half (48K) there are three partitions. The new 3340 disc drive has been trouble free. The only weak link in the Model 115 configuration is the 3203 printer, which has caused some downtime. The company found its old 1403 printer (used with the System/360 Model 25) more reliable.

When converting from the System/360 Model 25, the company also looked at the System/370 Model 125 but decided it was too big a processing resource for its purposes. The Model 115 slot in the market is not clearly defined; it is best selected for conversion from System/360s that are without a large processing volume.

Utility. A utility company converted from the System/360 Model 22 to the Model 115. It was the only company we spoke with that also considered competitive systems. The Burroughs B 1700, the NCR Century, and the Univac Series 90 Model 90/30 were considered. However, because of the ease of conversion, the System/370 Model 115 was chosen.

The company is using the 115 for utility billing, accounting functions, customer inquiry, and engineering planning. It recently added four on-line CRTs and is pleasantly surprised that the 115 can handle more work than it was expected to. The company is running bigger programs than anticipated and has done away with service bureau aid.

This company took the Model 115 at face value; it knew the 115 would be a bit slow and that it would need to be upgraded within 2 years. In spite of this the company is finding the Model 115 a capable and efficient machine.

Manufacturer. One manufacturing firm is using a 128K Model 115 for on-line order entry and batch processing. For order entry it is using 10 CRT terminals. Response time, even with the 10 terminals, has been good. The system operates 16 hours a day.

The firm finds the DOS/VS operating system quite efficient. Programming is done in BAL (Basic Assembler Language).

Mining. A mining company traded in its System/360 Model 25 for a Model 115 with 96K of memory. The system is being used for accounting functions, payroll, production work, and mine planning.

This company found the Model 115 little improvement over its System/360. It is interesting to note, however, that this is the only user we spoke with who was not using on-line CRTs. Only batch processing is being done. It is more common to expect slower response times when on-line CRT's are being used, but batch work is generally accepted to be IBM's Forté and the lack of addition thruput is unexpected. (See Instruction Timings following.)

The mining company is located in the northwestern part of the United States and service can be a difficult prospect. IBM, according to the spokesperson for the company, is delivering very good service.

CONFIGURATION GUIDE

IBM System/370 Model 115 uses the 3115 processing unit, which has a distributed processing architecture. The 3115 CPU contains the Machine Instruction Processor (MIP), the Service Processor (SVP) and the Input/Output Processors (IOPs). All of these units function independently and simultaneously. The MIP is what is normally called the arithmetic and logic unit; the SVP provides diagnostic and maintenance services; and the IOPs control all I/O operations. Each unit operates independently of the other units, and each has its own RCS.

RCS houses the microprograms that control the operation of the MIP, the SVP, and the IOPs. Like main memory, RCS is MOSFET (Metal oxide Semiconductor Field-Effect Transistor) technology; but RCS is separate from main memory. The microprogram for the MIP is 20K 22-bit words of control storage that may be expanded to 24K or 28K words.

IBM encourages the use of Model 115's integrated attachments/adapters for I/O processing. The 115 has one I/O channel dedicated to disc drive storage for the direct attachment of the 3340 Model A2 two-disc drive storage. Additional 3340s, Model B1 or B2, are attached to the 3340, for a maximum of four drives. Any other I/O equipment can be attached via optional integrated I/O attachments/adapters. The following list enumerates those devices:

- 3411 Magnetic Tape Units.
- 2560 Multi-Function Card Machine.
- 5425 Multi-Function Card Unit.
- 5203 Printer.
- 3203 Printer.
- 5213 Console Printer.

Model 115 must be configured with at least one card reader and one hard-copy output device, but no more than one card unit and one line printer can be used with the integrated attachments/adapters.

An optional byte multiplexor channel can be used instead of the integrated I/O attachments/adapters. The

channel has 32 subchannels (8 shared and 24 unshared) and a maximum data rate of 29K bytes per second in burst mode and 19K bytes per second in byte mode. Devices requiring higher sustained data transfer rates cannot be attached. The multiplexor channel and the integrated card I/O attachment require special features to be installed together.

Minimum Model 115 main memory size is 64K, and the maximum is 192K. The following is a list of available main storage models and their respective sizes.

- Model F: 65,536 bytes.
- Model FE: 98,304 bytes.
- Model G: 131,072 bytes.
- Model GE: 163,840 bytes.
- Model GR: 196,608 bytes.

Standard Model 115 features include a commercial instruction set, dynamic address translation (required for virtual storage; to address up to 16M bytes), channel indirect data addressing, program event recording, monitor call, interval timer, time-of-day clock, CPU timer and clock comparator, store and fetch protect, and byte-oriented alignment. Also included is the Display Operator Console (DOC), a CRT plus keyboard.

MAINFRAME

The distributed processing techniques of the Model 115 call for an architecture with integrated CPU, main memory, and I/O channels. All operate independently and simultaneously.

Central Processor

Like the larger System/370 models, the 115 uses virtual storage and operates under DOS/VS. RCS, separate from main storage, is used for three purposes on Model 115:

- It provides storage for microprograms that define native instruction sets and, optionally, repertoires of systems to be emulated (System/360 DOS and earlier IBM systems).
- It serves as control and working storage for the CPU, I/O channels, and integrated channel adapters.
- It provides storage for microdiagnostics used by IBM customer engineers to perform maintenance procedures.

A console file, which uses removable IBM diskettes, loads RCS microprograms into the system.

Data Structure

Table 2 shows the internal data structures used in all System/370 models. They are a superset of the System/360 data structure.

Data can be handled by CPUs in the following formats: byte (8 data bits), halfword (2 bytes), word (4 bytes), doubleword (8 bytes), quadword (16 bytes), and immediate operands. The latter is 1 byte contained in a portion of an instruction.

Table 2. IBM System/370 Model 115: Data Structure

Type of Information	Internal Representation
Alphanumeric characters (or zoned decimal digit)	1 byte, in EBCDIC code
Decimal digit (decimal operands are always fixed point in System/370 and 360)	4 bits, packed 2 (BCD) digits per byte
Fixed-point binary operand	1 word or 1 half-word, binary, 1-bit sign
Short floating-point operand	1 word; 24-bit fraction and 7-bit hexadecimal exponent
Long floating-point operand	2 words; 56-bit fraction and 7-bit hexadecimal exponent
Extended-precision floating-point operand	4 words; 112-bit fraction and 7-bit hexadecimal exponent
Decimal operand	1 to 16 bytes (1 to 31 digits plus sign)
Instructions	2, 4, or 6 bytes in appropriate format and code

To maintain maximum operating speed, operands must be aligned according to boundary rules; that is halfword and larger operands must begin at storage locations that are integral multiples of their length in bytes. The byte-oriented operand feature, however, allows main storage operands of nonprivileged instructions to be placed at any set of contiguous locations in storage. Programs will run that way, but degraded performance is the price paid for any possible increase in storage space utilization.

Byte manipulation fields can be 1 to 256 contiguous bytes in length. In addition, two special instructions for long moves and comparisons permit byte strings of up to 16 million contiguous bytes.

Decimal field limits are 1 to 16 contiguous bytes (31 packed digits plus sign).

Registers

Model 115 (like all the System/370 models) has 16 general-purpose registers. It also has 16 control registers and four floating-point registers. The general registers and the floating-point registers receive data, hold it,

Table 3. IBM System/370 Model 115: Selected Instruction Timings*

Mnemonic	Classification	Instruction	Time (μsec) Model 115	Model 125
LM	Load/store	Load Multiple	36.39(1)	37.66(1)
A	Fixed-point	Add (register)	14.03	8.69
CLR	Comparison	Compare Logical	10.40	3.86
NR	Logical	AND (register)	6.78	4.82
SRA	Shift	Shift Right Single	13.11 min(2) 28.05 max	14.95(2)
ADR	Floating-point	Add Normalized Long	62.33	65.9
AP	Decimal	Add Packed	148.82(3)	67.52(3)
MVC	Byte string	More contents	34.21(4)	27.04(4)
BCR	Brand (successful)	Brand or Condition	6.33	3.86
MR	Fixed-point mult	Multiply (register)	196.8(5)	118.3(5)
MER	Floating-point mult	Multiply (short)	31.19 (min) 143.87 (max)	191.7(6)
DR	Fixed-point divide	Divide (register)	226.6	241.2(7)
DER	Floating-point divide	Divide (short)	201.78 (min) 251.12 (max)	225.7

Notes:
* All timings assume no indexing is performed, no boundary realignment is required, best-case conditions.
(1) 10 registers involved
(2) Two 4-position shifts (8 bits)
(3) 8 bytes/operand, no sign change
(4) 10 bytes
(5) 14 1 bits and 0 bits in Multiplier
(6) 6 hex. digits in operand with most low-order 0 halfwords
(7) All halfwords in operand 1 are nonzero.

permit it to be operated on, and transfer it. The general registers are used for indexing and fixed-point and logic operations. The floating-point registers are used for floating-point arithmetic.

Control registers are used by the system control section (SVP) and are accessible only by specific instructions from the control program.

Instruction Set

The standard instruction repertoire for Model 115 is the System/370 Commercial Instruction Set, which is made up of 111 instructions. The System/370 takes its commercial instruction set from the System/360 standard instruction set and adds fourteen more instructions. Standard precision floating point is optional on Model 115.

Instructions are two, four, or six bytes long. Register-to-register (RR) instructions are two bytes; register-to-storage (RS), indexable storage (RX), and immediate operand instructions (SI) are four bytes; and storage-to-storage (SS) 2-address instructions are six bytes.

Instruction Timings

Table 3 lists selected instruction timings for Model 115 and Model 125. Calculations for the timings are data and system dependent.

Main Memory

Main storage on Model 115 uses MOSFET (Metal oxide Semiconductor Field-Effect Transistor) technology. Read/write cycle time is 480 nanoseconds per 2-byte access. Minimum memory size is 65,536 bytes, and maximum memory size is 196,608 bytes; increment size is 32,768 bytes. IBM storage models and their respective sizes are listed in the "CONFIGURATION GUIDE" section.

I/O Control

In a strictly technical sense, there are no I/O channels on Model 115. Input/Output processors (IOPs), which are controllers that transfer information between main storage and I/O devices, take the place of traditional channels. IOPs service I/O devices via specialized interfaces and integrated attachments/adapters. The only true channel on the Model 115 is the optional byte multiplexor channel, which uses a standard interface.

For programming purposes, the 115's mode of attaching I/O devices appears to the operating system as three I/O channels. The channels, addressed as 0, 1, and 2, are illustrated in Figure 1. This figure also illustrates the responsibilities of each channel.

Multiplexor Channel. The byte multiplexor channel supports a maximum of 32 subchannels (8 shared and 24 unshared), and it provides eight control positions. The byte multiplexor can operate in either of two modes:

- Byte-Interleaved mode — All devices share a common data path.
- Burst Mode — A single device monopolizes the data path.

When operating in the byte multiplexor mode (the channel's normal mode of operation), a large number of

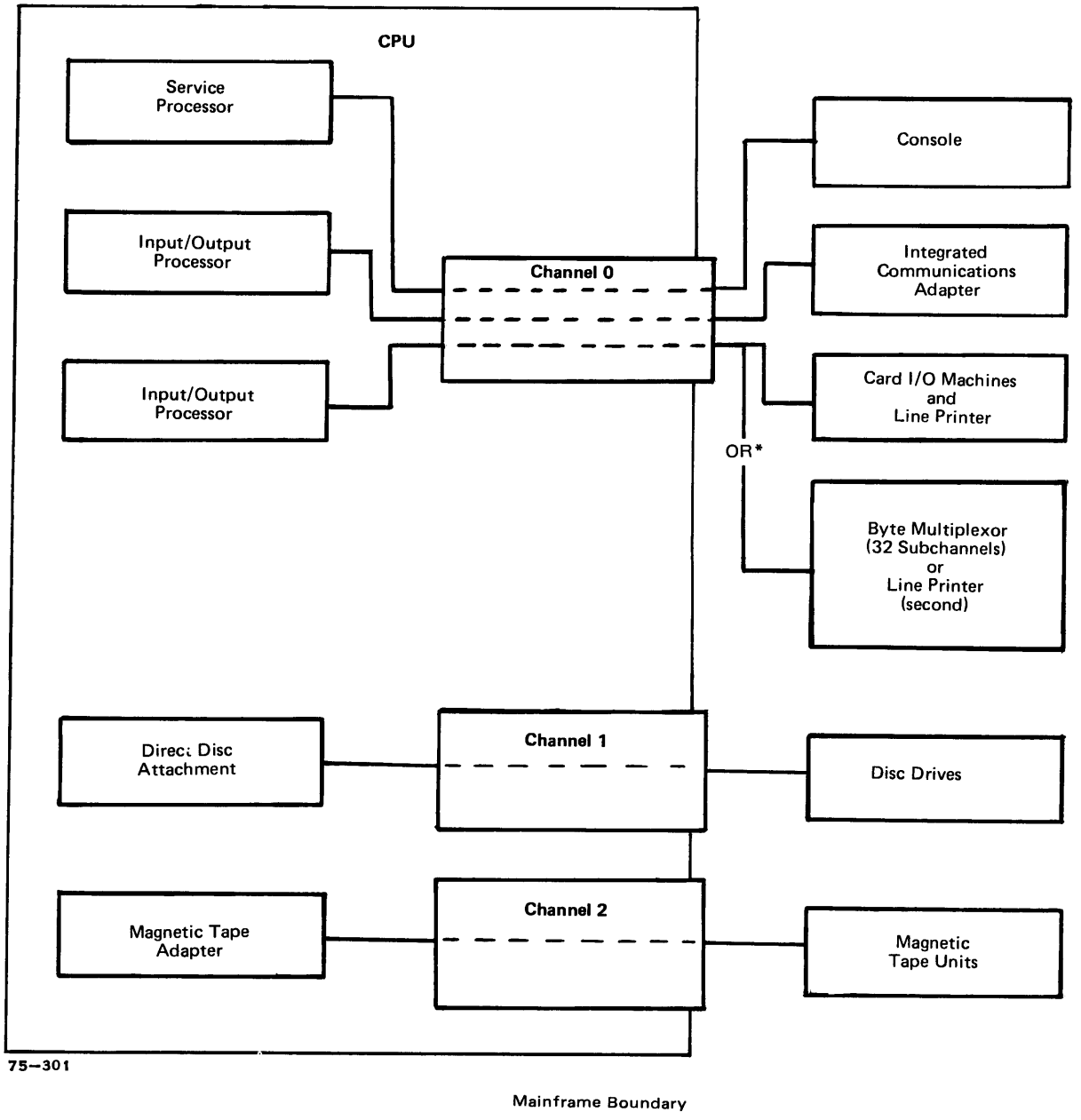


Figure 1. IBM System/370 Model 115: Channel Organization

*An RPQ (request price quotation) is needed to install both an integrated and I/O attachment and a multiplexor channel.

low-speed I/O devices can be controlled and several of them can operate simultaneously. In the burst mode, maximum data rate is 29,000 bytes per second; sustained data rates decrease to 19,000 bytes per second in the byte mode.

PERIPHERALS

The major peripheral offerings for use on the System/370 Model 115 most closely resemble those used with Model 125. The most commonly used peripheral

devices for the 115 are connected via the optional integrated I/O attachment; a listing of them can be found under "CONFIGURATION GUIDE". The optional byte multiplexor channel allows other low-speed I/O devices to be attached. A wider variety of devices (adopted from System/360) that are unavailable with the 115 are used with the larger models of System/370.

High-Speed Peripherals

Only one disc system is available with Model 115. The 3340 Model A2 Direct Access Storage Facility houses two drives and a control. Each drive contains one interchangeable-cartridge disc, the 3348 Data Module. The 3340 Models B1 (one drive) and B2 (two drives) can be attached to the 3340 Model A2 for a maximum of four drives. Storage capacity for individual drives is either 34.9M bytes or 69.8M bytes, depending on whether the Model 37 or Model 70 3348 Data Module is chosen.

Magnetic tape characteristics are listed in Table 4. The 3411 subsystem contains both the tape unit and the control. The 3410 is the tape unit only.

Slow-Speed Peripherals

Via optional integrated attachments/adapters or byte multiplexor channels, the 115 can use a variety of card I/O devices and printers. Available card equipment is listed in Table 5. The integrated card attachment cannot be used with the byte multiplexor channel unless RPQs 7B0141 and 7B0132 are present.

The 115 can attach both console printers and line printers. Via the Integrated Printer Attachment, the 115 can use the 5203 Printer, Model 3, or the 3203 Printer, Model 1 or 2. The 5203 is a 300 line-per-minute, 48-character-set cartridge printer. Its standard print line is 96 positions, which can be expanded to 120 or 132 positions. The 3203 is a train printer; both Models 1 and 2 have 132 print positions, and line print speeds are 600 and 1,200 lines per minute, respectively. Character sets for either model can have from 30 to 240 characters, but the standard line print speeds are based on a 48-character set.

The Integrated Console Printer Attachment connects the 5213 Printer Model 1. The 5213 provides hard copies of the messages displayed on the standard Display Operator Console. The number of print positions can be either 120 or 132; it prints 85 characters per second.

Special-Purpose Peripherals

Other low-speed devices available for use with Model 115 include the 1287 Optical Reader, the 3881 Optical Mark Reader, and the 3886 Optical Character Reader. The 7770 Audio Response Unit is also available.

DATA COMMUNICATIONS

The Model 115 can be used as a standalone communications processor or as a front-end processor with other members of the System/360 or 370 family.

Software support for communications is VTAM (Virtual Telecommunications Access Method). VTAM replaces BTAM (Basic Telecommunications Access Method), QTAM (Queued Telecommunications Access Method), and TCAM (Telecommunications Access Method). VTAM is responsible for monitoring data transfers between communications terminals and user programs. It uses the 370X Communications Controller.

Communications on the Model 115 can be implemented via the Integrated Communications Adapter (ICA) or a communications control unit on the multiplexor channel. The ICA allows direct attachment of up to five synchronous (BSC) communication lines or up to eight asynchronous lines. For combinations of synchronous and asynchronous communications lines, an Integrated Communications Adapter Extension (ICAE) is needed. The ICAE allows four synchronous and eight asynchronous communications lines to be used. Data transfer rate is 45.5 bits per second for asynchronous lines and up to 50,000 bits per second for synchronous lines.

By using the ICA, Model 115 users can implement communications on their systems without using IBM front-end processors, the 3704 or 3705 Communications Controllers. However, use of the ICA does not preclude the use of a 3704 or 3705 Communications Controller.

IBM's System Network Architecture (SNA), announced in September 1974, presents yet another option for the user of IBM communications. SNA features a standardized line protocol, Synchrnous Data Link Control (SDLC), which will replace IBM bi-sync for all future communications terminals.

SDLC does not effect communications on the Model 115, which employs the ICA. However, the Model 115 that uses the 3704 or 3705 Communications Controller will operate under SDLC.

IBM offers a wide selection of terminals for use with System/370 Model 115. General-purpose terminals are offered for all types of communications processing: data entry, inquiry response, interactive time sharing, remote job entry, and process control. Special-purpose terminals designed for particular industries and applications are also available; these include teller machines for savings banks, displays for graphics processing, and others. The following is a partial list of terminals available from IBM.

- 5275 Direct Numerical Control Station. Buffered,

Table 4. IBM System/370 Model 115: 3411/3410 Magnetic Tape

Identity	Columns	Channel[1] or Integrated Attachment	Control Unit Implementation
3504-A1, A2 Card Reader	80	I	Internal
3505-B1, B2 Card Reader	80	C	Internal
3525-P1, P2, P3 Card Punch[2]	80	C/3505	Internal
1442-N1 Card Read Punch	80	C	Internal
1442-N2 Card Punch	80	C	Internal
2501 Card Reader	80	C	Internal
2520-B1 Card Read Punch	80	C	Internal
2520-B2, B3 Card Punch	80	C	Internal
2540 Card Read Punch	80	C/2821	In 2821
2560-A1 MFCM (360/20 device)[2]	80	I	Internal
2596 Card Read Punch	96	C	Internal
5425-A1, A2 MFCU[2]	96	I	Internal

Notes:

(1) Channel is optional byte multiplexor.

(2) The 3525, 2560, and 5425 cannot coexist in integrated attachments, but either of the latter 2 can coexist with an integrated 3504.

Table 5. IBM System/370 Model 115: Card Equipment

Characteristic	Model 1	Model 2	Model 3
Data Rate (kb/sec)			
at 1,600 bpi/PE	20	40	80
at 800 bpi/NRZI	10	20	40
at 556 bpi/NRZI	6.9	13.9	27.8
at 200 bpi/NRZI	2.5	5	10
Tape Speed (ips)	12.5	25	50
Interblock Gap Time (msec)			
9-track (0.6 in.)	48	24	12
7-track (0.75 in.)	60	30	15
Avg Read/Write Access Time (msec)	15	12	6
Full-Reel Rewind Time (min.)	3	3	2
Max Drives/Subsystem*	4	6	6

Note:

* The 3411 is a tape drive with a built-in control unit. It can attach a number of single-drive 3410 tape units having the same model number. Connection to a 115 requires an appropriate attachment.

mobile, standalone keyboard and display used for numerical control machine tool productivity.
- 3270 Information Display System. Modular A/N display system, which can include 32 displays and printers in any combination; data entry and acquisition applications.
- 3725 Programmable Buffered Terminal. Versatile, programmable, data collection device capable of batching transactions off-line and trasmitting batch results on-line to central system: business applications.
- 3767 Communication Terminal. Typewriter-type terminal available in two Models; 40 CPS and 80 CPS. Buffer with editing capabilities is optional, as well as a scientific calculation feature. Will operate under SDLC.
- 3770 Data Communication System. Family of four keyboard/printer terminals with a selection of I/O devices and communications features. Will operate under SDLC.
- 2760 Optical Image Unit. Illustrations (color or black and white) or words projected on screen from cartridge-contained filmstrip based on light probe input from other half of screen; requires linkage to a 2740 Model 1 Terminal; computer-assisted instruction and business applications.
- 3770 Data Communications System. RJE-oriented terminal; configurable with printers, paper tape, magnetic tape cartridges, A/N displays, and magnetic character readers.
- 3780 Data Transmission Terminal. Series of binary sync RJE-oriented terminals equipped with printers and/or card readers.
- 2260 Display Station. A/N display; configurable in remote/local multidrop networks; data entry and acquisition applications.
- 2265 Display Station. A/N display; designed for point-to-point operation; data entry and acquisition applications.
- 2250 Display Unit. Graphics processing oriented CRT; A/N information drawn on tube face by program; positioning of CRT electron beam images constructed by displaying series of dots in desired pattern on CRT. Choice of three manual inputs: typewriter keyboard, programmed function keyboard, and a light pen; 2285 Display copier can be used to produce copy of displayed images.
- 3670 Brokerage Communications System. Video display stock-market-oriented system; uses magnetic card device to check operator qualification.
- 1030 Data Collection System. Remote plant to CPU communications; uses badges, data cartridges, and manual inputs.
- 1050 Data Communications System. For on-line data transmission or off-line data recording.
- 1060 Data Communications System. On- or off-line teller terminal system.
- Intelligent and Remote System on System/7, System/3, System/360, and System/370. Via appropriate attachment feature; i.e., binary sync communication adapter, integrated communications adapter, 270X, or 3705.

OPERATING SYSTEM

Model 115 operates under DOS/VS (Disc Operating System/Virtual Storage). Introduced late in 1974, the most recent release of DOS/VS (Release 30) provides support for the Byte Multiplexor channel on Model 115. Prior releases provided support for current 115 peripheral devices including the 3340 Direct Access Storage Facility.

DOS/VS is a greatly enhanced version of 360 DOS. Its main storage requirement is 96K bytes (minimum). The new operating system features include:
- Support of a single virtual storage of up to 16 million bytes divided into 64K-byte segments (on external page store) and 2K-byte pages.
- Increased problem program partitions from three to five.
- Ability to specify the dispatching priority of a partition at SYSGEN and alter it at IPL time and during system operation.
- A relocatable loader, thus allowing programs to be loaded and executed in any partition and with any size supervisor.
- Spooling of I/O by use of IBM's POWER spooler.
- Cataloging sets of job control cards on direct access storage.
- A multiple timer facility.

DOS/VS also includes a revised assembler, which supports all new System/370 instructions; the data accessing method, VSAM; a linkage editor; a librarian; system utilities; and diagnostic aids, such as OLTEP.

DOS/VS offers the user 16,777,216 bytes of virtual storage in segments of either 64K or 1,024K bytes and program pages of either 2K or 4K bytes. The figure of 6M bytes of virtual storage is at best theoretical and, even on a more limited basis, far outdistances the managing capabilities of an entry-level user who is trying to manage a sophisticated operating system for the first time. DOS/VS partitions are user defined; without careful utilization of resources, excessive thrashing is bound to occur.

A more complete analysis of the DOS/VS operating system can be found in the System Software segment of *AUERBACH Computer Technology Reports.*

PRICE DATA

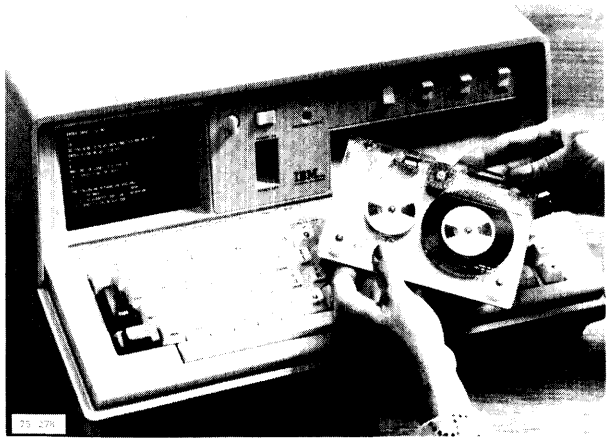
Model Number	Description	Monthly Rental (Maint. not incl) $	Purchase (Maint. not incl) $	Monthly Maint. $
	IBM SYSTEM/370 MODEL 115			
	Central Processor & Working Storage			
3115	Central Processing Unit (with display operator console; dynamic address translation; commercial instruction set, including decimal instructions; byte-oriented operand; storage protection; time-of-day clock, interval timer, CPU timer, and clock comparator; error checking and correction; program event recording; channel indirect data addressing; monitor call; direct attachment for the 3340 direct access storage facility; and core storage)			
-F	65,563 bytes	2,945	122,150	250
-FE	98,304 bytes	3,145	130,050	255
-G	131,304 bytes	3,345	137,950	160
-GE	163,840 bytes	3,545	145,850	265
-GF	196,608 bytes	3,745	159,050	
	Processor Options			
3898	External Signals	100	4,125	1
3900	Floating Point	NC	NC	NC
4640	Integrated Communications Adapter	205	8,460	21
4641	Integrated Communications Adapter Extension	75	3,105	1
4650	Integrated 3203 Attachment (4653 req'd)	75	3,145	6
4653	Integrated 3203/5203 Prerequisite	80	3,230	7
4670	Integrated 2560 Attachment	140	5,780	10
4690	Integrated 5203 Mdl 3 Attachment (4653 req'd)	75	3,145	6
4692	Integrated 5213 Model 1 Attachment	100	4,125	3
4695	Integrated 5425 Attachment	140	5,780	16
5248	Byte Multiplexer Channel	190	7,865	17
7520	S/360 Model 20 Compatibility	NC	NC	NC
	Mass Storage			
	Discs			
3340-A2	2 Drives	999	36,000	3
-B1	1 Drive	558	19,800	40
-B2	2 Drives	705	25,200	64
	Input/Output			
	I/O Attachments			
3540	Diskette I/O Unit			
-B1	1 Drive	535	22,000	25
-B2	2 Drives	805	33,000	35
3411	Magnetic Tape Adapter (7361 req'd)	100	4,850	3
7361	S/370 Model 115/125 Attachment	100	4,200	4
	Printers			
1443	Printer (240 lpm; 52-char set)	850	36,500	87
3203-1	Printer (600 lpm; 4650 req'd);	940	34,200	185
-2	(1,200 lpm; 4650 req'd)	1,234	44,100	240
5203	Printer (300 lpm; 4690 req'd)	435	17,400	127
5213	Printer (4692 req'd)	160	6,200	48
	Punched Cards			
1442-N1	Card Read/Punch (400 cpm read; 160 col/sec punch)	510	25,460	81
-N2	Card Punch (160 col/sec)	365	18,185	71
2501-B1	Card Reader (600 cpm)	260	14,590	51
-B2	Card Reader (1,000 cpm)	320	14,820	55
2520-B1	Card Read/Punch (500 cpm)	915	39,520	151
-B2	Card Punch (500 cpm)	810	35,000	142
-B3	Card Punch (300 cpm)	625	34,715	114
2596	Card Read/Punch	845	29,575	330
2560-A1	Multi-function Card Machine (500 cpm)	615	27,055	97
-A2	Multi-function Card Machine (310 cpm)	480	19,885	97
5425-A1	Multi-function Card Unit (250/60/60 cpm)	570	18,000	150
-A2	Multi-function Card Unit (500/120/120 cpm)	740	22,000	295
	Paper Tape			
1017-1	Paper Tape Reader (120 cps; reads strips of tape)	49	2,135	14
-2	Paper Tape Reader (120 cps; reads strips or rolls)	73	3,265	17
1018	Paper Tape Punch (120 cps)	121	4,950	40
2671	Paper Tape Reader (1,000 cps)	140	5,785	21
2822	Paper Tape Control (controls one 2671)	210	8,630	8
2826	Paper Tape Control (for up to 2 1017s and/or 2 1018s)	275	13,140	35
5801	Punch Adapter — Line 1 (for first 1018)	97	4,945	9
5802	Punch Adapter — Line 2 (for second 1018)	82	4,220	5
6101	Reader Adapter — Line 1 (for first 1017)	82	4,220	8
6102	Reader Adapter — Line 2 (for second 1017)	68	3,470	5
	Magnetic Tapes			
2495	Tape Cartridge Reader (900 cps)	340	18,670	155
3410	Magnetic Tape Unit (1 tape drive)			
-1	20K bps at 1,600 bpi	185	7,065	45
-2	40K bps at 1,600 bpi	245	9,450	50
-3	80K bps at 1,600 bpi	305	11,700	55
3411	Magnetic Tape Unit and Control (single-channel control unit with 1 drive)			
-1	20K bps at 1,600 bpi	405	15,570	70
-2	40K bps at 1,600 bpi	515	19,710	75
-3	80K bps at 1,600 bpi	625	24,030	80
3211	Single-Density Tape Unit	55	2,295	7
3221	Dual-Density Tape Unit	80	3,305	27
6550	7-Track Tape Unit	80	3,305	13
	Magnetic Character Readers			
1255	Magnetic Character Reader			
-1	500 Doc/Min — 6 Stackers	805	35,460	210
-2	750 Doc/Min — 6 Stackers	980	40,590	335
-3	750 Doc/Min — 12 Stackers	1,300	55,260	440
6360	S/360/370 Adapter (req'd)	450	21,600	31
1259	Magnetic Character Reader (max 1/system)	1,360	61,110	260
1419	Magnetic Character Reader	2,380	107,185	241
7720	S/360 Adapter (single address; req'd)	104	5,140	6
7730	S/360 Adapter (dual address; req'd)	282	12,705	8
	Optical Readers			
1287	Optical Reader (max 8/system; doc reading only)	3,400	111,600	1,160
3881	Optical Mark Reader (max 8/system)	1,351	51,390	140
3886	Optical Character Reader (max 8/system)	2,315	83,520	475
	Audio Response			
7770	Audio Response Unit (up to 4 lines)	1,165	48,370	38
4668	I/O Line Frame (for more than 16 lines; max 1)	194	9,310	2
4677	I/O Line Expander (4 more lines; max 11)	170	8,150	12

PRICE DATA (Contd.)

Model Number	Description	Monthly Rental (Maint. not incl)	Purchase (Maint. not incl) $	Monthly Maint. $
	Audio Response (Contd.)			
4679	I/O Line Panel (for each increment of 8 lines beyond first 8; max 5)	73	3,490	2
	Displays			
1053-4	Printer (appropriate adapter req'd on 2848; max 1)	49	1,675	10
2250-1	Display Unit (for single display unit)	1,065	51,215	157
-2	Display Unit (max 4 per 2840)	1,550	31,025	177
1002	Absolute Vectors and Control	390	15,520	11
1498	Buffer (4,096 bytes; req'd on 2250 Model 1)	340	16,295	7
1499	Buffer (8,192 bytes; req'd on 2250 Model 1)	485	23,280	10
1880	Character Generator	365	17,460	15
2840	Display Control (controls and attachments for up to 2 2250 Model 3s)	3,880	72,000	141
3352	Display Multiplexer (add'l attachments for up to 2 more 2250 Model 3s)	390	8,000	13
2848	Display Control			
-1	Up to Twenty-Four 2260 Model 2s (240 char/2260)	360	15,715	23
-2	Up to Sixteen 2260 Model 2s (480 char/2260)	390	16,480	23
-3	Up to Eight 2260 Model 1s (960 char/2260)	420	17,975	24
-21	Up to Twenty-Four 2260 Model 2s (240 char/2260)	725	32,735	28
-22	Up to Sixteen 2260 Model 2s (480 char/2260)	775	34,920	28
	Display Adapter (1 req'd for each two 2260s)			
3355	On Model 1 (3858 or 3859 req'd for more than 2)	40	1,505	2
3356	On Model 2 (3358 or 3859 req'd for more than 1)	80	3,005	4
3357	On Model 3 (3859 req'd for more than 1)	100	3,765	5
3368	On Model 21 (3868 req'd for more than 6)	58	2,620	2
3369	On Model 22 (3868 req'd for more than 4)	116	5,240	3
	Expansion Unit			
3858	On Model 1 or 2 (for add'l display adapters and/or a 1053 adapter-7927)	55	2,260	NC
3859	On Model 1, 2, or 3 (for add'l display adapters; 3858 req'd on Model 1 or 2)	45	1,835	NC
3868	On Model 21 or 22 (for add'l display adapters)	49	2,180	NC
	1053 Adapter (to attach a 1053 Model 4; max 1)			
7927	On Model 1 or 2 (3858 req'd)	40	1,505	3
7928	On Model 3	40	1,505	3
7938	On Model 21 or 22	102	4,585	5
2260-1	Display Station (for use with 2848 Model 3)	30	970	8
-2	Display Station (for use with 2848 Model 1, 2, 21, or 22)	30	970	8
3272	Control Unit (basic unit provides for attachment of up to 4 devices; one 3277 Model 1 is req'd with a 3272 Model 1; one 3277 Model 2 is req'd with a 3272 Model 2)			
-1	480 Char	190	6,505	11
-2	1,920 Char	205	7,108	23
3250	Device Adapter (each attaches up to 4 add'l devices; max 7)	55	1,075	1
3277-1	Display Station (480 char; for 3272 Model 1 or 2)	75	2,940	7
-2	Display Station (1,920 char; for 3272 Model 2 only)	110	3,810	15
3284-1	Printer (40 cps; 480 char; for 3272 Model 1 or 2)	150	5,065	28
-2	Printer (40 cps; 1,920 char; for 3272 Model 2 only)	160	5,685	28
3286-1	Printer (480 char; for 3272 Model 1 or 2)	180	6,775	28
-2	Printer (1,920 char; for 3272 Model 2 only)	190	7,505	28
	Data Communications			
1201	Asynchronous Line Group	40	1,950	3
1231	Asynchronous Line Medium Speed	40	1,950	2
1241	Asynchronous Line Pair, Low Speed	55	2,650	3
1291	Auto Call Adapter, Line Position A1	20	950	1
1292	Line Position A2	20	950	1
1295	Line Position S1	20	950	1
1296	Line Position S2	20	950	1
2701	Data Adapter Unit (attaches up to 4 lines or adapters)	200	7,915	15
2702	Transmission Control (attaches up to 15 lines, max 600 bps; up to 32 lines, max 200 bps)	850	38,395	46
2703	Transmission Control	1,450	65,485	76
2715	Transmission Control Unit	1,550	67,240	185
3704-A1+	Communication Controller (attaches up to 32 lines)	646	26,000	115
3705-A1+	Communication Controller (attaches up to 352 lines, max 50K bps)	1,152	47,150	150
4743	IBM Leased Line Adapter	14	490	2
	IBM 1,200-bps Line Adapter			
4781	Nonswitched	15	525	2
4782	Switched with Autoanswer	20	700	3
4791	Switched with Autocall and Autoanswer	65	2,275	10
4792	Line Adapter Base 2	25	1,200	2
4793	Line Adapter Base 3	25	1,200	2
7100	Synchronous Line Group	40	1,950	3
7121	Synchronous Line High Speed	100	4,850	7
	Synchronous Line Medium Speed with Clock			
7141	Line Position S1	55	2,650	3
7142	Line Position S2	55	2,650	3
7143	Line Position S3	55	2,650	3
7144	Line Position S4	55	2,650	3
	Synchronous Line Medium Speed			
7151	Line Position S1	45	2,200	3
7152	Line Position S2	45	2,200	3
7153	Line Position S3	45	2,200	3
7154	Line Position S4	45	2,200	3
7881	Telegraph Line Pair	55	2,650	7

IBM CORP.

5100 Portable Computer



OVERVIEW

IBM's fast-moving General Systems Division announced its smallest computer, the 5100 Portable Computer. Referred to by IBM as the "Problem Solver," the 5100 is a full-fledged stand-alone computer. It is being marketed as a personal computer for the business, engineering, and scientific professional who has a requirement for local computing. A member of the programmable calculator class of device, the 5100 also features a limited communications capability, which permits it to act as an intelligent terminal to a larger IBM computer system.

The IBM 5100 is a desktop system weighing approximately 50 pounds. It requires no special arrangements such as air-conditioning or heavy-duty electrical wiring. The processor, keyboard, display screen, and cartridge tape unit are housed in a single enclosure. Optional printer and auxiliary tape desktop units can be easily cabled to the 5100.

IBM has made no public statements about the future of the 5100. It has not released the type of technical specifications that would offer clear evidence of the processing potential of the unit, which can host up to 64K bytes of RAM and 190K bytes of ROM (called ROS, Read Only Storage, by IBM). Only speculation will offer answers to questions about IBM's plans for the ultimate uses of the 5100's processing potential. Currently it offers an adapter for its own peripheral devices (printer and magnetic tape unit), as well as an optional serial I/O adapter for any piece of peripheral equipment that has a five- to eight-bit code and a data rate of 20 to 9,600 bps. Independent manufacturers will undoubtedly look upon this new option as the opportunity to introduce a new crop of peripheral devices for the 5100. As the 5100 becomes adaptable to a broader range of applications, especially business applications, it should be watched for its possible impact on the System/32 market.

The 5100 offers both APL and BASIC. Depending on the model, the user can choose either APL or BASIC, or both. While APL (which is not offered by any of the 5100's competitors) is a large plus for the scientific, mathematical, and engineering community, neither APL or BASIC is normally used for commercial business data processing. Both languages, however, could be adapted for that purpose.

Three program libraries written in either APL or BASIC and stored on magnetic tape cartridges are available for the 5100. The Business Analysis Library, the MATH Library, and the STAT Library offer application programs for business analyses, general math routines, and statistical routines.

IBM offers 12 models of the 5100, differentiated mainly by the amount of main memory they host (16, 32, 48, or 64K bytes) and the languages they support (BASIC, APL, or both). Purchase prices range from $8,975 to $19,975. Also, IBM has introduced a new purchase pilot test plan that allows the user a 90-day trial period before he purchases the 5100. First deliveries began in September 1975.

Compatibility

The 5100 is not a lower member of IBM's business computing systems (the System/32 and the System/3), although it could be termed an ancillary product to these. IBM appears to have made efforts to box in the 5100.

- It features magnetic tape cartridges rather than the floppy discs of the System/32 or the cartridge discs of the System/3.
- It uses an asynchronous (start/stop) transmission mode (IBM 2741 compatible) rather than bisync or SDLC communications protocols.
- The 5100's languages, APL and BASIC, are supported only marginally by other IBM GSD and DP products. An extended version of APL, APLSV, is supported by the larger System/370 models (Model 145 and up). The

HEADQUARTERS

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BASIC supported by the 5100 is the interactive version of the language, and only System/3 Model 6 (the defunct member of the System/3 family) and System/370 models using the Interactive Terminal Facility (ITF) or Time Sharing Option (TSO) also support interactive BASIC.

The 5100, in short, is a new departure for IBM. Its family ties with the other IBM products are very distant. The 5100 is breaking new ground and may be the forerunner of a series of small-scale computer products.

PERFORMANCE AND COMPETITIVE POSITION

The 5100 is a departure for the IBM General Systems Division (GSD) group, whose bread-and-butter products have been aimed at the business market for standard, repetitive business applications such as accounts receivable, accounts payable, payroll, and inventory. The 5100 offers a new twist to the usual GSD product; it is a personal problem solver that specializes in analysis and computation.

Why has IBM tackled the personal computing market? Perhaps it hopes to scatter the new computer around like its typewriter. A computer on every desk offers more revenue potential than an interactive system hosting multiple terminals — but will the market buy the concept or opt for the multiple terminal system? Drawing a parallel with the typewriter market, the development of the two has been from opposite directions. The typewriter began as an individual stand-alone device and developed into a multiple terminal system, such as that used in work processing systems. In contrast, the office computer, originally oriented toward multiple terminal systems, is now confronted with a reversal of that trend — the stand-alone, one-man computer.

Additionally, by its very nature, the 5100 has defined its own market. Whether or not personal computing has a future, the 5100 undeniably appeals to professionals — analysts, engineers, scientists, planners, researchers — who have highly individualistic work habits and, more importantly, fluctuating budgets. A purchase-only system would guarantee that these individuals' long-term computing needs would be satisfied.

What Does the Competition Have To Say?

Any time IBM marshals its marketing troops and advertising corps into a new area, it stirs up enough residual prospects so that the market as a whole expands — with IBM usually holding the lion's share. Manufacturers such as Wang with its System 2200 Advanced Programmable Calculator and Hewlett-Packard with its 9830 Programmable Calculator were in the desktop computing market long before IBM. But until IBM came in with the 5100 and "defined" the market, these systems were without a firmly defined marketing slot. Now they will undoubtedly enjoy the fruits of the 5100's publicity. The Tektronix 4051 Graphic Computing System is a new machine that is also targeting the personal, desktop computing market. The Tektronix machine adds a new dimension to the desktop computer market — its CRT displays graphics as well as alphanumeric characters. Also, the Tektronix 4051 can support up to 15 peripheral devices.

If the 5100 has any advantage over its competitors, it is in its offerings of languages. The Wang system supports only BASIC, the Hewlett-Packard system supports only BASIC, and the Tektronix system supports only BASIC. For those users who have been looking for a small computer that uses APL, the 5100 is a real find.

Indirectly the 5100 will have an effect on the entire small-computer market. Entry-level systems from manufacturers such as Digital will also be affected. The competition, for the most part, has been adopting a wait-and-see attitude. The activity generated by IBM may expand competitors' markets rather than take business away from them. One sure bet is that a lot of small-computer manufacturers will discover, or rediscover, the market for personal computers.

CONFIGURATION GUIDE

The IBM 5100 is a desktop, self-contained computer. Housed in the approximately 50-pound unit is:

- A Metal Oxide Semiconductor Field Effect Transistor (MOSFET) main storage with a 530-nanosecond cycle time. Main storage is available in 16, 32, 48, or 64K bytes (for either APL or BASIC). The BASIC language interpreter uses 4,400 bytes of main storage, and the APL language interpreter uses 6,700 bytes of main storage.
- Read Only Storage (ROS), a read only memory unavailable to the user and configured by IBM.
- An adapter for black-and-white TV monitors.
- An alphanumeric keyboard and a separate numeric pad. To the right of the numeric pad are four keys for arithmetic calculator functions.
- A 5-inch diagonal CRT display screen. Up to 1,024 characters in 16 lines or 64 characters per line can be displayed. A switch allows either the right or the left half of the lines (32 positions) to be displayed.
- One removable tape cartridge for data and program storage. The tape stores 204K bytes and has a read rate of 2,850 bytes per second and a write rate of 950 bytes per second. The tape cartridge fits into the system just above the keyboard on the right side of the machine.

Options for the 5100 include:

- A communications adapter (1525) that allows the 5100 to act as an IBM 2741 terminal to a remote System/370 or 3704/3705 Communications Controller. Transmission is in an asynchronous mode at 134.5 or 300 bps. A 6-foot modem cable is provided with the communications feature.

- An external I/O adapter (3601) for the attachment of the 5103 printer (80 cps) or 5106 auxiliary tape unit. The adapter provides one I/O port; when both devices are attached the printer is connected to the tape unit, which is in turn attached to the 5100.
- A serial I/O adapter that allows the 5100 to attach to a variety of peripherals including standard CRTs, plotters, card readers/punchers, printers, or any other peripheral device that operates at a data rate of up to 9,600 bps.

MAINFRAME

The 5100 is a compact desktop model with the processor, keyboard, display and tape cartridge all housed in a single unit. The optional printer and auxiliary tape unit are free-standing desktop units that are simply cabled to the 5100 chassis. The 5100 is available in 12 models differentiated by the languages offered and the amount of main memory they can host. See Table 1 for a listing of the models and their specifications. The models are completely field upgradable from the smallest to the largest. The peripherals are likewise field installable.

Table 1. IBM 5100 Portable Computer: Specifications

Model	Language	Main Memory (bytes)
A1	APL	16,384
A2	APL	32,768
A3	APL	49,152
A4	APL	65,536
B1	BASIC	16,384
B2	BASIC	32,768
B3	BASIC	49,152
B4	BASIC	65,536
C1	APL & BASIC	16,384
C2	APL & BASIC	32,768
C3	APL & BASIC	49,152
C4	APL & BASIC	65,536

Features	
Memory Cycle Time	530 ns
Keyboard	Alphanumeric, 10-key numeric pad
Display	CRT, 1,024 char
Tape Cartridge	204K bytes
Printer	Opt; 80 cps

Processor

The processing unit of the 5100 is a microprocessor with both read/write and read only memories. The read/write or main memory sizes available are 16, 32, 48, and 64K bytes. Up to 190K bytes of read only memory are available, depending on options selected including languages. The user selects the size of main memory; the read only memory, which is called Read Only Storage (ROS), is configured by IBM.

Keyboard and Controls

An attractive feature of the 5100 is its uncomplicated keyboard layout. The keyboard area consists of a standard typewriter-like keyboard with a separate 10-key numeric pad for data entry and 4 calculator function keys located to the right of the numeric pad. The control switches located just above the keyboard area on the faceplate of the machine have been kept to a minimum, and therefore the unit invites use by anyone familiar with a standard typewriter, CRT, or teletype. The tops of typewriter keys are clearly marked with the standard typewriter letters, numbers, and symbols, as well as the special symbols used by the APL language. The BASIC command symbols appear on the front edges of the keys. Just above the keys is a side-by-side listing of the commands for BASIC and APL for prompting. The 10-key numeric pad on a BASIC machine can be programmed to perform special functions.

Display Screen

The built-in display unit for the 5100 is surprisingly small in size; equally surprising is the number of characters that can be displayed on the screen (a 5-inch diagonal CRT) — 1,024 characters in 16 lines of 64 characters. A full boat of characters on the 5-inch screen might be a bit much to reckon with, so IBM has conveniently provided a three-position control switch that permits the right 32, left 32, or the entire 64-character line to be displayed. When either the right or left 32 positions are displayed, there is additional space between characters to enhance clarity. The screen may be switched from black characters on a white background to white on black. If the switching of line sizes and character/background color are not sufficient, IBM has conveniently provided a built-in adapter for attaching large-screen, black-and-white TV monitors. In addition to the standard uppercase character set and standard symbols, all APL and BASIC special symbols may be displayed.

Tape Cartridge

The 5100 features a tape cartridge integrated into the processing unit and an optional auxiliary tape cartridge. The optional tape cartridge attaches to the 5100 via an external I/O adapter (3601). The specifications for either unit are identical. Each tape is capable of reordering up to 204K bytes of data on 300 feet of ¼-inch tape. Tape speed is 40 inches per second; read rate is 2,850 bytes per second; and the write/check rate is 950 bytes per second.

The cartridge tapes are bidirectional and support sequential files. Files of any size can be stored on the cartridge.

PERIPHERALS

Available with the 5100 is an auxiliary tape cartridge (described in the preceding section entitled "Tape Cartridge"), a printer, and a serial I/O adapter for any one of a variety of peripherals.

Printer

The optional printer is a desktop unit with a forms tractor, operating at a speed of 80 characters per second using bidirectional matrix printing. Line spacing is six lines per inch and printing is 10 characters per inch on a print line of 132 positions. Up to six-part continuous forms can be accommodated by the forms tractor. Commands to the printer can be in either APL or BASIC languages or by pressing the copy display command key on the 5100's keyboard.

Serial I/O Adapter

A serial I/O adapter allows the 5100 to attach any peripheral that meets EIA Standard RS-232-C specifications. The devices are controlled through 5100 APL or BASIC language. Data rates of 20 to 9,600 bps and 5-, 6-, 7-, or 8-bit codes are supported.

DATA COMMUNICATIONS

IBM offers an optional data communications feature for the 5100. It is a single-line interface compatible with IBM's venerable 2741 Communications Terminal using EBCD code. The 2741 uses a start/stop (asynchronous) transmission mode with speeds of 134.5 or 300 bps. As a 2741, the 5100 is supported by a remote System/370s or 3704/3705 Communications Controller running the following software programs: OS/VS1, OS/VS2, DOS/VS, VM/370. BTAM, TCAM, or VTAM teleprocessing access methods are also supported. A 6-foot modem cable is supplied with the communications feature, but the user must supply the modem.

Input to a remote system from the 5100 may be from the keyboard or tape cartridge. Output from a remote system to the 5100 is normally to the display but it can also be recorded on the tape cartridge and printed.

The data communications option makes the 5100 useful as an intelligent terminal but leaves the user wanting for several reasons. Certainly the 2741 discipline is not the most desirable from the aspect of transmission speed, nor is it widely used by time-sharing systems that users would commonly couple with. It will certainly, at least in the short run, confine 5100 users to calling up only IBM time-sharing systems. IBM's widely supported bisync communications discipline would have been a better alternative, and teletype, which is universally supported by time-sharing systems, would have been even better. The lack of faster transmission speeds and a faster and wider variety of peripherals virtually rules out the 5100 as a remote-batch processor.

While the 5100 is in the communications mode it is a dedicated terminal. During the transmission process the user cannot access the language interpreters. Program development or the running of a program can take place only after the communications session is completed.

SOFTWARE

Like many of its small-business and office computer counterparts, the 5100 does not have an identifiable operating system. These functions are preprogrammed by IBM and run automatically. The user has to concern himself only with applications software, and IBM has anticipated much of that effort. The firm is currently offering libraries of programs for business, mathematical, and statistical areas. These programs are available from IBM on a "one-time monthly charge" basis (see "Price Data," herein, for an explanation of the concept).

The Business Analysis Library offers some 30 interactive routines written in BASIC for performing spreadsheet analysis, investment and depreciation analysis, and break-even and time-series analysis.

The MATH Library, available both in APL and BASIC, is a set of interactive programs for the solution of common mathematical problems in science and industry. It includes routines for the following: linear equations, matrix eigen-value problems, zeros of polynomials, zeros and minima of functions, quadrature/differentiation, interpolation, approximation and smoothing, ordinary differential equations, discrete Fourier transform, special functions, and linear programming.

The STAT Library is a collection of interactive programs, available in both APL and BASIC, for commonly used statistical techniques in the analysis of numerical data. It encompasses the areas of data generation, elementary statistics, regression and correlation analysis, multivariate analysis, analysis of variance, nonparametric statistics, time-series analysis, and biostatistics.

Languages

Users have a choice of APL or BASIC or both. The BASIC implemented by the 5100 is on a level with IBM's implementation of BASIC on its 370 systems' VS/BASIC, although for obvious reasons the 5100 BASIC lacks the disc I/O capabilities. Highlights of the 5100 BASIC include stream data files, substring operations, matrix operations, and independent output between the display and the printer.

The 5100's implementation of APL is likewise based on the System/370 version, APLSV. APLSV is an extended APL. The 5100 APL is the standard version of the APL language, and is, in effect, a subset of the APLSV. The 5100 APL supports data files on tape, up to 63 dimension arrays, and independent output between the display and the printer.

PRICE DATA

When the 5100 was first introduced, it was announced with a purchase-only policy — a dramatic departure for IBM. Two months after the 5100's announcement, IBM released a purchase pilot test plan. This plan allows the customer to contract the 5100 for 3 months (and an additional 3-month extension) and pay a monthly installment fee. Up to 70 percent of the payments made on the machine during the term of the contract apply to the purchase price of the machine, and the user may opt to buy the machine at any time during the 3- to 6-month period. Maintenance charges are included in the monthly installment fee. The customer can cancel the contract only after the full 3-month trial period.

The software libraries for the system are available from IBM on a "one-time monthly charge." This means the user pays for a library program only once, but IBM can still claim the software as its own property. Consequently the user is legally prohibited from copying or reselling the libraries.

Model	Language	Main Memory (bytes)	Purchase Price $	Monthly Maint. $
A1	APL	16,384	9,975	65
A2	APL	32,768	12,975	70
A3	APL	49,152	15,975	75
A4	APL	65,536	18,975	80
B1	BASIC	16,384	8,975	55
B2	BASIC	32,768	11,975	60
B3	BASIC	49,152	14,975	65
B4	BASIC	65,536	17,975	70
C1	APL & BASIC	16,384	10,975	70
C2	APL & BASIC	32,768	13,975	75
C3	APL & BASIC	49,152	16,975	80
C4	APL & BASIC	65,536	19,975	85

Optional Features

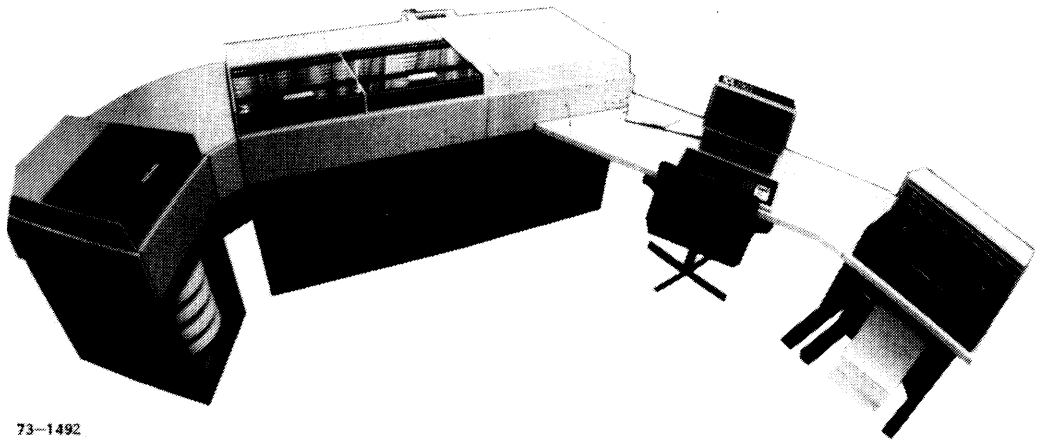
	Purchase Price $	Monthly Maint. $
Expansion Feature (req for comm)	300	6
Communications Adapter	600	10
Serial I/O Adapter	700	15
External I/O Adapter	300	6
Printer	3,675	29
Auxiliary Tape Unit	2,300	10
Tape Cartridges (package of 5)	100	—
Carrying Case (for 5100)	125	—

Software	License $
Business Analysis/Problem Solver Library (BASIC)	500
MATH/Problem Solver Library (APL or BASIC)	500
STAT/Problem Solver Library (APL or BASIC)	500

Purchase Pilot Test Plan

Type	Model/ Feature	Purchase Price $	Contract[1] Period Unit Charge (maint. incl) $
5100	A01	9,975	1,500
	A02	12,975	1,950
	A03	15,975	2,400
	A04	18,975	2,850
	B01	8,975	1,350
	B02	11,975	1,800
	B03	14,975	2,250
	B04	17,975	2,700
	C01	10,975	1,650
	C02	13,975	2,100
	C03	16,975	2,550
	C04	19,975	3,000
Expansion Feature (for comm feature)	1524	300	45
Comm. Adapter	1525	600	90
External I/O Adapter	3601	300	45
Serial I/O Adapter	6301	700	105
5103	001	3,675	555
5106	001	2,300	345

(1) For entire 3-month period.



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OVERVIEW

The ICL 2903 is a small disc-processing business computer announced in April 1973 and first delivered to European customers in January 1974. It is designed for first-time computer users and small businesses converting from unit record, keyboard-oriented accounting systems or service bureau facilities. It is equally suitable for the decentralized processing requirements of large corporations and institutions. It can be used as an intelligent remote job entry (RJE) terminal to larger 2903 systems, ICL System 4, 1900 and large 2900 series systems as well as to IBM System/3, 360 and 370.

The highlight of the 2903 is its ability to serve as a multistation key-to-disc Direct Data Entry (DDE) system concurrently with batch processing and/or the real-time processing of file enquiries. Two to eight DDE terminals can be connected to a 2903 processor by local cables. The 2903 processor is equipped with a special DDE microprogram that provides optional verification and selective search facilities.

The 2903 offers also extensive real-time disc file enquiry facilities. Such enquiries can be entered on the operator's console (even on minimum systems), as well as on any DDE terminals that may be connected to the system. The system can be expanded to include 16 additional local and remote CRT display terminals to interrogate and update user files in real time. The terminals may be distributed among a maximum of four local and/or remote data communications lines with 600 to 4,800 bits per second transfer rates. Remote terminals may be optionally equipped with 60 characters per second hard copy printers, which allow distributed point-of-sale order entry and invoicing and similar applications to be performed.

A choice of single program, multitasking and multiprogramming Executives is available for different 2903 configurations. All allow input and output spooling to take place concurrently with at least one batch user program — provided main memory is adequate. The batch program can be interrupted at any time and rolled out to disc to make room for an on-line console, DDE terminal, or VDU terminal file enquiry. The batch program can also be rolled back in and resumed as soon as the enquiry has been processed. The multiprogramming Executive can handle up to four user programs concurrently, including one file enquiry program that may be either locked permanently in main memory or rolled in as required.

The 2903 has a microprogrammed central processor. Currently, its principal microprogram implements the 1900 series instruction set and provides full object program and data structure compatibility with the ICL 1900 series. Source program compatibility is restricted by ICL to the COBOL and FORTRAN compilers, and six 1900 series applications packages. The main 2903 programming language is RPG 2. ICL also offers three applications packages specially written in RPG 2 for the 2903: On-line Order Entry, Bill of Materials Processor, and Stock Control. By restricting source programming to high level languages, ICL has left the door open to the implementation of a different instruction set on the 2903 at a later date.

The 2903 offers 64K to 192K characters of main memory and 9.8 to 270 million characters of disc backing storage. Standard peripherals include: a 300 or 600 cards per minute card reader; 150, 300, or 600 lines per minute line printer; and an operator's console with a 1,000 character CRT display. Optional central site peripherals include a 100 cards per minute card punch, 1,000 characters per second paper tape reader, 110 characters per second paper tape punch, and 80K bytes 9-track magnetic tape drives.

The 2903 is designed and manufactured by ICL at its Stevenage, England works. It is marketed in all European countries (except Portugal, Spain, Italy, and Greece), as well as South Africa, Australia, New Zealand, New York State (USA) and Ontario (Canada). See Table 1 for system specifications.

Table 1. ICL 2903: Mainframe Characteristics

Orientation	Batch; interactive
Multiprogramming	Yes: 2-4 levels + Roll in/Roll out
Central Processor	
Type	TTL/MSI microprogrammed
Control Memory	Loadable Control Storage (LCS)
Size	4K; 8K or 12K 32-bit words
Use	Instruction set implementation, Direct Data Entry (DDE), and data communications line control microprograms
No. Internal Registers	6 + 8 per program in main memory
Addressing	
Direct	4K wds (operands); 32K wds branch
Indirect	256K wds
Indexed	32K wds
Instruction Set	
Implementation	LCS microprograms; executive routines
No. of Instructions	100 + 11 opt
Decimal Arithmetic	None
Floating-Point	Opt: executive routines or microprograms
User Microprogramming	No
Main Memory	
Type	MOS
Cycle Time (usec)	1.14
Width of Access	24-bit wd
Basic Addressable Unit	24-bit wd
Capacity (words)	
Minimum	16,384
Maximum	49,152
Increment	4,096
Ports per Module	1
Error Checks	Parity
Protection	Base-limit lock-in
Input/Output Channels	
Programmed	1 opt (DDE)
DMA Channels	1 (integrated disc adapter)
Multiplexed Channels	2-8
Maximum Transfer Rate (chars/sec)	
Within Memory	3,500,000
Input/Output	520,000
Simultaneous Operations	10

COMPATIBILITY

The current standard 2903 loadable control store (LCS) microprogram implements the 1900 series instruction set. It stores data and programs on FEDS and EDS 60 backing stores in fixed length 128-word (512-character) "buckets" conforming to UDAS standards, and on 9-track magnetic tape in 1900 series formats (one 24-bit word in three 9-bit rows). The 2903 is thus currently fully machine code compatible with the 1900 series, allowing 2903 users who have outgrown their system to migrate upwards to the 1902T and larger systems.

In a reversal of the more usual situation, 2903 source code compatibility with the 1900 series is restricted to the COBOL and FORTRAN compilers, and the six 1900 series applications packages. ICL offers no PLAN assembler or NICOL compiler on the 2903, nor as yet an RPG 2 compiler on the 1900 series. This is partly a marketing move, to prevent existing 1901A or 1901S users from "downgrading" to the cheaper but faster 2903 instead of upgrading as intended to the 1901T. but it also makes all 2903 source programs machine code independent, and keeps the option open of replacing the current 1900-compatible LCS microprogram by a 2900 series-compatible microprogram at a later date. This is unlikely to happen before the smaller and as yet unannounced members of the 2900 series have replaced the current 1900T series in the ICL catalogue.

The 2903 RPG 2 is a compatible superset of IBM RPG II used on the System/3, Burroughs B700, B1700, and a growing number of other small business computers. RPG 2 is in turn a superset of IBM 360/20 RPG. This makes transfer of source programs easy from other systems to the 2903. The 2903 FEDS disc cartridges are identical to those used on IBM 5444 cartridge disc drives, and the EDS 60 discpacks identical to those used on double-density IBM 2314 and 2319 replacement drives. Data is stored on these differently, however, and users converting from a System/3 to a 2903 will have to reformat their files.

Communications. The F1560 RJE microprogram makes the 2903 look like a 7020 remote batch terminal to any System 4, 1900 or 2900 series system or like an IBM 2780 to an IBM System/3, 360 or 370. The F1560 microprograms controlling transfers to/from 7181/2 and 7500 series VDU terminals use a line control protocol that is a superset of the ISO (ASCII) Basic Mode, with data in variable length blocks of seven bits plus parity ASCII characters. In addition to ICL 7181/2 and 7500 series VDUs, on-line file enquiry terminals may thus include also other manufacturers' 7181/2 compatible VDUs, such as the Ferranti PT 7, Raytheon-Cossor Unitel Four, Incoterm SPD 20/20, Datapoint 1100 and 2200, and SE Labs 2000.

PERFORMANCE AND COMPETITIVE POSITION

Since its announcement in April 1973, the ICL 2903 has become ICL's most popular computer system to date, and one of the most favoured disc processing small business computers in an increasingly crowded market. By the end of 1974 more than 800 orders for the system were taken. Customers are divided equally between European and overseas markets.

Competition for the ICL 2903 includes: IBM System/3 Models 8, 10, and 15; Burroughs B1712, B1714, B1726, and B1728; DEC Datasystem 500; Honeywell 61/60, 62/40, and 62/60; NCR Century 75 and 151; Nixdorf Systems 880/65 and 900; Singer Systems 110 and 10; Unidata 450, 455, and 7.720; Univac 9200 and 90/30. At equivalent configuration sizes the 2903 is generally less expensive than most of its competitors except the DEC Datasystem 500.

Expandability. The 2903 can be expanded on site from a basic system with 64K characters of main memory and 9.8 million characters of disc backing store to a system with up to 192K characters of main memory and 269.4 million characters of disc backing storage. This range of sizes is covered by competing manufacturers in two, three, or even four different models. A notable exception is the Univac 90/30 which offers small business to medium system configurations without a processor change.

Support. The 2903 is far from being the most inexpensive disc processing small business computer on the market. Cheaper but less expandable systems include the ABS Multibus, BCS Molecular 6ME and 18, Datapoint 2200, DEC Datasystem 340, General Automation TOM, Hewlett-Packard 2000A, Honeywell 61/58, Intertechnique Reality 20, MAI Basic Four, Singer 6800, and the new Nixdorf System Computer 8870 announced in West Germany in December 1974. However, apart from the Honeywell, Nixdorf, and Singer systems, these cheaper systems are mostly offered by much smaller companies, or by minicomputer manufacturers with little experience of the commercial data processing market as yet. Outside the main metropolitan areas, few of these cheaper competitors can offer the level of support that ICL offers at its 2903 Customer Centres: unlimited training in RPG 2 for user programmers, free assistance in writing programs for user staff working at the Customer Centres, etc. It remains to be seen how the 2903 will fare in competition with the recently announced IBM System/32.

Direct Data Entry. The use of directly connected key display data entry terminals is a 2903 option, but one that has been taken up by nine out of every ten 2903 users. The popularity of this feature has naturally encouraged imitation among competitors, and key-to-disc data entry facilities of one sort or another are now offered also on the IBM System/3 Models 8 and 10, Burroughs B700 series, Honeywell 61/58 and 61/60, Nixdorf System Computer 8870, and the Unidata 450 and 455. The 2903 design approach still remains the most cost effective, especially in larger DDE terminal configurations.

IBM and Burroughs offer direct data entry facilities on intelligent key-to-disc terminals with internal data entry logic simply connected on-line to the EDP systems: IBM 3741 Data Entry station, Burroughs AE 300 Audit Entry Terminal. Honeywell, Nixdorf, and Unidata like ICL, rely on the central processor's data entry programs and use the same buffered CRT display terminals for data entry and on-line file enquiries. Both these rival solutions — especially the IBM and Burroughs — cost substantially more per terminal than the ICL 2251 DDE terminals that rely on the 2903 processor for their microprogram control and data buffers.

Until recently, ICL's DDE terminals were limited. Users who had begun by installing DDE terminals for batch key entry were likely to be told that they had to order VDU terminals as well, if they wished to introduce more sophisticated on-line order entry procedures. This limitation has now been removed. Under the new Enquiry Terminal System (ETS) 2, DDE terminals can also be used for user disc file record enquiries and updating. They can alternate between enquiry and data entry roles at the press of a switch.

USER REACTIONS

A large number of the 2903 customers are small manufacturing firms, but there are also a significant number of banks, insurance companies, money brokers, and other specialised businesses. Most of the 2903 users claimed that their major reasons for choosing the ICL system were: its on-site expandability, its direct data entry facilities, and (in the UK) the quality of support provided by ICL 2903 Customer Centres.

Banks. An overseas bank from a former British colony has seven branches in the London area offering current and deposit accounting facilities used by 20,000 customers. Early in 1973 it considered the IBM System 3/10, ICL 2903, and BCL Molecular 18. It chose the ICL 2903 because it was more expandable and cheaper than either of its competitors. Its design was more recent than the IBM 3/10, and ICL seemed more solidly based than BCL.

The system, delivered in May 1974, includes a 24K word processor, 10M character fixed/exchangeable cartridge disc drive, four magnetic tape drives, 300 cards per minute card reader, paper tape reader, paper tape punch, and 300 lines per minute line printer. It is used for maintaining current and deposit account files for all customers. Counter transactions at the seven branches are processed on the spot by Olivetti TC 380 bank terminals, which record details of the transactions on paper tape. This paper tape is then read by the ICL 2903 at the centre. Future plans call for putting the Olivetti terminals on-line to the 2903. The bank has found that the 2903 fully lives up to its specifications and has processing capacity to spare, thus allowing it to offer bureau facilities to its customers.

One of England's large clearing banks has 1,800 branches throughout England and Wales. It uses six Burroughs B6700 systems in two computer centres to process all customer current and deposit accounts, with on-line links to Burroughs TC 500 terminals at all branches. In 1974, however, it was decided that economically it was wiser to process small, specialised applications locally on dedicated small computers. One such application was the issuing and accounting for foreign currency travellers' cheques at a specialised branch in the City of London. For this application, the bank investigated the BCL Molecular 18, Hewlett Packard 2000A, and the ICL 2903. It ordered the 2903 in July 1974 because of its greater on-site expandability, its direct data entry facilities, and the possibility of adding data communications facilities at a later date. The system, which was delivered in December 1974, comprises a 24K word processor, 10M character fixed/exchangeable disc drive, 300 cards per minute card reader, 300 lines per

minute line printer, and four DDE keystations. All applications programs are being written in COBOL on a turnkey basis by ICL's software subsidiary Dataskil.

Manufacturers. A bedding manufacturer in northeast England manufactures 40 product groups, ten models within each group, six sizes of each model, and six types of upholstery for each size. Its order record files include some 20,000 current and recent orders. Until the end of 1974, it used a Honeywell G-105 for batch processing incoming orders and stock control, while payroll, purchase ledger, sales ledger, and general ledger were processed on two Philips P350 visible record computers. In 1973 it conducted an investigation into small business computers suitable for replacing the above equipment which was reaching the limits of its capacity. Systems considered included the IBM System 3/10, Burroughs B1700, Honeywell Model 58, Singer System Ten, and the ICL 2903. It chose the 2903 because it was technically ahead of all its competitors, and it had a solid sales team and backup organisation. It was also cheaper than most competing systems except the Honeywell 58.

The 2903 was ordered in October 1973 and delivered in September 1974. It comprises a 20K word processor, 10M character fixed/exchangeable disc drive, 300 cards per minute card reader, 300 lines per minute line printer, and two DDE keystations. The user is programming all his applications in RPG 2. He was able to transfer order processing and stock control from the Honeywell G-105 to the 2903 at the end of 1974. The Philips P350 applications will be transferred during the first quarter of 1975. The user has found that the 2903 meets its published specifications entirely, and that the ICL Customer Centre support is fully up to expectations. However, he also found that the 2903 was not quite as simple to operate as ICL salesmen had led him to believe. Operators have to be trained, and the job control language is quite complex.

A frozen food manufacturer in a northeastern English seaport distributes 400 product lines from 12 depots. It has to prepare some 80 invoices per depot per day. Until early 1975, it used NCR TR 31 accounting machines for invoicing, sales ledger, and purchase ledger, and an ICL 1901A equipped service bureau for stock control and payroll. In 1973 it investigated the IBM System 3/10, Burroughs B1700, and ICL 2903 to take over all this data processing work. It chose the ICL 2903 because it was the cheapest system able to do the work. The 2903 configuration, installed in November 1974, comprises a 24K word processor, 10M character disc drive, 300 cards per minute card reader, 300 lines per minute line printer, three DDE keystations, and one local VDU file enquiry terminal used for stock availability enquiries. Future plans call for the installation of VDU terminals with hard copy printers at each of the 12 depots to perform on-the-spot order entry and invoicing. All programs are written in COBOL by the user. The system has given complete satisfaction to date.

CONFIGURATION GUIDE

The basic 2903 system comprises a central processor with 4K 32-bit words of loadable control storage (LCS) currently used for implementing a 1900-compatible, basic commercial (100 instructions) set. It also includes 16K 24-bit words (64K 6-bit BCD characters) of MOS main storage and an operator's console with a 1,000-character CRT display which can be used for on-line file interrogation and for updating. Peripherals include a 300 or 600 cards per minute card reader; a 150, 300, or 600 lines per minute line printer; and 9.8 million 6-bit BCD characters of backing storage on a FEDS drive (holding a fixed disc and an exchangeable disc cartridge). All these components are integrated into a common desk-type console. Basic software for this configuration includes the Single-Program Executive "O" and an RPG 2 compiler

The system's instruction set can be augmented by 11 floating-point instructions in either of two ways: by the Floating-Point Extracodes option (a set of Executive software routines); or the Fast Floating Point Facility, which implements the additional instructions by microcode in LCS. The latter requires an additional 4K word module of LCS and is therefore more expensive. The system's main memory may be expanded at the factory or in the field in 4K word increments to a current maximum of 48K words (192K BCD characters). Systems with 20K word or larger memories may run under the Multislot executive "1" or the Multiprogramming Executive "2". The latter also requires the addition of the Teletype RO 33 hard copy printer to the video console.

The backing FEDS disc storage can be expanded to a current maximum of 29.4 million BCD characters by the addition of up to three 4.9 million character exchangeable cartridge disc drives, and the addition of a 4.9 million character fixed disc to the first of these additional drives. In addition, systems with at least 20K words of main memory and running under the Multiprogramming Executive "2" can also be equipped with one to four EDS 60 million character exchangeable discpack drives, either as substitutes or as complements to the FEDS drives. The maximum combined on-line capacity of four drives of each type is 269.4 million characters. Only one transfer to/from either system may take place at any one time.

Up to eight additional peripheral controllers can be added to the configuration: one or two direct data entry (DDE) couplers and six other couplers. The latter may include any desired combination of up to five data communications single line controllers and up to four 1900 series standard interface connections.

Direct Data Entry. The F1551 and F1552 DDE couplers can each control up to four 2251 Direct Data Entry (DDE) keystations equipped with keypunch keyboards and 256-character CRT screens arranged as eight lines of

32 characters. The keystations must be locally connected by a cable that may be up to 100 metres (330 feet) long. A special 4K 32-bit word LCS microprogram controls the DDE keystations and offers operators a choice of entry, verification, and selective search modes; CPU LCS capacity must thus be expanded by this amount as part of the DDE option. The DDE program uses also 4K to 6K words of main memory as input buffer area prior to the transmission of complete input messages to backing disc store.

In addition to key entry and key verification, the DDE keystations can also be used for on-line file enquiries in the same manner as the video console is used. The DDE file enquiry facility requires a third 4K 32-bit word module of LCS, which can, however, be shared with the Fast Floating Point Facility.

File Enquiry/Updating CRT Display Terminals. Up to sixteen local and/or remote CRT display terminals on 2903 systems (with at least 24K words of main memory) running under Multislot Executive "1" or Multiprogramming Executive "2" can be used for interrogating and/or updating user disc files.

The terminals may be any combination of the following models:

- 7181/2 stand-alone VDU terminal, 2,000-character screen and buffer arranged as 25 lines of 80 characters, hard-wired screen editing logic, including character insert/delete, line insert/delete, and split screen facilities.
- VT 960 terminal, 960-character screen arranged as 12 lines of 80 characters, controlled by a 7502 MTP 2 Modular Terminal Processor, which provides stored program control, buffering, screen editing, and screen format validation facilities for up to eight display terminals and up to four hard copy printers at a common site.
- VT 2000 terminal, 2,000-character screen arranged as 25 lines of 80 characters, controlled by a 7502 MTP 2 Modular Terminal Processor.

An HCP 60 Hard Copy Printer (60 characters per second) may be optionally connected to each 7181/2 stand-alone VDU terminal. Clusters of up to eight VT 960 and/or VT 2000 terminals controlled by a common 7502 MTP 2 can share access to up to four HCP 60 printers that the MTP 2 can also control. The sixteen CRT display terminals are additional to the 8 DDE terminals and the video console, even if the latter are also used for on-line file enquiries.

The sixteen or fewer CRT display terminals may be distributed among up to four local and/or remote communications lines, with a maximum of eight terminals on any one line. Local lines not exceeding 100 metres (330 feet) cable length are controlled by F1559 Local Communications Couplers. Each local line may lead to a single 7181/2 VDU terminal or a 7182/1 Transparent Line Sharing Adapter (TLSA) to which up to eight 7181/2 VDUs may be connected, or a 7502 MTP 2 controlling up to eight VT 960 and/or VT 2000 terminals, as well as up to four HCP 60 printers.

F1560 Remote Communications Couplers control a V.24 interface to a 600 or 1,200 bits per second asynchronous, or 2,400 or 4,800 bits per second synchronous modem terminating a point-to-point connection to the switched public telephone network, or a leased point-to-point or multidrop line. Point-to-point lines lead to a single remote site with a single modem. Multidrop lines may have up to eight modems at eight different sites connected to them. Each modem may interface to a single 7181/2 VDU terminal, or a 7182/1 TLSA or 7182/2 Queueing Line Sharing Adapter (QLSA) to which up to eight 7181/2 VDUs are connected, or a 7502 MTP 2 controlling up to eight VT 960 and/or VT 2000 terminals and up to four HCP 60 printers. The maximum combined number of display terminals connected at one or more sites to a single line controlled by an F1560 coupler is always eight. F1560 line control protocol procedures are microcoded and held in a 4K word LCS module that can be shared with DDE file enquiry and Fast Floating Point microprograms.

Remote Job Entry Facility. In addition to the one to four F1559 Local and/or F1560 Remote Communications Couplers controlling lines to which file enquiry display terminals are connected, 2903 systems with at least 20K words of main memory can also be equipped with an F1560 Remote Communications Coupler. The coupler controls a single 600 to 4,800 bits per second data communications line connecting the 2903 to another 2903, ICL System 4, 1900 or larger 2900 series system as well as IBM System/3, 360 or 370. The microcoded communications protocol for this line emulates the ICL 7020 or IBM 2780 communications terminal's procedures, and allows the 2903 to be recognized by the larger system as a remote job entry (RJE) terminal. The 2903 can perform RJE functions:

- Either directly, transferring input jobs and/or data directly from the system card reader to the line, or output from the line to the system line printer. In this mode, the card reader can be equipped with a three-zone character option to transmit any of the 128 characters of the ASCII-8/ISO-7 code to a System 4, ICL 2900 series or IBM System/3, 360 or 370.
- Or indirectly, transferring input jobs and/or data from the system disc to the line, or output data from the line to the system disc. Input jobs and data will have been previously spooled to disc by the normal input spooling program; output data will be printed subsequently by the normal output spooling program.

1900 Series Standard Interface Peripherals. Any 2903, irrespective of main memory size, can be equipped with up to four F1558 1900 series Standard Interface Couplers, but subject to a maximum combined number of six F1558, F1559, and F1560 couplers. Each F1558 SIC can be used to connect one of the following optional central site peripherals to the 2903: 100 cards per minute card punch, 1,000 characters per second paper tape reader, 110 characters per second paper tape punch, and/or 80K characters/second magnetic tape subsystem comprising a controller and two, three, or four magnetic tape drives, a second 600 CPU printer, and/or a graph plotter.

PERIPHERALS

Peripherals for the 2903 include standard slow-speed input/output devices, high-speed mass backing stores, communication couplers, and couplers for direct data entry terminals (DDE). Table 2 summarizes the available peripherals for the 2903.

SOFTWARE

ICL provides all 2903 users with the Single Program Executive "0" and the RPG 2 compiler at a nominal charge. All other 2903 program products, including Executives 1 and 2, are separately chargeable. To preserve its copyright, ICL is only prepared to license use of its program products at monthly fees, even to users who purchase their hardware.

Executives. The Single Program Executive "0" can be used on any 2903 configuration. It can control a single batch user program concurrently with input and/or output spooling. If the optional Console and/or DDE File Enquiry Facility modules are included, it can interrupt the batch program whenever a key depression is detected on

Table 2. ICL 2903: Peripherals

Model No.	Device	Performance Characteristics	Connection to
	DISCS		
2815/1	EDS 60 Drive and Control	60M char exchgble. 47.5 ms access 416 Kc/s transfer	Integrated disc coupler
2815/2	EDS 60 Drive	60M char exchgble. As above	2815/1. Max 4 drives/control = 240Mc
2822/1	FEDS Drive and Control	4.9M char fixed + 4.9Mc exchgb 52.5ms access. 416 Kc/s transf	Integrated disc coupler
2822/2	FEDS Drive	4.9M char fixed + 4.9Mc exchg	2822/1. Max 2 FEDS drives/ctrl
2822/3	(F)EDS Drive	4.9M chars exchangeable only	2822/1. Max 1 FEDS + 5 (F)EDS or 2 FEDS + 4 (F)EDS = 29.4Mc EDS 60 and FEDS systems may both be connected to same integ disc coupler
	CARD I/O		
2104/1	Reader	600 cpm	F1549 SIC replacing integr CR coupler
2108/2	Reader	300 cpm	Integrated card reader coupler
1920	Punch	100 cpm	F1558 SIC
	LINE PRINTERS		
2409/3	Printer	600 lpm, 64 chars, 132 pp	F1550 SIC replacing integr prntr coupler or F1558 for 2nd printer
2410/3	Printer	150 lpm, 64 chars, 132 pp	Integrated printer coupler
2411/3	Printer	300 lpm, 64 chars, 132 pp	Integrated printer coupler
	MAGNETIC TAPE		
2508/1	MT Control + 2 drives	80 Kc/s, 9-track 1,600 bpi	F1558 SIC
2508/2	MT Ctrl + 3 drives	80 Kc/s, 9-track 1,600 bpi	F1558 SIC
2508/3	MT Ctrl + 4 drives	80 Kc/s, 9-track 1,600 bpi	F1558 SIC
	PAPER TAPE		
1916/2	PT Reader	1,000 cps, 5-8 track	F1558 SIC. FORTRAN programs only
1925	PT Punch	110 cps 5-8 track	F1558 SIC. FORTRAN programs only
	DISPLAY TERMINALS		
2251	DDE	256 char (8 lines of 32 pos)	F1551 DDE Coupler (1-4 stations) F1552 DDE Coupler (stations 5-8) Max 8 local stations (100m cable)
2255/1	Console	1,000 char (20 lines 50 pos)	1 standard on every 2903
7181/2	VDU Stand-Alone	2,000 char (25 lines 80 pos)	F1559 Local Communications Coupler or F1560 Remote Communications Coupler + 600-4800 bps voice line
7500	MTP 2	Modular Terminal Processor for 1-8 VT 960 or VT 2000 terminals	Up to 8 terminals per line/coupler, Up to 4 lines, 16 terminals per system
VT 960	VDU	960 chars (12 lines 80 pos)	MTP 2
VT 2000	VDU	2000 chars (25 lines 80 pos)	MTP 2

Notes: ICL abbreviations used in Table 2:
DDE - Direct Data Entry
EDS 60 - Exchangeable Disc Store 60 million character capacity
FEDS - Fixed/Exchangeable Disc Store
(F)EDS - Exchangeable Disc Store compatible with Fixed/Exchangeable Disc Store
SIC - Standard Interface Coupler
VDU - Visual Display Unit
VT - Video Terminal

the console or a DDE terminal, roll the interrupted program out to disc, and roll in the enquiry handling program. As soon as the enquiry has been serviced, the interrupted batch program will be rolled in again and resumed.

Alternatively, Executive "0" can be dedicated to controlling DDE key-to-disc operations. When this is the case, DDE terminals cannot be used for on-line file enquiries.

The Multi-Slot Executive "1" can run on any 20K word or larger 2903 system. It can multiprogram: one batch user program, input and output spooling, DDE key-to-disc operations, and an RJE transfer between the card reader, disc, or line printer and the line linking the system to a larger EDP system. DDE keystations can alternate individually between data entry and on-line file enquiries, allowing on-line order entry procedures to be developed. The system recognises enquiry interrupts from the console, DDE keystations, and/or local and remote VDU enquiry terminals. Whenever such an interrupt is detected, the batch program is interrupted and the enquiry serviced. The batch program is only rolled out to disc, if its main memory space is required to accommodate the file enquiry program. During file enquiry processing, DDE keying, I/O spooling, and RJE transfers continue undisturbed.

The Multiprogramming Executive "2" can also run on 20K word or larger 2903 systems whose video console is equipped with a Teletype RO 33 output printer. 24K words are required to provide VDU enquiry facilities under Executive "2." This Executive can multiprogram up to four user programs with DDE key-to-disc operations, input spooling, output spooling, RJE transfer, and/or on-line file enquiry programs. On-line file enquiry programs, unless locked permanently in main memory, can interrupt any of the four user programs and displace them in main memory for as long as required to service a current enquiry.

Table 3. ICL 2903: Software

Software Package	Main Memory Requirements (24-bit wds) Used by Package	Minimum System
OPERATING SYSTEMS		
Exec 0 Single Program		
Basic	2,704	16,384
Floating-Point Extracodes	300	
Fast Floating Point Facility	260	
Input Spooling	1,024	
Output Spooling	1,024	
Console File Enquiry	260	
Direct Data Entry: 1-2 stations	4,096	
Each additional station	350	
Console & DDE File Enquiry	300	
Exec 1 Multi-Slot		
Basic	3,730	20,480
Exec 2 Multiprogramming		
Basic	5,632	24,576
Exec 1 & 2 Options		
Floating Point Extracodes	300	
Fast Floating Point Facility	—	
Input/Output Spooling	425	
Remote Job Entry (7020 emulat)	100	
Console File Enquiry	15	
Direct Data Entry: 1-8 stations	100	
Console & DDE File Enquiry: Basic	60	
+ Established RIRO Enq. Prog	128	
or + Established Locked-In Prog	256	
Console + DDE + VDU File Enquiry:		
Basic	120	24,576
+ Per Comm-Line & Coupler	45	
+ Established RIRO Enq. Prog	256	
or + Established Locked-In Prog	896	
LANGUAGES		
RPG 2	12,032	16,384
COBOL	13,624	16,384
FORTRAN IV	10,728	16,384
APPLICATIONS PACKAGES		
2903 Stock Control	11,136	16,384
Bill of Materials Processor	11,500	16,384
On-line Order Entry	15,500	20,480
1900 Series COMPAY	7,500	16,384
Statistics	8,000	16,384
FIND 2	12,000	16,384
PERT	12,500	16,384
PROSPER	13,200	16,384
Linear Programming	20K - 36K	28K - 44K

Languages. In addition to RPG 2, COBOL and FORTRAN compilers are available at extra charge. These are the same compilers that are also used on the ICL 1900 series. The FORTRAN compiler can only be used on 2903 systems equipped either with the Floating Point Extracodes option or the Fast Floating Point Facility.

Applications. Nine applications packages are currently available on the 2903: three written specially for it in RPG 2 and six 1900 series packages. See Table 3. 2903 packages include an On-line Order Entry system for use on local and/or remote VDU terminals equipped with HCP 60 output printers. This package cannot be used on the video console or on DDE terminals.

MAINTENANCE

ICL maintains all rented 2903 configurations and is prepared to sign maintenance agreements with purchasers. The normal maintenance contract provides for engineering cover during any 8-hour working period between 8 and 18 hours (8:00 a.m. and 6:00 p.m.) Monday to Friday, but coverage can also be provided outside these prime shift hours at extra charge.

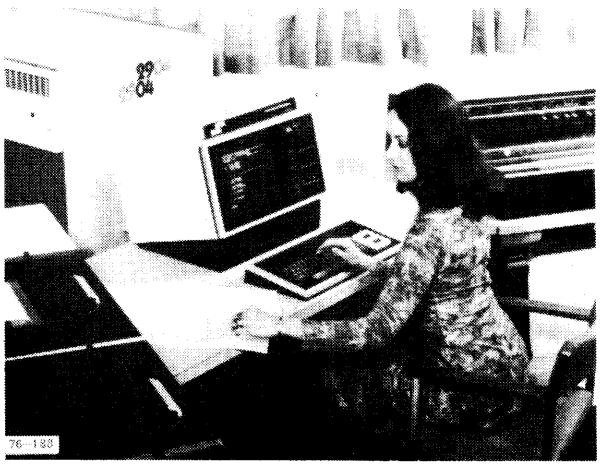
Engineering cover includes normal preventive maintenance visits and immediate response to an emergency call. Within the main urban and industrial areas, it does not generally take an ICL engineer more than one hour to travel to any customer site, but journey time may take longer to outlying areas.

HEADQUARTERS

(World Marketing)
ICL International Computers Ltd,
ICL House, Putney,
London SW15 1SW
Tel: 01-788 7272

INTERNATIONAL COMPUTERS LTD. (ICL)

ICL 2904



THE BRITISH ARE COMING

With its introduction in the United States of the ICL 2904, International Computers Limited (ICL), a United Kingdom-based company, has actively launched a U.S. marketing campaign. The 2904 will satisfy what ICL sees as the need for additional computing powers beyond the capabilities of the ICL 2903 range of small business computers (see ICL report 140.7400.120).

Viewing itself as the largest non-American computer company in the world, ICL hopes to expand its share of the U.S. market. As yet, however, ICL service covers only the New York City metropolitan area, and Toronto and Montreal, Canada; undefined plans for nationwide expansion await final decision from the headquarters in the U.K. ICL has suggested that it may pursue a joint venture with a U.S. company or purchase an established nationwide organization.

The anticipated U.S. market will be under the control of an ICL umbrella organization that will encompass the U.S., Canada, and the area of the Caribbean, in addition to Singer Business Machines, operations in Mexico (ICL has not expressed any interest in Singer's U.S. customer base).

ICL believes that the more powerful hardware and additional software of the 2904 will make it an attractive solution to the growth requirements of small businesses. As an upgrade system for the ICL 2903, the speed of instruction execution of the 2904 is 50 percent greater than that of the 2903. Main storage of the 2904 is 128-348K, as compared with 64-192K characters for the 2903. On-line disc storage capacity for the 2904 is up to 510M characters-90 percent greater than that of the 2903.

As part of its effort to serve the business user, ICL offers several types of auxiliary storage for the 2904: a fixed and interchangeable disc with 5 or 10M characters, a 20-or 60M-character exchangeable disc, and a floppy disc with a ½ - MB capacity. Other peripherals include a new magnetic tape system, three types of line printers, and the same card readers, paper tape, and graph plotters available on the 2903.

The 2904 also makes available extensive data entry facilities. Six communications channels service data terminals, video terminals, printers, and satellite systems proven with the 2903 range of systems.

New software for the 2904 systems includes a Multiple Transaction System (MTS) that allows the 2904 to handle up to forty separate inquiry programs. A full analysis of the software and hardware characteristics of the 2904 can be found in AUERBACH report 140.7400.140.

ICL products are marketed in 53 countries throughout the world through wholly owned subsidiaries as well as associated companies. With its expansion into the U.S. market, ICL plans to offer its customers the same service it offers worldwide. In New York a staff of approximately 60 employees are ready to implement ICL's full-service engineering, operational 24 hours a day.

ICL FACES U.S. COMPETITORS

The ICL 2904 competes in the same performance range as the IBM System/3 Model 15 and System/370 Models 115-0 and 115-2, the Burroughs B1726 and B1728, and the Univac

HEADQUARTERS

International Computers Limited (ICL)
555 Madison Avenue
New York, NY 10022
(212) 486-7400

Series 90 Model 90/30. ICL boasts the great multiprogramming ability of the 2904; the new Multiple Transaction System (MTS) can theoretically attach up to forty display terminal processing terminals. A newer competitor that all the preceding manufacturers must eventually encounter is the Hewlett Packard 3000 II. HP has carefully analyzed the commercial market and has responded with the HP 3000 II, Models 5, 7, and 9. Model 9 features a maximum of 320 KB of memory and 94 MB of disc storage, as well as being capable of attach 16 CRT terminals. Model 9 should be an able competitor in this field.

PRICE DATA

Model No.	Description	Purchase (maint. not incl.) $	Monthly Maint. $	Monthly Rental (maint. not incl.) $
2904/42	2904 Model 40/42 Processor Package including: - 2255 video console, - 32K words store, - F1555/00 peripheral enhancement plane, - F1548/00 store enhancement plane, - F1556/00 EDS 30/60 coupler	113,005	498	2,357
	Processor Features			
2904/02	Additional 8K words 1140 nsec store (up to 48K words) (max 2)	12,116	22	252
2904/03	Additional 12K words 1140 nsec store (above 48K words) (max 4)	18,174	22	380
F2052/00	Store enhancement bay (required for stores above 48K words)	17,475	75	361
F1557/00	EDS coupler for 5-8 transports	5,639	30	116
F1551/00	Direct Data Entry (DDE) Coupler for 1 to 4 stations	3,681	24	42
	Conversion of 2903/30 with 32K words store to 2904/42 [1]	20,527	113	440
	Peripherals			
2108/62	Card reader 80 col. 300 cpm 60HZ	5,301	29	105
2417/63	Line printer 600 lpm 132 pp 50/60HZ	41,000	218	800
2417/62	Line printer 300 lpm 132 pp 50/60HZ	19,199	72	378
2417/61	Line printer 150 lpm 132 pp 50/60Hz (2903 integrated peripheral)	14,201	72	278
C1684/00	Conversion of 2417/61 to 2417/62	4,998	-	100
C1685/00	Conversion of 2417/61 to 2417/63	26,799	146	522
C1686/00	Conversion of 2417/62 to 2417/63	21,801	218	422
2421/60	Hard copy facility (for 2903) 60HZ	4,345	57	81[2]
2251/61	Direct Data Entry (DDE) station 60HZ (EACH) (for use on DDE System only) Max 8	4,008	16	78
2822/61	Fixed and exchangeable disc store 60 HZ, (4.9 Mch + 4.9 Mch)	20,306	100	397
2822/63	Fixed and exchangeable disc store 60HZ (FEDS) Additional Units 0+4.9 Mch Exchangeable (max 3, or 2 if 2822/62 is specified)	10,153	100	199[3]
2822/62	Fixed and exchangeable disc store, 60HZ	20,306	100	397
2814	Exchangeable disc store (30 Mch)	40,800	366	784
2814/62	2 transports (60 Mch), 60HZ	22,200	-	344
C1319/60	Conversion of 2814/62 to 2815/62			
2815	Exchangeable disc store (60 Mch)			
2815/61	1 Transport (60 Mch), 60HZ	29,000	184	514
2815/62	2 Transports (120 Mch), 60HZ	58,000	366	1,028

PRICE DATA

Model No.	Description	Purchase (maint. not incl.) $	Monthly Maint. $	Monthly Rental (maint. not incl.) $
2815/63	3 Transports (180 Mch), 60HZ	87,000	551	1,542
2815/64	4 Transports (240 Mch), 60HZ	116,000	735	2,056
C1257/60	Conversion of 2815/61 to 2815/62	29,000	184	514
C1258/60	Conversion of 2815/62 to 2815/63	29,000	184	514
C1238/60	Conversion of 2815/63 to 2815/64	29,000	184	514
2510/01	Magnetic tape control and integrated transport	32,620	200	672
2511/01	Magnetic tape transport	18,640	105	382
F2009/00	NRZI facility for 2510 control unit	2,333	11	50
7181/02	Visual display-Remote 2000 char	4,613	37	111
7184/01	Visual display unit 2000 char	7,687	55	166
7184/02	Auxiliary visual display unit 2000 char	2,563	19	56
7184/09	Keyboard for 7184/01 and 7184/02	512	3	12
7184/03	Dual visual display system 2000 char, including keyboard	10,250	74	222
F1558/00	Standard interface coupler	3,402	16	67
F1559/60	Communications coupler (local), 60HZ	3,402	16	67
F1560/60	Communications coupler (remote)	3,402	16	67
F1548/60	Store enhancement plane, 32K and above (for 28KW or greater and when DDE is spec with 24KW), 60HZ	15,000	-	300
F1549/00	Standard interface coupler for 2104/01 (card reader)	2,854	16	57
F1550/60	Coupler for 2417/63 only	2,854	16	57
F1552/60	Direct Data Entry (DDE) coupler for 5 to 8 stations, 60HZ	5,196	16	103
F1555/60	Peripheral ennancement plane, 60HZ	NC		
F1556/60	Exchangeable disc store coupler, EDS 30, 60HZ	5,256	30	103
F1556/60	Exchangeable disc store coupler, EDS 60, 60HZ	10,256	30	203
7502/03	Modular terminal processor with 12K bytes and line unit at 600, 1200, 2400, and 4800 bps	8,621	59	181
7502/15	Modular terminal processor system package comprising 7502/05 modular terminal processor with 12K bytes of store and line unit at 600, 1200, 2400, 4800, and 9600 bps and 7551/12 dual floppy disc drive (including coupler and housing unit)	14,213	113	297
7512/00	Additional 4K bytes of store (max 1)	1,049	5	21
7561/01	Video terminal and keyboard	2,330	11	58

Model No.	Description	Monthly License Charge $
	SOFTWARE	
E7360	Nonstandard executive 1	152
	Executive 1 nonstandard options	
E7310/55	2780 emulation facility	82
E7320/56	7020 mode RJE to 1900	82
E7320/21	ETS2 option, buffered inquiry system	58
E7320/00	Executive 2 basic	175

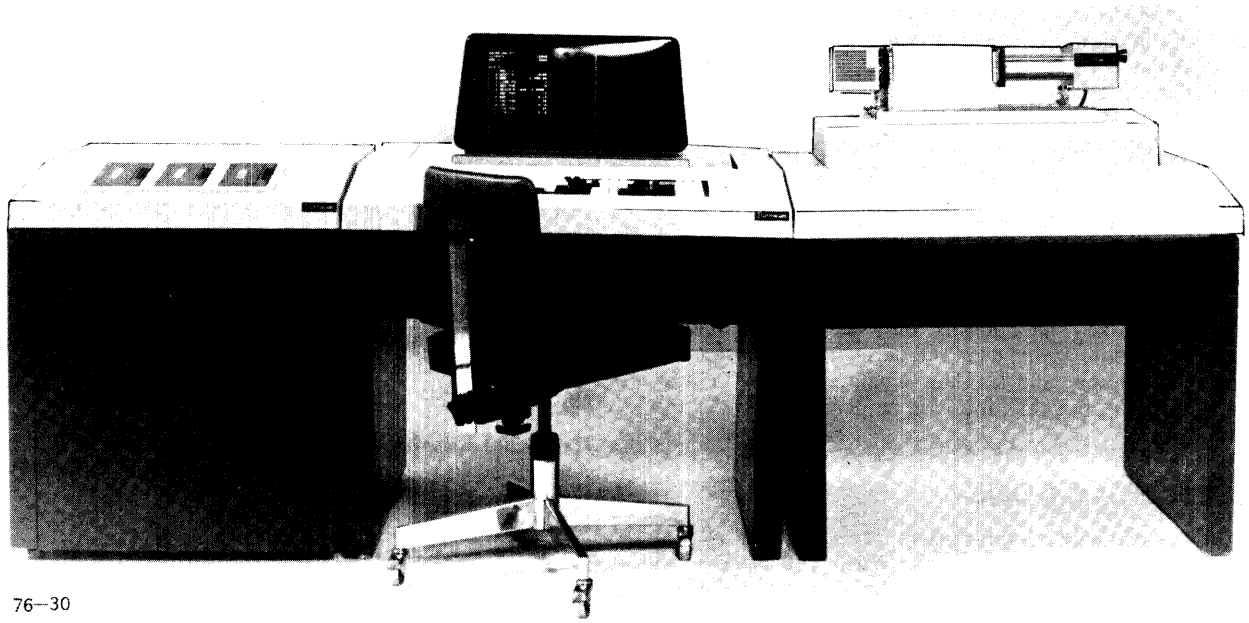
PRICE DATA

Model No.	Description	Monthly License Charge $
	UTILITIES AND LANGUAGES	
S40100/00	General and direct access utilities	1
S40100/01	General and magnetic tape utilities	1
S40100/02	File reorganization and sort/merge	23
S40200/00	RPG II (diagnostics in English)	1
S40200/01	RPG II (diagnostics in French)	1
S40200/02	RPG II (diagnostics in German)	1
S40200/03	RPG II console inquiry subroutines	1
S40200/04	RPG II inquiry terminal subroutines	70
S40200/05	RPG II ETS2 common and console inquiry subroutines	1
S40200/06	RPG II ETS 2 7181 VDU subroutines	70
S40200/07	RPG II ETS2 DDE subroutines	70
S40201/00	COBOL	117
S40201/01	COBOL console inquiry subroutines	1
S40201/02	COBOL inquiry terminal subroutines	70
S40201/03	COBOL ETS 2 common and console inquiry subroutines	1
S40201/04	COBOL ETS 2 7181 subroutines	70
S40201/05	COBOL ETS 2 DDE subroutines	70
S40202/00	FORTRAN (requires extracode floating point or fast-floating point executive option)	140
	APPLICATIONS SOFTWARE	
S40300/00	Bill of materials processor	82
S40301/00	Online order entry (requires S40200/04 and S40302/00)	105
S40302/00	Stock control	82
S40303/00	COMPAY	140
S40304/00	PROSPER (requires extracode floating point or fast-floating point executive option)	140
S40305/00	FIND 2 multiple-inquiry system	82
S40306/00	PERT (requires extracode floating point or fast-floating point executive option)	350
S40307/00	Linear programming (EDS)	291

1. In addition to 32K conversion charges above, there will be the one time charge of $5,000 for field installation.
2. Special Requirement.
3. Available on 5-year noncancellable contract only.

LITTON INDUSTRIES INC.

ABS 1300



76-30

OVERVIEW

The Automated Business Systems (Sweda) division of Litton Industries produces and markets the ABS 1300 series for the small business computer market, with heavy emphasis on the general accounting applications of general ledger, accounts receivable, accounts payable, etc. The ABS 1300 series offers either cassette based or floppy disc (diskette) based systems. Users may select varying amounts of memory and differing numbers of media devices. All systems have a keyboard unit and a medium-speed character printer, and may optionally be equipped with a CRT display.

Litton markets its systems on a turnkey basis, with all programming, training, and installation guidance provided by its staff. The firm now offers over a dozen applications modules, covering many common business requirements for both the cassette and diskette versions of the system. Customized programming modifications are also available.

First deliveries of the ABS 1300 were made in November 1974.

PERFORMANCE AND COMPETITIVE POSITION

Litton markets the ABS 1300 system as a higher performance version of its older 1200 series. As a turnkey small business computer, the ABS 1300 is targeted at those users who do not have the sophistication or EDP staff needed to deal with the problems of software, and whose file requirements are such that they can be efficiently handled by cassette- or diskette-sized files. Also, the 1300 has been designed to provide a degree of automation for users who need to perform repetitive accounting functions. In practice, this machine would appear to be of interest to companies with an annual sales volume in the general range of $500,000 to $5,000,000.

The marketplace in which the 1300 will be competing is a large one, with a number of strong competitors. Directly comparable products would include the Burroughs L Series accounting mini-computers, the NCR 399 System, and the Philips P350 equipment. At a somewhat different level, the 1300 will compete with such mini-computer-based business systems as the DEC Datasystems, Basic Four, and the IBM System/32.

HEADQUARTERS

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Sweda International
34 Maple Ave
Pine Brook NJ 07058
(201) 575-8100

The Burroughs L Series, the NCR 399 Series, and the Philips P350 are ledger-card-oriented systems with communications capabilities. While the 1300 is a direct competitor of those systems, it does not usually support ledger cards and it does not offer communications. The ABS 1300 relies on the invisible forms of storage media, cassettes and diskettes, and provides stand-alone rather than interactive processing. However, the major users of the 1300, accounting service organizations, are not normally ledger card or communications oriented although their clients may be.

The major competitors (Burroughs and NCR) offer peripheral devices, and support the same classes of applications on their accounting machines. The 1300's uniqueness, however, lies in its integral CRT console which is a novel device for this class of accounting computer. Another major differentiation of the 1300 from other accounting computers centers around Litton's policy of complete turnkey installations; they sell unbundled standard applications to the user and perform all the programming, installation, and training. Customization is available if required, but this, too, will be performed by Litton personnel.

USER REACTIONS

Interviews with several users revealed that all had recently upgraded from an older ABS 1200 system. All were quite pleased with the ABS 1300's performance, primarily citing the system's improved speed of operation over the earlier units. All users interviewed were using three cassettes with their system, rather than the recently announced diskette version. Most felt that the cassette system was adequate for their present needs; one indicated that he had looked at the diskette system but would go to it only if he felt he needed to perform inventory applications.

The users mainly considered competing Burroughs or IBM machines when deciding to acquire a system. Some felt that the performance of the 1300 made it the best buy; others feared the expense of programming costs implied by competitors.

The upgrade from a 1200 to a 1300 system can result in large performance improvements. One user estimated that throughput increased by a factor of three; another stated that what had been a 12-hour-per-day operation, including off-line data preparation, had been reduced to less than six hours on average, with data capture brought on-line.

Users were unanimous in their enthusiasm for the Litton applications and were generally pleased with the system reliability and service response. One accountant (decidedly, the majority of their users) stated that the 1300 is "a tool that every accountant should have". None of the interviewed users felt any need to perform programming themselves; whatever customization they required was quite infrequent and was provided by Litton at nominal (or no) cost.

CONFIGURATION GUIDE

The ABS 1300 has two primary configuration schemes: cassette media systems and floppy diskette media systems. Typically, two or three drives are attached to a system. The standard turnkey software is written to support systems with no intermixing of cassettes and diskettes.

Variable amounts of core memory may be attached to a system. The minimum amount of memory is 7K bytes, and additions are permitted in units of 4K, up to a limit of 31K bytes of user core memory. (1K bytes of memory are reserved for system firmware.)

All systems have a 132-column printer attached, printing at a rate of 140 characters per second and capable of making an original and four copies. The character set is a 64-character subset of ASCII with only upper case alphabetics. Printer forms control is by means of an internal (program modifiable) forms control table. A single forms tractor is standard, and a dual forms tractor may be added as a system option.

The CRT display unit is an optional device but is usually used in the turnkey applications. See Table 1 for systems specification.

Table 1. Litton ABS 1300: Specifications

CENTRAL PROCESSOR	
Main Memory (bytes)	8K to 32K, core (1K reserved for firmware)
Cycle Time (μsec)	1.2
Word Size (bits)	8
No. of Instructions	90
SOFTWARE	
Operating System	Firmware, macro services, utilities
Language	Assembly, turnkey applications
AUXILIARY STORAGE, CASSETTE	
Capacity (bytes)	160,000
Transfer Rate (bytes/sec)	1,250
Rewind Speed (in./sec)	120
Attachment Limits	1 to 3
AUXILIARY STORAGE, DISKETTE	
Capacity (bytes)	315,000
Latency Time (msec)	83
Transfer Rate (bytes/sec)	31,250
Attachment Limits	0, 2, or 3
KEYBOARD ENTRY	
Console Layout	Typewriter, expanded
Numeric Cluster	Yes
No. of Keys	26 alphabetic, 10 numeric, 27 special, 24 function
No. of Characters	64
CRT DISPLAY OUTPUT	
Viewing Area (in.)	9 by 7
Screen Capacity (char)	1,056
Lines	12
Characters per Line	48
Character Type	5 by 7 dot matrix
Attachment Limits	0 or 1
PRINTER	
Speed (char/sec)	140
Columns per Line	132
Double tractor	Optional

SOFTWARE

Applications are usually offered for the ABS 1300 only on a turnkey basis, and considerations of system software are, therefore, of less importance than for systems requiring user programming. The typical application is initiated by a simple program loading procedure, with all operator actions prompted by either the application program or by the application operating instructions.

While no operating system software as such exists for the ABS 1300, a number of utilities are available and a group of macro subroutines may be used in the construction of an application. The utilities include a text editor and tape-to-printer and tape-to-tape functions.

ABS 1300 application programs are written in Litton's Assembly language. This language consists of a set of relatively high-powered instructions, implemented in firmware, which allows for straightforward implementation of the functions required by small business applications: e.g., edit a field, print a line, etc.

Litton's future plans for the 1300 include a wide range of application software packages covering transaction data entry, general ledger, accounts receivable and payable, payroll, medical, utility, inventory, insurance and encumbrance accounting, job costing, and sales reporting. Most applications will run on either the cassette or diskette versions of the system.

Accountants' Package

The Accountants' Package of programs is an integrated set of application modules designed for the needs of the accounting profession. The package is built around an unattended General Ledger run, and the user may produce a variety of balance sheet and income statement formats, including previous and current year comparisons, budget to actual comparisons, division consolidation, and unlimited supporting schedules. The income statement may be produced with zero balance suppression, multiple percent base assignments, and specially calculated allocations.

In addition, a number of subsidiary reports may be produced: a statement of changes in financial condition; balance sheet ratio reports; cash flow analyses; and payroll tax reporting, including W-2 and 941-A preparation. The package also contains a number of specialized modules which are of special usefulness to accountants: depreciation and amortization schedules or calculations, detail search audits, check reconciliation, and automatic fiscal year closing.

Professional Billing Package

The Professional Billing Package provides a means of easily capturing and controlling the time and billing of professional and service personnel. Data entry of customer and service codes is used, in conjunction with a number of stored rate schedules, to produce client activity charges for each period, together with updating of client accounts based on payments received and previous balances. The application produces an aged receivable report, as well as dunning reports broken down by any desired category, and a personnel productivity report. Optionally, client invoices may be prepared automatically by the system.

Accounts Receivable Package

The Accounts Receivable system takes sales and other receipts as input and produces journals, statements, trial balances, and transaction analysis reports. Data is entered only once and is retained within the application files. There are two variants of the application: open item and balance forward. Features of the system include automatic customer account number verification, automatic dating, totaling and audit trials, classic account aging, current period finance charges, sales activity to date by customer, and selective statement messages. Most operations of the package function in an unattended mode.

MAINTENANCE

Litton ABS has 34 service centers in the United States and Canada. Sales are restricted to within 100 miles of a service center.

Service representatives usually restore operation in no more than 24 hours after placement of a call. This rapid repair time is due to the modular design of the system components and the presence of a resident set of system firmware diagnostics.

PRICE DATA

Model No	Description	Purchase Price $
1300	Basic system, including processor, 1K firmware, 7K core memory	14,200
	1 cassette	1,000
	2 cassettes	2,850
	3 cassettes	4,700
	2 diskettes	5,750
	3 diskettes	7,250
	Each additional 4K memory	1,500
	Printer stand	1,000
	CRT display	2,500
	Dual tractor printer option	500

Rental plans are not provided. Typical maintenance costs, depending on the distance from service centers, are:

System with 2 cassettes, 12K memory, CRT display	$96 to $131 per month
System with 3 cassettes, 20K memory, CRT display	$112 to $167 per month

PRICE DATA (Contd.)

Model No. *	Description	Purchase Price $	Monthly Maint. $
810 910	Accountants' Package	600	12.50
820 920	Accounts Payable	600	12.50
840	Accounts Receivable	600	12.50
940	Accounts Receivable, balance forward	600	12.50
945	Accounts Receivable, open item	600	12.50
840CC	Accounts Receivable, country club billing	600	12.50
840MB	Accounts Receivable, medical billing	600	12.50
850 950	Payroll	600	12.50
980	Invoicing, inventory control	750	12.50

*800 series for cassette systems, 900 series for diskette systems.

OVERVIEW

The Lockheed System III is a small business computer system based on Lockheed's SUE (System User Engineered) minicomputer. The basic hardware/software package includes a processor, memory, disc, printer, and CRT keyboard console together with the Disc Operating System, RPG II Compiler, Assembler, Sort-Merge Program, Data Editor, and Source Editor.

Software packages are similar to IBM System/3 software and provide the user with a total system which is easy to use and program. The Lockheed System III RPG II compiler is compatible with IBM System/3 Disc System RPG II in source language and file structure, with minor deviations in its implementation with specific devices. The system is housed in a desk suitable to an office environment; additional memory and peripherals, including magnetic tape and a data inquiry CRT can be added. Asynchronous low-speed data communications are available but high-speed communications are not currently supported.

SUE processors are 16-bit, word-oriented microprogrammed processors. The SUE computer systems, like their predecessors the MAC 16 and MAC Jr., are designed, marketed, and supported by the Lockheed Electronics Data Products Division primarily as an OEM product; but SUE systems are offered to the end user as well. SUE is designed to protect the user from system obsolescence by making it easy to add new technology on a function basis. This is accomplished by designing the system around a central bus system called the Infibus, over which system modules communicate with each other on a signal-response basis. System modules operate asynchronously with respect to each other and are synchronized only for information transfer cycles. The processor and memory, like all other pluggable system modules, connect to the Infibus, which is in turn controlled by the Infibus controller.

The System III version of SUE was announced in June 1973. The same basic system, including DOS and the RPG II compiler, was previously marketed then as the SUE Business System. The configuration was developed in 1972 for a CNA Systems application. Thus, the system has really been on the market over two years, and there are over 100 installations. LEC's market for it is as an "OEM small business system" to service bureaus and software houses instead of the end user.

COMPETITIVE ANALYSIS

The marketing approach for the System III should prove profitable for Lockheed and beneficial to the small business user who ends up with the system. Because most businesses customize their software to some extent, a large number of service bureaus and programming houses have sprung up to assist companies that do not want to support an in-house programming staff. These houses are proliferating at a great rate, riding on the wave of the small computer boom. Instead of developing software facilities to provide customized software needed to market to small businesses, Lockheed sells to the software houses and service bureaus who in turn sell, lease, or rent as they choose. The Lockheed name can appear on the hardware, or, as in cases like the CNA Systems (versus System 100) for independent insurance agents, the hardware is repackaged slightly and presented to the small business end-user under the CNA label. The end user of the service bureau can contract with Lockheed for maintenance or obtain it from another party, as they choose.

For a manufacturer using a small business computer for the first time, this marketing approach presents a number of attractive features. Lockheed has identified a sizeable market that by its very nature circumvented the problem of applications software support for small novice users, allowed systems to be sold rather than leased, and consisted of repeat customers. The software house gains experience with the manufacturer's software and makes an in-house investment in applications software. Thus it becomes increasingly profitable to continue marketing the same system.

Wang has been marketing the 2200 to some extent along the same lines, but the 2200 is a much smaller system and moreover, it has been designed with the idea that the small business user would be doing at least some of his own programming. Most other manufacturers of small business systems of a size comparable to Lockheed's system market directly to end users, and they must compete directly with the formidable IBM System/3.

LEC has one advantage over most minicomputer and small business computer manufacturers. It is a large core memory supplier to the computer industry as a whole, and consequently the cost of core memory for its system is low, and total system cost is low.

CONFIGURATION GUIDE

The basic System III configuration consists of a Lockheed SUE decimal processor and 16K bytes of core memory; IBM 5444-compatible cartridge disc (five million-byte capacity); and printer (100 characters per second). The system is housed in a desk with the CRT/keyboard recessed; alternatively, a desk without the recess for the CRT/keyboard can be specified at additional cost. A medium-speed (200 lines per minute), or high-speed (600 lines per minute) impact printer can replace the system printer.

In addition to these replacement options, a variety of options can be added to the basic system, see Table 1. Nine slots are available in the CPU for this purpose. The Heavy Duty Power Supply Package must be added for large configurations: more than 32K bytes of memory, 24K bytes of memory, and three additional single control board peripherals, or two disc interfaces.

Table 1. Lockheed Electronics System III: Mainframe Characteristics

CENTRAL PROCESSOR	
No. of Internal Registers	7 general-purpose plus "P" counter
Addressing	
Direct (no. of bytes)	64K (doubleword instructions); 512 (singleword)
Indirect	Multilevel
Indexed	Yes
Instruction Set	
Number	73
Decimal Arithmetic	Firmware plus subroutines
Priority Interrupt System	
Lines	4
Levels	4 (unlimited sharing)
MAIN STORAGE	
Type	Core
Cycle Time (nsec)	850; 250 (access)
Basic Addressable Unit	Byte/word
Bytes per Access	1 or 2
Min Capacity (bytes)	8K
Max Capacity (bytes)	64K
Increment Size (bytes)	8K; 16K
Parity	None
Protect	None
ROM	
Use	Control memory
Capacity (bytes)	2K
I/O CHANNELS	
Programmed I/O	Yes
DMA Channels (no.)	Yes (unlimited no.)
Multiplexed I/O	None
Max Transfer Rate (words/sec)	
Within Memory	2.2M (overlapped core)
Over DMA	5M

Additional memory is available in 8K-byte or 16K-byte modules; each module requires three slots, allowing a maximum of 62K bytes total; 2K bytes are devoted to control memory. Card readers and punches, more discs, cassette drives, and auxiliary inquiry CRT, and computer tape drives can also be added. Specifications for the individual items and the number of slots each requires are listed in Table 2. The maximum configuration size is determined by the number of slots required by the devices and by the DOS software. Disc drives include one fixed and one removable platter per drive; up to eight drives can be added to a system.

MAINFRAME

Central Processor

The System III is a 16-bit, word-oriented binary processor controlled by a microprogrammed control memory. The processor is organized around an arithmetic and logic unit, seven general-purpose registers, and a microcoded control memory. Internal bus lines connect the processor, control memory, and Infibus controller cards. The processor communicates with memory and I/O controller modules via the Infibus.

Data transfers on the Infibus are performed in a master-slave relationship. A module is a master if it can cause another system module to receive or transmit data; processors, I/O controllers, and control panels can be masters. Modules that receive or transmit data when addressed are slaves. A master module operates as a slave when addressed by another master module. Memory modules can only be slaves; when accessing instructions and operands from memory or transferring data to memory, the processor is the master.

The processor communicates with peripheral devices in the same way as with core memory. No special I/O instructions are required because the processor addresses I/O device registers with the same instruction set that addresses memory.

Some devices connected to the Infibus are able to assume master control of the bus, address a slave unit, and transfer data independently of the processor. Data transfer can be directly between any master device and any slave, although the usual path for data is between processor (master) and memory (slave) or between memory (slave) and device (master). Table 1 lists mainframe characteristics.

Data Structure. Each word consists of 16 bits divided into two 8-bit addressable bytes. The left byte has an even address that is also the word address; the right byte has an odd address. Negative numbers are in two's complement form with the most significant bit representing the sign.

Special Registers. The processor's register file contains seven general-purpose registers, a program counter, a status register, instruction register, and two registers used by the processor's microcode control registers. All registers are 16 bits long.

The general-purpose registers can function as accumulators, stack or address pointers, or index registers. All addressing is done through these registers for singleword instructions. Doubleword instructions can address memory directly. The program counter can be used with the autoincrement or autodecrement addressing modes for immediate operands.

Instruction Set. The System III instruction set is divided into 11 classes: seven general register, two branch, one shift, and one control. Instructions are one or two words long. The first word is divided into four 4-bit fields; the second word contains a data word address. The most significant field indicates the class of the instruction; the next most significant field gives the operation for all classes except branch. User of the two remaining fields varies with addressing mode and class designation. Instructions address bytes or words.

Interrupt Control. There are two classes of interrupts on a SUE computer: external interrupts (system interrupts that affect the flow of data across the Infibus) and internal interrupts (processor self-interrupts that do not use the interrupt lines on the Infibus). The external interrupt system is controlled by the Infibus controller

Table 2. Lockheed Electronics System III: Add-On Peripherals

Peripheral	Slots Required	Characteristics	Comments
DISCS			
380302, 303, 304 Disc drives (second, third and fourth drive)	3	1 fixed, 1 removable disc/drive; 5M-byte capacity/drive; IBM 5444-compatible	Up to 4 drives/system
CARDS			
380201 Reader and Interface	2	285 cpm	For 80-col cards
380210 Interpreting Data Recorder with Interface	1	Reads 300 cpm, punches 60-120 cpm	For 96-col cards; includes interpreter
380211 Data Recorder	1	Reads 300 cpm, punches 60-120 cpm	For 96-col cards; no interpreter
380212 Sorting Data Recorder	1	Reads 300 cpm, punches 60-120 cpm	For 96-col cards; includes interpreter
380213 Printing Reader Punch	1	Reads 300 cpm, punches 60-120 cpm	For 96-col cards; includes printer
380214 Reader Punch	1	Reads 300 cpm, punches 60-120 cpm	For 96-col cards; no printer
380220 Reader and Interface	1	300 cpm	For 96-col cards
PRINTERS			
380021 Line Printer	–	Prints 200 lpm; 132 cols	Heavy duty; replaces 100-cps printer
380030 Line Printer	–	Prints 600 lpm; 132 cols	Heavy duty; replaces 100-cps printer
380150 Line Printer	1	Prints 100 cps; 132 cols	Used for second printer
380160 Line Printer	1	Prints 200 lpm; 132 cols	Used for second printer
380170 Line Printer	1	Prints 600 lpm; 132 cols	Used for second printer

which first assigns priorities to modules primarily on the basis of the function of the service request line required, and then, if several devices request the save service line simultaneously, according to the priority of the device. Devices are assigned priority on the basis of physical proximity to the Infibus controller.

SOFTWARE

System III operates under control of a foreground/background Disc Operating System (DOS) which supports a System Control Language (SCL) interpreter, RPG II Language Compiler, and LEC LAP-2 assembler for easy generation of printed reports and for business processing. A powerful DOS utility package, Sort/Merge program, Data Editor and Source Editor are also standard components of the delivered software package. There are no plans to develop standardized applications packages (such as Accounts Payable, Accounts Receivable, Payroll, etc.) because of the company's "OEM" marketing thrust.

DOS allows one interactive program in the foreground while a batch program is being run in the background. Language processors, utility programs, and most application programs are executed in the background area of memory. These are transferred to the disc if a higher priority foreground program, such as an on-line data file inquiry, interrupts the background processing. Upon completion of the foreground program, or during intervals of waiting (for example, during an I/O request), the background program is rolled in and restarted at the point of interruption.

DOS has four basic functional components.

- System Control Monitor: Consists of an initialization module for the initial program loading, a resident control module to service and control all jobs, and nonresident (transient) facilities such as the background loader, background check point/restart, operator error messages, etc.
- Control Language Processor: Interprets the System Command Language (SCL) that provides the linkage between the user and the system. Has an optional interactive mode, allowing partial commands, and requesting additional parameters.
- Language Processors and Link Loader: Generates object code from disc, card, or other batch input, and either stores it in a work file or links it to system program library subroutines and catalogues it into the program library, to be loaded and executed later.

- Disc Utility Routines: Initializes and maintains disc files. Includes a disc initialization program for formatting new packs, a Library Allocate Program, a File and Volume Label Display Program, a Disc or File Copy/Dump Program, and a File Delete Program, all operating under control of the Control Maintenance Facility.

RPG II Language Compiler. The System III RPG II Compiler is compatible with the IBM System/3 Disc System RPG II (manual number SC21-7517-2) with regard to language structure and diagnostic message meanings, but some specifics vary because Lockheed peripherals differ from IBM peripherals. The Lockheed disc is recorded in ASCII, the IBM in EBCDIC; IBM supports communications while Lockheed supports magnetic tape, etc. Lockheed's file organization, the arrangement of records into indexed, sequential, and direct files, is compatible with IBM's.

The Lockheed RPG II compiler operates under DOS, using the resident DOS I/O handlers and IOCS. The compiler consists of multiple overlays residing on the disc system file. The object code is acceptable to the Link Loader, and can be organized into object code segments which can be executed in the overlay mode, if the user so specifies.

Sort/Merge. Disc sort/merge is an important utility for business applications that operates under DOS. It handles sequential, indexed or direct files and provides four types of output:

- SORTR—Sorted records with data and/or control fields (tag-along sort).
- SORTA—Sorted records containing relative disc record locations.
- SORTS—Sorted records containing control and/or summary data fields.
- MERGE—Merged records from presequenced input files.

Sorting is usually done in three phases: an assignment and checking phase, a dispersion sort that edits and sorts into a number of strings, and a final merge that combines the sequenced strings into one sequenced file for the disc. If certain conditions are met, the second phase can be bypassed. Sort/Merge enhances throughput and improves disc-file allocation, because records can be shortened and when selected from a file, require a smaller work area.

Editing Programs. Two programs enable editing of data already in the system. Data Edit can edit either original data or call out, edit, and replace data on the disc. Source Edit can go into the RPG source statement file and the user at the console can edit and replace RPG source statements.

HEADQUARTERS

Lockheed Electronics Company
6201 E. Randolph Street
Los Angeles CA 90040

PRICE DATA

Model Number	Description	Prices, $/Quantity 10-24	25-49	50-99	100-	Monthly Maint. $
	CENTRAL PROCESSOR AND WORKING STORAGE					
370000	Basic System III (includes decimal processor with 16K bytes of memory, 5M byte disc storage drive (IBM 5444 type), disc autoload, 100-cps line printer with stand, video display with keyboard console, power supply, control electronics, power distribution, and system cables, cooling fan, desk enclosure, and 9 expansion slots)(1)	26,240	24,570	23,785	22,995	290
	PROCESSOR OPTIONS					
380000	Heavy Duty Power Supply (required for systems with: over 32K bytes of memory; 24K bytes of memory and three additional peripheral interfaces, Replaces standard power supply)	900	850	800	770	5
380010	Desk without recessed CRT/Keyboard (replaces standard desk)	260	240	220	210	–
380021	Line Printer, Medium Speed, (features 200 lpm @ 132 columns. Heavy duty, drum impact type replaces 100-cps printer)	7,075	6,700	6,325	5,950	50
380030	Line Printer, High Speed (features 600 lpm @ 132 col. Heavy duty, drum impact type replaces 100-cps printer)	11,000	10,475	10,100	9,725	85
	MASS STORAGE					
380111	Memory (8K bytes; requires 3 slots).	1,900	1,740	1,580	1,425	22
380120	Memory (16K bytes; requires 3 slots)	3,500	3,250	2,750	2,295	38
	Discs (cartridges not included)					

PRICE DATA (contd.)

Model Number	Description	Prices, $/Quantity 10-24	25-49	50-99	100-	Monthly Maint. $
380302	Disc Drive (second unit; IBM 5444 type, 1 removable disc; 1 fixed disc; total 5M bytes storage, cables)	5,610	5,500	5,390	5,290	60
380303	Disc Drive with Cabinet (third unit, IBM 5444 type, 1 removable disc, 1 fixed disc, total 5M bytes storage, cables, accommodates extra disc drive unit in cabinet)	6,110	5,955	5,800	5,650	60
380304	Disc Drive (fourth unit, IBM 5444 type, 1 removable disc, 1 fixed disc, total 5M bytes storage, cables)	5,610	5,500	5,390	5,290	60
380330	Disc Cartridge (IBM 5440 type)	180	165	155	150	–
	PERIPHERALS					
	Printers					
380150	Line Printer, Low Speed (features 100 cps @ 132 columns, wheel impact type, interface electronics and cable; requires 1 slot).	4,570	4,340	4,110	3,880	65
380160	Line Printer, Medium Speed (features 200 lpm @ 132 columns; drum impact type, heavy duty, interface electronics and cable; requires 1 slot)	12,050	11,475	10,900	10,325	105
380170	Line Printer, High Speed (features 600 lpm @ 132 columns; drum impact type, heavy duty interface electronics and cable; requires 1 slot)	15,590	14,915	14,260	13,605	140
	Punched Card					
380201	Card Reader (80-column, 285 cpm with interface electronics and cables; requires 1 slot).	4,095	3,690	3,480	3,275	44
380220	Card Reader (96-column. Features 300-cpm read with interface electronics and cable; requires 1 slot)	3,205	3,025	2,845	2,665	28
380213	Printing Reader/Punch (96-column. Features 300 cpm read, 60-120 cpm punch, printing, interface electronics and cable; requires 1 slot)	9,915	9,605	9,295	8,995	70
380214	Reader Punch (96-column. Features 300 cpm read, 60-120 cpm punch interface electronics and cable. Similar to 380213 except does not include print capability; requires 1 slot)	8,250	7,800	7,350	6,900	65
	Data Recorders					
380210	Interpreting Data Recorder (96-column. Features 300 cpm read, 60-120 cpm punch, interpreting [printing], keyboard, interface electronics and cable; requires 1 slot)	13,150	11,915	11,330	10,750	88
380211	Data Recorder (96-column. Features 300 cpm read, 60-120 cpm punch, keyboard interface electronics and cable. Similar to 380210 except does not include interpreting print capability; requires 1 slot)	11,800	10,610	10,080	9,550	75
380212	Sorting Data Record (96-column. Features 300 cpm read, 60-120 cpm punch, keyboard, interpreting [printing], off-line card sorting, interface electronics and cable. Similar to 380210 except includes card sort capability; requires 1 slot)	16,850	15,515	14,980	14,450	95
	ACCESSORIES					
380100	Control Panel (drawer-mounted. Note: Space allowance for control panel is mandatory)	895	850	805	760	11
	SOFTWARE See Note (2)					

Notes:
(1) Rental agreements are not available for the System III. System III is sold in OEM quantities of a minimum of 10 units.
(2) With the first disc pack (380330), the following software is provided:
- *Disc Operating System (DOS).*
- *DOS Utilities.*
- *Disc Sort/Merge.*
- *RPG II Compiler.*
- *Source and Data Editors.*
- *Assembler (LAP-2).*

Additional software is available for $375/disc pack.

MARTIN WOLFE INC.

MESA TWO Model 4000 and Model 7000 Series

OVERVIEW

The MESA TWO Model 4000 and Model 7000 Series are disc-based small business systems offered by Martin Wolfe Inc. (MWI) for both the novice computer user and the experienced computer user who requires simplicity and ease-of-use above all else. They are aimed at the rapidly expanding turnkey small business market. Both the Model 4000 and 7000 are stand-alone systems suitable for interactive and batch processing. The Model 4000 Series is an entry-level system with a fixed configuration, and the Model 7000 Series is the highest end of the MWI product line. Both can control remote terminals and printers and both can offer emulation of IBM's 3780 remote batch terminal.

MWI has designed the MESA TWO as a complete hardware/software turnkey package for the business user. Easy-to-use data entry via a typewriter keyboard and an operating system that requires little or no user intervention are the highlights of the MESA TWO systems. Application packages for general ledger, payroll, inventory, accounts payable, accounts receivable and shipping and invoicing are part of the basic Model 4000 or Model 7000 system and are tailored to the user's individual needs. MESA-RPG and FORMS, languages exclusive to MWI, are available to the user for his own programming. To date systems have been designed and installed by MWI for retailers (with or without point-of-sale terminals), contractors, manufacturers, and distributors.

MWI was organized in March of 1971 by Robert Martin and Ramon Wolfe, former employees of Logicon Inc., a systems analysis firm. The company is based on the West Coast in San Diego, California and they are presently marketing the MESA TWO only on the West Coast, with the exception of large distributed processing systems that are installed on a nationwide basis.

To date, there are approximately 125 MESA TWO systems installed. The Model 4000 and the Model 7000 comprise the entire MWI product line. Model 4000 is upward compatible with the Model 7000, and MWI plans to announce a larger MESA TWO system — the Model 9000 Series. See Table 1 for a listing of MESA TWO Model 4000 Series and Model 7000 Series specifications.

HEADQUARTERS

Martin Wolfe Inc.
8369 Vickers Street
San Diego CA 92111
(714) 277-3700

Table 1. MESA TWO Model 4000 Series and MESA TWO Model 7000 Series: Specifications

	MESA TWO Model 4000 Series	MESA TWO Model 7000 Series
PROCESSOR		
Main Memory	32K	32 to 64K
Word Length	16 bits	16 bits
Increment Modules	16K	16K
Cycle time	1000 nanoseconds	1000 nanoseconds
Program Languages	MESA-RPG, FORMS	MESA-RPG, FORMS
Maximum number of devices	62	62
AUXILIARY STORAGE		
Fixed/Removable Disc	4.8MB	9.8MB, 40MB
No. of units	1 (upgradable to 2)	1 (upgradable to 3)
Transfer rate	312,000 char/sec	312,000 char/sec
Access time	35 milliseconds	35 milliseconds
INPUT/OUTPUT		
Keyboard	Typewriter and 10 key numeric	Typewriter and 10 key numeric
CRT	1998 characters	1998 characters
No. of CRTs	1 (upgradable to 2)	2 to 6
Printers	60 lpm (upgradable to 125 lpm)	200 to 600 lpm
Card reader	100 cpm	100 cpm
Card punch	–	–
Mag. tape unit	9 track, 800 bpi	9 track, 800 bpi
COMMUNICATIONS		
Transmission code	ASCII	ASCII
Data rate	2000 bps, 1700 bps	2000 bps, 1200 bps
Interface	CBS DAA (1001-A)	CBS DAA (1001-A)
Data set	Bell 201	Bell 201
COMPATIBILITY		
Emulation	3780	3780
Communication Protocols	asynchronous/bi-synchronous	asynchronous/bi-synchronous

COMPETITIVE POSITION

According to MWI, 80% of the MESA TWO users are novice DP users. Some have had service bureau experience, but the majority have never had an in-house system. Some MESA TWO systems, however, are being used by sophisticated data processing users who are implementing them in large distributed processing networks. This is indicative of the increasing trend toward turnkey business systems by both the novice user and the sophisticated user.

Because MWI markets only on the West Coast, it has an advantage in being able to offer its services to a concentrated geographical area. In addition to this, MWI markets through local distributors who can provide the high level of hardware and software support that is often required by the small business user.

MWI, however, claims that their objective is to provide a system that can be operated with a minimum amount of training as well as one that has been tailored to meet the user's specific needs. Turnkey software packages are offered for a variety of vertical markets — auto parts, retail business, printing, medical for small clinics, and broadcasting.

Currently, however, MWI cannot provide the user with the wide selection of peripheral equipment that is available from large vendors. This may be a consideration for users who feel more comfortable when they have a large company's extensive product line at their disposal.

MWI cites as their competitors IBM System/32, IBM System/3 Models 6, 8, 10, 12, and 15, Basic/Four, Burroughs B 700 and B 1700 Series, Digital Equipment's Datasystem 300 and 500 Series, Microdata Reality and Qantel. These systems represent the broad spectrum of the small business computer market, and their individual competitive capabilities often depend on the particular nature of the installation. Despite the MESA TWO's flexibility, it is unlikely that it has the model range to compete with all of the above systems. Analyses of its most likely competitors follow.

MWI feels that it meets IBM's System/32 head-on in data entry methods. If more than one operator's position is required with the System/32, the IBM 3740 Data Entry System or another System/32 must be used for off-line data entry. MESA TWO can have up to 6 on-line operator's terminals for data entry.

In addition, MWI will offer customized software and modify application packages for individual end users. IBM, however, is reluctant to make changes to application packages for the individual user. They offer a large selection of vertical market packages that are meant to satisfy the needs of the end user.

Recent price cuts on the System/3 and advent of the new System/3 Model 12 may be an encouragement for users who have in the past shied away from IBM because of price factors to reconsider their decision. System/3 is marketed to the same type of user as the MESA TWO, however it is probably best suited for a DP user. MWI can provide the processing power of the System/3 at a lower price, and it can offer the user a turnkey system that can be operated by the existing in-house staff.

Basic/Four is a major competitor of the MESA TWO. Comparable configurations for the two systems are

competitively priced; however, Basic/Four offers a well-known business system (especially on the West Coast) and MWI is the dark horse. Basic/Four does not offer a total hardware/software turnkey business system; users must arrange for their own software packages.

Burroughs offers a complete line of small business computers including the L Series Business Minicomputers, the B 700 Series and the B 1700 Series. The Burroughs B 700 Series and the upper end of the L Series have been especially designed to compete against the System/32, and offer a competitive range of vertical market application packages. In addition to this, Burroughs offers a complete line of terminals and special purpose peripheral equipment for building distributed processing networks.

Burroughs' marketing procedures are difficult to map; consequently, a consistent analysis of their competitive position is hard to come by. They have met MESA TWO head-to-head in competitive bidding while trying to upgrade some B 700 users to B 1700s. The jump from the B 700 to the B 1700 is a significant one both price-wise and sophistication-wise for the small business user. The MESA TWO's operating system can offer many of the features available with the B 1700 — dynamically controlled memory and variable size program pages.

USER REACTIONS

MWI's clientele look upon themselves as rebel DP users — they have chosen to trust their DP future to a small computer company that cannot offer the long-standing reputation of a large and well-established computer company. However, each user we spoke with had made a surprisingly careful study of the small business computer market and had a specific reason for choosing MWI over its competitors. Clearly, they are being offered something by MWI and MESA TWO that cannot be gotten elsewhere. An important factor, as always, is price. But more significantly, the users praised the tightness of the complete hardware/software package, as well as the minimum amount of hardware, ease of data entry, and the integrated application packages. Many expressed the desire to continue growing with MWI.

Mechanical Contracting. This West Coast-based company uses the MESA TWO Model 7000 for complicated payroll applications and varied types of accounts payable. The spokesperson for the company said that they refer to their MESA TWO as an "integrated accounting system." It provides complete cost accounting functions; from data entry to the finished report product, the company found that the MESA TWO did 100% of their accounting work.

This firm is one of MWI's largest and most sophisticated users, as well as one of their original customers. Their Model 7000 is configured with 32K bytes of core, three 9.8MB drives, one 600 lpm printer and 6 data entry terminals. They have plans to add larger disc drives. The system runs 24 hours a day, 7 days a week.

The company had been a service bureau user for 10 years. They worked closely with the bureau, taking responsibility for data input and editing. Before choosing an in-house system, they carefully considered the upper end of the small business market: the IBM System/3 Model 10 and 15, the NCR Century, the Burroughs B 1700 and the Univac Series 90 Model 90/30. After bucking management's objections to a small rather unknown computer company, it was decided to go with the local company — Martin, Wolfe Inc. Some mutual hand-holding has occurred during their three year relationship with MWI; MWI has given and continues to give the company a lot of support, but in return the company has worked with MWI in developing accounting packages.

Wholesale Distributing. While MESA TWO can serve extensive and rather sophisticated data processing needs, it can also solve the needs of the first-time computer user.

A wholesale distributor of janitorial and paper supplies uses a MESA TWO Model 7000 for payroll, accounts receivable, accounts payable and inventory. They have never had an in-house computer, and have never used a service bureau regularly. They have no DP staff as such, just one person who controls data input and is responsible for the functioning of the system for 8 hours a day.

This company's Model 7000 is configured with 32K of memory, one 9.8MB disc drive, one 250 lpm printer, and 2 data entry terminals. Before installing the MESA TWO, the company considered the IBM System/32 and the Basic/Four system. In System/32's case, they discovered that the system couldn't be tailored to their needs, and in Basic/Four's case they found it a difficult system to work with.

The company uses the complete software package provided with the MESA TWO, and the person in charge of the system is being trained in MESA-RPG; he is finding the language easy to work with and expects that with some further instruction he will be able to write his own programs and alter report forms.

There have been some minor service problems. According to this user, service was spotty at first, but has improved within recent months.

Material Company. A MESA TWO Model 7000 is being used to handle the billing, payroll, general ledger and financial statements of two companies and 3 subsidiaries that are the producers of rock, sand, salt, and concrete.

The company had been a service bureau user, but decided to move to an in-house system in order to expedite processing. Certain requirements had to be met by the system chosen: it had to occupy a limited amount of space and it had to run without an operator. The company considered the IBM System/3, the NCR

Century and the Honeywell Series 50 Level 58 before choosing the MESA TWO to fulfill the requirements.

The Model 7000 is answering the company's processing needs without the use of any specially developed application packages. They are using the standard turnkey package that is supplied by MWI.

The system is configured with 32K bytes of core memory, a 9.8MB disc drive, 3 data entry terminals (2 are remote) and one 200 lpm printer. Service and performance has been excellent for the 2 years it has been installed.

CONFIGURATION GUIDE

The MESA TWO Model 4000 and the MESA TWO Model 7000 are capable of operating as stand-alone processing units or as intelligent remote job entry terminals.

Both the MESA TWO Model 4000 and the MESA TWO Model 7000 consist of a central processing unit (CPU) with core storage and integrated input/output interfaces for disc drives, data entry terminals, a printer and a data communications modem. All units are housed in office furniture type cabinets.

The Model 4000's configuration is fixed at: 32K bytes of core memory, one 4.8MB disc drive (field upgradable to 2), one data entry terminal (upgradable to 2) and one 60 lpm printer (upgradable to a 125 lpm printer). Data communications is handled by a modem that operates in a bi-synchronous mode at 2000 bps.

The maximum configuration for the Model 7000 is 64K bytes of core memory, two 40 megabyte disc drives, 6 data entry terminals and up to a 600 lpm printer. Data communications is handled by a modem that operates in a bi-synchronous mode at 2000 bps. To control remote terminals and printers the MESA TWO Model 7000 uses an asynchronous modem that operates at 1200 bps.

Options for the MESA TWO Model 7000 include: a 9.8MB fixed/removable disc drive (up to 3 drives can be attached), a 200 or 400 lpm printer, and a 9-track, 800 bpi magnetic tape unit (only 1 can be attached).

MAINFRAME

Both models of the MESA TWO have the same basic architectural features. Each system has a CPU which handles logic and arithmetic functions. An operator's keyboard and display screen, storage devices and a line printer are interfaced to the CPU. I/O functions are controlled by the system software Executive program.

Martin Wolfe uses Data General's Nova 2 as the mainframe for the MESA TWO. They have adopted Data General's 16K word memory module which has a 1000 nanosecond cycle time, and a 16-bit word length. The maximum main memory of the Nova 2 has been kept at 64K.

Console

Data entry terminals for the MESA TWO are operator's consoles consisting of a CRT screen and alphanumeric keyboard. The MESA TWO Model 4000 can have 2 data entry terminals; the MESA TWO Model 7000 can have from 2 to 6 terminals.

Keyboard and CRT. The operator's console has a standard typewriter keyboard plus a ten key numeric pad. The operator's video screen displays 1998 characters. It operates in the interactive under the control of an editor program. The screen operates at 4800 bps.

PERIPHERALS

The majority of peripheral offerings for the MESA TWO are concentrated in the high-speed, mass storage area. A selection of line printers and special-purpose peripherals are also included. A table-top card reader (100 cards per minute) is available for file conversion. No paper tape equipment is available.

Fixed/Removable Disc. The MESA TWO uses the removable disc for permanent storage and the fixed disc for temporary files and backup. The Model 4000 uses the 4.8MB fixed/removable disc drive. The Model 7000 can use either the 9.8MB (up to 3 drives) or the 40MB (2 drives required) fixed/removable disc drives.

The specifications for all the fixed/removable discs are the same. Average access time is 35 milliseconds; average latency time is 12.5 milliseconds. Average transfer rate is 2.5 million bytes per second.

Magnetic Tape Unit. A 9-track, 800 bpi magnetic tape unit is available for use with the MESA TWO models. It is industry compatible and operates in the phase encoded (PE) mode.

Printers. A selection of line printers are available for use with the MESA TWO:

- 60 lpm matrix printer; 132 print positions
- 125 lpm matrix printer; 132 print positions
- 200 lpm matrix printer; 132 print positions
- 400 lpm matrix printer; 132 print positions
- 600 lpm drum printer; 132 print positions

All printers can use either standard (8½" wide) forms or data processing (14" wide) forms.

DATA COMMUNICATIONS

Data communications on the MESA TWO is handled by a bi-synchronous modem that operates at 2000 bps. It allows the MESA TWO Model 4000 or 7000 to perform remote job entry functions and emulate an IBM 3780 data communications terminal. It uses the CBS DAA (1001-A) to interface to phone lines, and it is compatible with the Bell 201 data set.

Optionally, the MESA TWO can control remote printers and CRT terminals via an asynchronous modem that operates at 1200 bps.

SOFTWARE

The MESA TWO has an operating system that requires no user intervention. As such, the operating system is fully automatic and unidentified. Its Executive program is comprised of 5 individual programs:

- Supervisor
- File System
- Editor
- MESA RPG
- MESA RPG Run Time

The supervisor program maintains control over the entire system. It is responsible for the interactive communications between the operator and the system, and allows the appropriate application programs to be called into use.

The file system for the MESA TWO provides all disc storage management capabilities. It can catalogue, store, maintain, and retrieve all stored data. It features independent formatted files for application programs.

The editor program allows for interactive data entry and the editing of data already stored in the files. Its vehicle is the programmed format, or form, as Martin Wolfe calls it, that allows the operator to communicate with the system. The screen format is programmed in Martin Wolfe's FORMS language, a high-level language with its own translator. New formats can be written using FORMS. The editor program also makes format, error, and diagnostic checks for incorrect entries.

MESA-RPG is not an industry compatible RPG. Martin Wolfe has made changes to standard RPG (Report Program Generator) in order to facilitate MESA's operation; MESA-RPG is particularly intended for interactive data input, the definition of new application programs and the generation of file and report formats.

The RPG compiler generates variable size pages that dynamically adjust to core size, program size, or file requirements. Program swapping occurs automatically if virtual storage is called for.

Predefined application programs are executed via the MESA RPG run time program, a feature of MESA-RPG. Reports are generated from application programs written in MESA-RPG.

Utility Programs

In addition to the Executive programs, the MESA TWO operates under utility programs that control printing, disc backup, and disc maintenance. A file utility allows Executive commands to be catalogued and called up.

Application Programs

MWI offers an integrated application subsystem. The application programs are turnkey systems designed for the small business user. These subsystems are field-tested standard packages that can be tailored to the user's needs.

General Ledger Subsystem. The general ledger subsystem receives its input from the other application programs, thus acting as a general accounting system for all the application subsystems. In this way MESA can offer an entirely integrated software system. Each time an entry is made into any sales category, inventory and the general ledger is immediately updated.

The general ledger subsystem provides a general ledger activity report, a general ledger trial balance, balance sheets, and income statements as well as the ability to make journal voucher entries into the general ledger.

Payroll Subsystem. The payroll subsystem is capable of performing the following functions: hourly or salary payrolls, payroll reports and general ledger posting data. Its data base is comprised of two master files, the Employee Master file and the Employee Accruals file. Accurate records for each employee can be maintained using these two files.

Report generation and form output from the payroll subsystem consist of the following:

- Payroll validation reports
- Paychecks and stubs
- Payroll register
- Payroll summary
- Employee earnings and tax summary
- Voluntary deductions report
- Miscellaneous taxable earnings report
- Workmen's compensation report (optional)
- 941A Quarterly tax report
- W-2 forms
- General ledger posting data

Inventory Subsystem. The inventory subsystem receives input information from the accounts receivable subsystem, accounts payable subsystem, and operator entered data — stock transfer, and unit cost and inventory adjustments. Via these methods the inventory subsystem will record and analyze the average unit cost, last price paid, selling price and turn-over per month of all inventoried merchandise. Automatically, the inventory subsystem will generate the following reports: inventory maintenance-rejected report, inventory maintenance-accepted report, inventory transaction exceptions report, inventory transaction detail report, account summary report, and monthly inventory journal. In addition, the inventory subsystem maintains an inventory master file that catalogues descriptive data for each piece of merchandise.

Accounts Payable Subsystem. Purchase orders, delivery receipts, vendor invoices, handcheck and void check data and file maintenance data are all used as input for the accounts payable subsystem. From this data the application program produces several reports, including: a daily vendor invoice report, a purchase journal, aged accounts payable report, open accounts payable report, vendor checks, check register, cash disbursements

journal, inventory control information, and general ledger posting.

Accounts Receivable Subsystem. Shipping order data, invoice data and cash receipts are all used as input for the accounts receivable subsystem. From this data the application program produces the following information and reports: shipping orders, invoices, statements, inventory sold data, statement of business report, sales analysis reports (includes commission reports, distributor reports, sales itemization), sales register, sales summary journal, aged accounts receivable report, and cash receipts worksheet.

Shipping and Invoicing. This subsystem generates warehouse documents, updates inventory records and records and checks customer records.

PRICE DATA

MWI offers the MESA TWO on a purchase only basis. However, third party leasing can be arranged.

Model Number	Description	Price (Maint. not Incl) $	Monthly Maint. $
MESA TWO Model 4000 Series	BASIC SYSTEM Includes one (1) Central Processing Unit with 32,000 bytes of 1 microsecond core memory, dual power regulator, line filter, power fail safe with auto restart, one (1) video terminal with keyboard and controllers, one (1) 4.8 million byte disc drive with controller, (1) 60 line per minute printer with controller, electronic enclosures, work station desk, and A5 operating system software.	36,000	
MESA TWO Model 7000 Series	BASIC SYSTEM Includes one (1) Central Processing Unit with 32,000 bytes of 1 microsecond core memory, dual power regulator, line filter, power fail safe with auto restart, one (1) video terminal with keyboard and controllers, one (1) 9.8 million byte disc drive with controller, one (1) 200 line per minute printer with controller, electronic enclosures, work station desk, and Co operating system software.	54,109	320
	Options		
7001	Additional 16,000 byte core module	3,935	10
7002	Additional 32,000 byte core module	6,275	20
7516	Synchronous communications controller (for one 2000 baud line)	3,750	5
7517	Modem – 2000 baud synchronous with auto answer (requires Model 7516 controller)	3,950	15
7524	Multiplexor for connecting up to four (4) video terminals	2,685	5
7527	Video terminal with keyboard & adapter	4,900	35
7546	600 line per minute printer instead of 200 line per minute printer	10,000	20
7582	Additional 9.8 million byte disc drive and adapter (maximum of three (3) drives per system)	10,250	80
7583	40/40 Megabyte disc subsystem Two (2) 40 megabyte units & controller instead of one (1) 9.8 megabyte unit & controller	29,500	150
	*Disc Pack for Model 7582 Disc Drive	200	NA
	*Disc Pack for Model 7583 Disc Drive	500	NA

*Formatted and Tested
NA Not Available

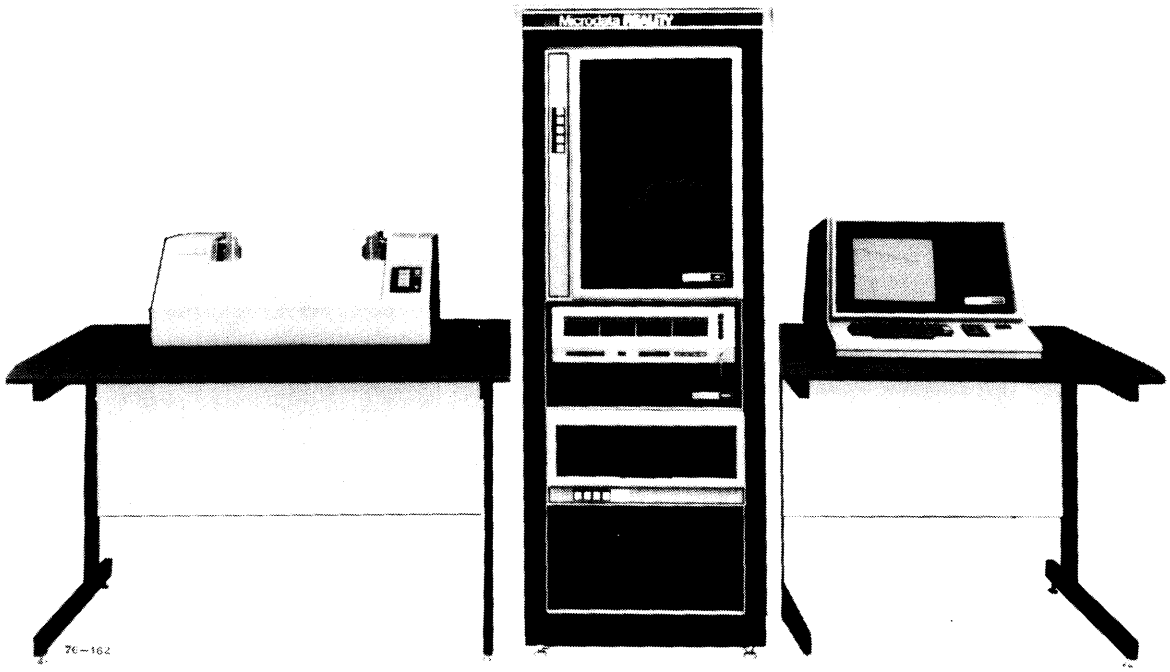
MAINTENANCE AND SUPPORT

MWI will perform maintenance for hardware and software under a monthly service contract. For 3 months after installation, both hardware and software maintenance are available from MWI at no charge. There are 23 hardware service centers and 4 software service centers in major cities in the U.S.

Support for the MESA TWO includes a user training program that covers the following areas: MESA-RPG, data input and editing, system operation, data conversion, and management information. MWI stresses that training in the first area, MESA-RPG, is not a necessity for system operation. It is offered as an option for those users who may want to modify application programs and report formats.

MICRODATA CORP.

Reality®



OVERVIEW

Microdata's Reality(TM) system is a disc-based, interactive small business system that supports up to 32 on-line users. It offers a virtual memory operating system for managing system resources and data files, as well as one of the more distinguished small business data base management software packages.

Reality is a user-oriented system; the virtual memory operating system (VMOS) is implemented in microprogrammed firmware which makes its operation transparent to the user. Also, Reality offers something for everyone in terms of language selection: Microdata's own ENGLISH(TM) for data retrieval, PROC for data entry and file updating, DATA/BASIC, an enhanced version of BASIC for file access and updating, and format handling, an IBM System/3-compatible RPG II, a Terminal Control Language (TCL), and REAL, a two-pass assembler.

The basic Reality package consists of a CPU with 16K bytes of memory, one PRISM(TM) display terminal and port, a 5MB disc drive, one 9-track 800 bpi magnetic tape system, and one open terminal port. A maximum Reality system can include up to 64K bytes of memory, up to 32 terminals, 200MB of disc storage a local serial or line printer, and a magnetic tape system. Options for the system include a card reader and bisync communications interface that allows the Reality system to communicate as a 2780 remote batch terminal or HASP workstation to a larger mainframe. See Table 1 for Reality system specifications.

The Reality system, based on Microdata's 1600 minicomputer, was introduced in July, 1974. Microdata is a growing OEM minicomputer company that has shipped over 6,000 1600 minicomputers, and has successfully commenced their marketing to the end user with the Reality system and its own line of peripherals (the PRISM CRT terminal, a disc drive and a magnetic tape drive, etc.).

Dealers. Reality is marketed through an international network of dealers. A list of authorized dealers follows.

HEADQUARTERS

Microdata Corporation
17481 Red Hill Avenue
Irvine CA 92714
(714) 540-6730

(TM) Reality, ENGLISH, and PRISM are registered trademarks of the Microdata Corporation.

Table 1. REALITY: Specifications

PROCESSOR	
Main Memory (K bytes)	16-64
Main Memory Technology	Core
Cycle Time (msec)	1.0
Char Size (bits)	8
Addressable Registers	16 plus 1 extended accumulator/terminal
No. of Instructions	109
AUXILIARY STORAGE	
Fixed Removable Disc (MB)	5 or 10
Rotational Speed (rpm)	1,500 or 2,400
Rotational Delay (msec)	20 or 12.5
Transfer Rate (K bytes/sec)	200 or 312
Removable Disc (MB)	25
Tracks/Inch	19
Rotational Delay (msec)	12.5
Transfer Rate (K bytes/sec)	312
System Capacity (MB)	40-200
Magnetic Tape	9-track
Formats	800 bpi NRZI or 1,600 bpi PE
Speed (ips)	25
PERIPHERALS	
CRT (PRISM™)	1,920 char
Serial Matrix Printer (cps)	165
Drum Line Printer (lpm)	300
Card Reader (cpm)	300
DATA COMMUNICATIONS	
No. of Lines	32
Bisync	2,780, HASP
Async (bps)	110-9,600
SOFTWARE	
Operating System	Virtual Memory Operating System (VMOS)
Languages	English™, DATA/BASIC, RPG II, PROC
Utilities	File Manager; Message Processor; On-Line Editor; On-Line Debug
FIRST DELIVERY	July 1974

Hardware maintenance is performed by Microdata's service organization, while software service is performed by the dealer that supplied the system.

UNITED STATES DEALERS

B & B Computer Systems Inc
New Hartford NY

California Data Products
San Diego CA

Century 21 Data Systems
Farmington Hills MI

Computer Management Services Inc
Portland OR

The Computer Works
Emeryville CA

Datatel Inc
Alexandria VA

Distributed Data Services
Raleigh NC

Electronic Systems Inc
Bellevue WA

Electronic Systems of Colorado
Englewood CO

Infocomm
Anchorage AK

Infocomm
Juneau AK

Insurnational Inc
Dallas TX

Keystone Data Systems
Maple Shade NJ

Minicomputer Sales & Leasing Inc
Atlanta GA

Minicomputer Sales & Leasing Inc
West Orange NJ

Northeast Data Systems
Sudbury MA

Ohio Data Products
Cleveland OH

PPI Programs Inc
New York NY

Southern California Data Products
Irvine CA

Systems Management Inc
Des Plaines IL

Systems Management Inc
St. Charles MO

Tidelands Data Products Inc
Houston TX

INTERNATIONAL DEALERS

Computer Machinery Company Ltd
Hertfordshire, England

Computer Machinery Corporation
Admiral-Rosendahl-Str. 10, Germany

Henrique Pfeffer, CA
Caracas, Venezuela

Informatica Nacional, SA
Mexico 18, DF

Intertechnique
Plaisir, France

D. E. McMullen & Associates
Toronto, Ontario, Canada

Spectro Data Division (Pty) Ltd
Transvaal, South Africa

PERFORMANCE AND COMPETITIVE POSITION

As a sophisticated small business system, Reality encounters a broad range of competitors. In the traditional small business market, the Reality system competes against Basic/Four, Burroughs B 700 and B 1700 Series, Digital Equipment Corporation Datasystem 300 and 500 Series, NCR Century 8200, Honeywell Series 60 Level 61, and IBM System/3. Except for Basic/Four, all of these systems are marketed by one of the major mainframe manufacturers, and consequently their approach to the small business user is dictated by the constraints of corporate marketing policy: hand-holding and application tailoring are usually out-of-bounds. The Reality system, however, is marketed by a network of independent dealers that can approach the small business user on an individual basis and provide a turnkey answer to data processing needs.

The other feature which distinguishes the Reality system from its field of competitors is its data base management system. It has been designed to fulfill the following functions: data entry, editing data and verifying its correctness, updating files, sorting files into report sequences, and creating reports. All this is done in an on-line mode via the PRISM CRT terminal. To encourage users to work with their systems Microdata supplies a variety of languages: ENGLISH, a data retrieval language, a PROC language for data entry and file updating, DATA/BASIC (a version of BASIC) for file access and updating, as well as RPG II and an assembler. DATA/BASIC, particularly, seems well-received by users (it accounts for 80 percent of language use); users who have never worked with a programming language are writing their own programs with DATA/BASIC.

Outwardly it would appear that Reality, because of its multiple terminal orientation, would compete with intelligent terminal manufacturers that offer multiple terminal configurations. However, the Reality system has a different orientation than intelligent terminal systems such as those marketed by Four-Phase, Raytheon and Datapoint. Reality is oriented toward on-line central site computing,

while the intelligent terminal systems are oriented toward distributing the computing power away from the central site, and providing local user sites with localized storage, printing, and processing capabilities.

USER REACTIONS

All of the users interviewed commented on the ease-of-use inherent to the Reality system. Once a Reality system had been set up by the dealer, the user ran the system with the existing office staff, and in some cases was using office members to do programming for the system. Most users remarked that they felt quite comfortable with the system; they had a general idea of how it worked, and felt that when minor problems came up they could handle them without calling the Microdata dealer. One user commented that the Reality could be thought of as "your individual system."

While Microdata markets the Reality system through a dealer network, it handles maintenance through its own service centers. Potentially, this could be a problem since two organizations are involved in delivering one product, but all users commented that both preventive maintenance and down-time maintenance were excellent.

Book Distributor. This firm (as were all the firms interviewed) is a first time in-house DP user. Prior to acquiring the Reality system, a service bureau was used. Now the firm owns a Reality system with 32Kb of memory, 5MB of disc, 2 CRTs and 165 cps printer. Before talking with the dealer who supplied the Reality system, the user considered Basic/Four, IBM, Datapoint, NCR, Burroughs and Digital Equipment Corporation. IBM had provided the maintenance service for the time sharing terminal the firm had before obtaining the Reality system; service was not good, and consequently this user now shies away from the large mainframe corporations.

This firm is as confident about its dealer as it is about its hardware. This is important because the user must work with the dealer to customize a system that will fit the user's needs. For the book distributor, the dealer created a system that would handle accounts receivable, accounts payable, invoicing, freight accounts and check writing; inventory is planned for the near future.

Although the dealer handled most of the initial software for the firm, the user picked up where the dealer left off and did his own programming in DATA/BASIC. The user had never done any programming before, but finds the DATA/BASIC unmysterious and easy to work with. The user emphasized that he felt comfortable with the system; consequently he was not uneasy about experimenting with it and solving his own problems.

Supply Company. This firm is a novice in-house user; before obtaining the Reality system it used a service bureau. The Reality system, purchased through a local dealer, is configured with 40KB of memory, 10MB of disc, four CRTs and a 300 lpm printer. As with the majority of the Reality systems, programming and customizing was done by the dealer. The user has no plans to do programming himself; any further software development will be done on a contract basis.

The feature of Reality that this user liked best was the PRISM CRT terminal. He felt that its formatting and editing functions allowed him to set up the screen to suit his needs.

This user had high praises for both the preventive and downtime maintenance provided by Microdata.

Industry. This user chose a small business computer system with several questions in mind: "Could regular office personnel handle it?" or "Is it another office tool?" Reality offered positive answers to both questions.

The user also made a thorough investigation of the systems on the market that would meet his needs. He considered the IBM System/3, Basic/Four, Digital Equipment's Datasystem 300, and Burroughs B 700. The user felt that none of these systems could offer a complete hardware/software package that met his needs as closely as Reality.

The firm's Reality is configured with 54KB of memory, 20MB of disc, 13 CRTs, 3 hard copy terminals and one line printer. Two of the terminals are remote and communicate with the Reality at 1,200 bps.

CONFIGURATION GUIDE

The basic Reality system includes the Microdata 1600 CPU with 16K bytes of core memory, one PRISM display terminal and port, one 5MB disc drive, one 9-track, 800 bpi magnetic tape system and one terminal expansion port. Standard CPU features include a real-time clock, power fail/restart, power supply and operator control panel.

Memory is increased in 8K byte increments. For supporting more than four display terminals, Microdata suggests 32K bytes of memory for five to eight terminals, 48K bytes for nine to 16 terminals, and 64K bytes for 17 to 32 terminals. Memory can be added above that required for the terminals to improve response time.

A maximum Reality system can include up to 64K bytes of memory, one magnetic tape system, 200MB of disc storage, 32 terminals and/or modems and a local serial or line printer. Disc storage can be four 5 or 10MB disc drives (sizes cannot be mixed) for a total of 40MB or eight 25MB disc units for a total of 200MB. The basic system cabinet has 35 vertical inches available for the addition of an expansion chassis, disc drives, or tape drive. Field upgrades are easily accommodated and specific chassis or cabinet hardware required by these upgrades are provided by Microdata at no charge to the user.

Configuration options include a remote serial printer that interfaces to the PRISM display terminal, a local 300 cpm card reader, and a bisync communications interface.

MAINFRAME

Because three of the major components of the Reality system, the virtual memory operating system, the software architecture and the terminal input/output routines are implemented in high-speed microprogrammed firmware, only the central processor functions will be included in the MAINFRAME section. The SOFTWARE section covers virtual memory, software and input/output functions.

Central Processor

Reality's central processor is a microprogrammed word- and byte-oriented Microdata 1600 minicomputer with the instruction set and much of the virtual memory operating system implemented in firmware. In addition to the instruction set, the multi-user operating system executive, the virtual memory manager, the I/O processors and special data management instructions are all implemented in firmware rather than software.

The instruction set includes 109 instructions: single- and double-precision arithmetic; byte string manipulations; register/memory operations; memory-to-memory moves of eight-bit bytes, 16-bit words, 32-bit doublewords, and 48-bit triplewords; a variety of branch-on-condition and bit manipulations; and others relating to stack processing, I/O handling, subroutine calls and program linkages.

CPU architecture is engineered so that up to 32 asynchronous processes (or terminals) can be handled concurrently. It has 16 eight-byte address registers, a 32-deep return stack for recursive subroutine calls, and an extended accumulator for each terminal. The 16 address registers can directly address any byte in virtual memory.

All addressing is virtual memory addressing with bytes, byte strings, words, doublewords, and triplewords referenced as the number of bytes per word relative to the first data byte of a frame. Each frame (page) is 512 bytes long and stored on disc; when a virtual storage frame resides in core, it is called a buffer. References to instructions are always via a 12-bit frame number, so programs must be located in the first 4,096 frames (two million bytes).

The first four buffers in core memory contain status information on each main storage buffer, a map of the frames in each buffer, a monitor program used to swap frames in and out, a bootstrap, a buffer queue, a disc address table, and an address register/return stack area. This region is hardware memory protected. The next four buffers in core are used for process identification blocks and an extension of the monitor software.

Process identification blocks, each 32 bytes long, contain information on the status of the process associated with each terminal: status bits for peripheral I/O operations, error codes, special communications and disc status bits, counters, and various parameters. The three buffers used for process housekeeping are software protected from the rest of memory. The remainder of memory can be used for user programs, system software, and data.

The logical disc capacity of the system is 16 million 512-byte frames or eight billion bytes, but the current maximum capacity is 200 million bytes. There are 511 frames of virtual memory reserved for programs shared by all users; this reserved area can be optionally expanded up to 4,095 frames. The first 399 of the 511 frames are further reserved for Microdata-supplied system software.

PERIPHERALS

Peripheral equipment for the Microdata Reality system includes the PRISM CRT terminal, a variety of serial and line printers, disc storage systems and magnetic tape systems, and a card reader.

Display Terminal. The Prism display terminal has a 12-inch diagonal screen and displays 1,920 characters in 24 lines of 80 characters. It also has a detachable keyboard with a standard typewriter layout plus a 10-key numeric pad. Characters may be displayed in black on a white background or white on a black background. A standard RS-232-C communications interface permits I/O rates of up to 9,600 bps.

Printers. A serial printer, which operates at 165 cps and offers a 132 column, 64- or 96-character set can be used locally or remotely. As a remote printer it interfaces to the printer port on the Prism; character format is a seven by nine dot matrix.

The high speed line printer prints at 300 lpm and offers either a 64- or 96-character set. Line length is 136 characters and form lengths can be 3, 3½, 4, 5½, 6, 7, 8, 8½, 11, 12 and 14 inches.

Disc. There are two disc units available for the Reality system. The smaller unit houses one fixed and one removable disc and has a capacity of 5 or 10MB per drive (200 or 400 tracks per disc). Rotational speed is 1,500 or 2,400 rpms. Average latency time is 20 milliseconds (1,500 rpm) and 12.5 milliseconds (2,400 rpm).

The larger disc unit uses a removable disc pack that stores up to 25MB. Rotational speed is 2,400 rpm, and the transfer rate is 312,000 bps. Average latency time is 12.5 milliseconds.

Magnetic Tape. Nine-track, 800 bpi NRZI or 1,600 bpi PE tape transports are available for the Reality system. Tape speed is 25 ips; rewind/fast forward is 200 ips; and reel size is up to 10½ inches.

Card Reader. An 80-column card reader that reads 300 cpm is available as an option.

DATA COMMUNICATIONS

The Reality system supports up to 32 asynchronous and binary synchronous communications lines. Async communications are from 110 to 9,600 bps. Reality can communicate as a 2780 data communications (remote batch)

terminal or an HASP multileaving workstation to a host computer at up to 2,400 bps.

SOFTWARE

Microdata Reality is a bellwether small business system in the area of software and data base management capabilities. As the basis of its software architecture, Reality has a virtual memory operating system (VMOS) implemented in firmware (high-speed read-only memory). Language processors include ENGLISH, PROC, DATA/BASIC, TCL (Terminal Control Language), RPG II, and REAL (a two-pass macro assembler). Other software processors include an EDITOR, data base management and utility processors.

VMOS

The operating system monitor uses approximately 4K bytes of main memory, but everything else — operating system, dictionaries, procedures, programs and data — is swapped in and out of memory in 512 byte "frames" or pages. VMOS swaps core with disc frames and performs all the housekeeping tasks needed to make these swaps transparent to the user. Frames are written back to disc on a "least-recently-used" basis.

ENGLISH

ENGLISH is a data retrieval language that depends on a sentence structure using verbs, file names, data selection criteria and control modifiers. ENGLISH input sentences are created from dictionaries that can be designed for each individual user of the Reality system. In addition to individual user dictionaries, the ENGLISH processor provides:

- Automatic or user-specified output formatting and printing.
- Sorting capabilities and the generation of statistical information.
- Relational and logical operations.
- Support of 15 digit signed arithmetic.

The verb must be the first word of the ENGLISH sentence, usually followed by a file-name. Some typical verbs are: LIST, SORT, SORT-SELECT, and COUNT.

To interpret an input message such as the LIST example shown above, Reality first scans the user's master dictionary looking for a verb that corresponds to one of the words in the message. When the verb has been found, Reality next looks for a file-name in the master dictionary that corresponds to the file-name in the input message. If the file-name is not found, the next level of dictionary is scanned. Having found the file-name entry in either the master or lower level dictionary (see "File Structure" following), Reality passes control to the verb processor already identified and sends to it information about the file. The rest of the input message can then be interpreted by consulting individual fields in the dictionary.

If an error is detected at any stage of decoding of the input message an appropriate error message will be generated. In most cases, a slight mistake in syntax will have caused the error.

File Structure. There are four Reality file levels: System Dictionary, User Master Dictionary (M/DICT), User-File Dictionary and User-File Data. They are organized in a hierarchical structure with each file level pointing to the files below it. A description of file structures follows.

- System Dictionary contains all legal user log-on names, passwords, and security codes. Each entry points to a corresponding User Master Dictionary.
- User Master Dictionary contains individual user vocabulary (verbs, nouns, connectives and throw aways), all accessible file names, application procedural programs (PROCs), and attributes describing the structure of the information in the dictionary.
- User-File Dictionary contains attributes (and attribute synonyms) describing the structure of the data in the user-file. These attributes define the data field names, describe how it is to be accessed and displayed, and any functions or interrelations with other files or data records.
- User-File Data contains the actual data stored in a variable field length format. In addition to the normal record/field data structure, a field can contain multiple values and a value can consist of multiple sub-values.

Procedure Language (PROC)

Microdata's Procedure (PROC) language is a powerful tool for data entry and file updating. Procedures to format CRT screens, prompt input fields, edit information and display error messages can be written easily and they can utilize primary and secondary input and output buffers to build "batchstrings" of transaction data that will be used to "batch-update" a file. The PROC language has several editing features such as testing conditions for alpha or numeric, comparing against an alphanumeric pattern, and testing for null value. The ability to build user exits into procedures enables overly complex tasks to be performed by assembler language subroutines. For example, Microdata-provided system software routines may be the exits for standard subroutines such as table-lookups or screen formatting.

Procedures can also be used for just data entry. The printing of standard reports can be controlled from procedures as can inquiry facilities be tailored around a particular user's needs.

A procedure is invoked by entering its name as a Reality command. When the corresponding dictionary entry is found, a code in the entry specifies that it is a procedure rather than a verb. The only limit to the length of the procedure is practical: the amount of work-space available to the user. If the procedure cannot be copied into a user's work-space for execution, an error occurs causing the last command to be cancelled.

DATA/BASIC

DATA/BASIC is Microdata's version of Dartmouth BASIC that has been enhanced to accommodate the Reality data base file structure. DATA/BASIC is a multi-user, interactive, programming language used to access and update files, handle special input/output formats and special procedural processing.

TCL

The Terminal Control Language (TCL) processor is the entry point for the user and the rest of the system software. TCL expects a verb as the first entry, and depending on the type of verb, control is retained by TCL-I or transferred to the English processor, TCL-II processor, PROC processor, or LOGON/LOGOFF processors. In general, TCL and the other interactive processors work on one statement (verb plus nouns, qualifiers, conditionals, and connectives) at a time.

RPG II

Standard RPG II, like that used on IBM's System/3, is also available on the Reality system. This capability allows System/3 users to transfer their programs to a Reality system easily without expensive reprogramming.

REAL

REAL is a two-pass macro symbolic assembler that can be used to implement cross-assemblers for other computers.

EDITOR

The EDITOR can be used to create or change DATA/BASIC programs, PROC programs, data files and file dictionaries. Among the EDITOR's capabilities are input/output formatting, prestoring of commands, conditional and unconditional line deletion and character string locate and replace.

Data Base Management Processor

The data base management processor allows the generation and manipulation of files for the Reality system. It includes the CREATE-FILE, CLEAR-FILE, DELETE-FILE, and COPY processors.

Utilities

Reality offers the standard utility functions which include: line printer spooling control, magnetic tape unit functions, creation of user accounts, setting of terminal characteristics, virtual memory dumping and systems accounting.

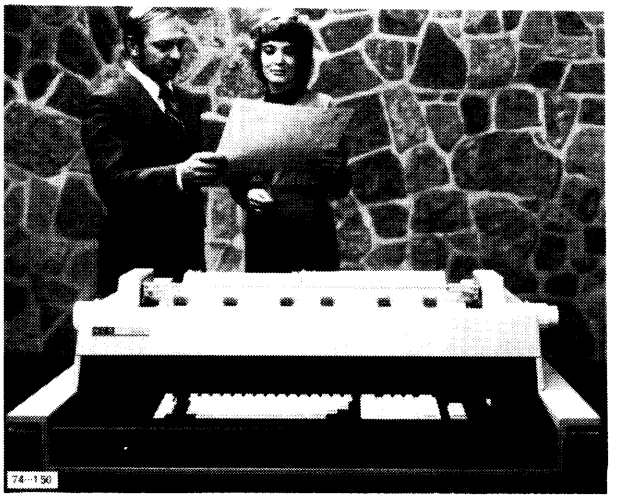
PRICE DATA

Reality is a purchase-only system.

Description	Purchase Price (Maint. Not Incl.) $	Monthly Maint. $
BASIC SYSTEM		
16K BYTES CORE, 5MB disc 800 BPI MAGNETIC TAPE and CONTROLLER' PRISM™ TERMINAL AND PORT, ONE OPEN TERMINAL PORT	33,950	225
MEMORY OPTIONS		
24K BYTES	3,600	25
32K BYTES	7,200	50
40K BYTES	10,800	75
48K BYTES	14,400	100
56K BYTES	18,000	125
64K BYTES	21,600	150
DISC		
10 MB, 1,500 RPM	5,000	15
20 MB, 1,500 RPM	18,000	95
30 MB, 1,500 RPM	30,000	175
40 MB, 1,500 RPM	41,000	255
5 MB, 2,400 RPM	1,500	0
10 MB, 2,400 RPM	6,500	15
20 MB, 2,400 RPM	21,000	95
30 MB, 2,400 RPM	34,500	175
40 MB, 2,400 RPM	47,000	255
LOCAL PRINTERS		
165 CPS, 132-COLUMN, 64-CHARACTER SET	6,000	45
165 CPS, 132-COLUMN, 96-CHARACTER SET	7,200	50
300 LPM, 136-COLUMN, 64-CHARACTER SET	13,500	85
300 LPM, 136-COLUMN, 96-CHARACTER SET	14,600	90
MAGNETIC TAPE SYSTEM		
800 BPI, 9-TRACK, NRZI, 25 IPS	0	0
1,600 BPI, 9-TRACK, PE, 25 IPS	4,000	25
PRISM™ (2nd PORT) 1,920 CHARACTERS	3,500	15
TERMINAL PORT (Maximum of 32 PORTS)	1,200	10
REMOTE PRINTER (Interfaces to PRISM™)		
165 CPS, 132-COLUMN, 64-CHARACTER SET	7,500	45
165 CPS, 132-COLUMN, 96-CHARACTER SET	8,700	50
LOCAL CARD READER		
300 CPM	4,900	50
BISYNC COMMUNICATIONS INTERFACE	8,000	75
FIELD UPGRADES		
8K CORE (64K maximum)	3,600	25
DISC UPGRADES		
5MB DISC, 1,500 RPM (must have 1, 2, or 3 5MB drives @ 1,500 RPM)	9,000	80
5MB DISC, 2,400 RPM (must have 1, 2, or 3 5MB drives @ 2,400 RPM)	10,500	80
10MB DISC, 1,500 RPM (must have 1, 2, or 3 10MB drives @ 1,500 RPM)	13,500	80
10MB DISC, 2,400 RPM (must have 1, 2, or 3 10MB drives @ 2,400 RPM)	15,000	80

PRICE DATA (Cont)

Description	Purchase Price (Maint. Not Incl.) $	Monthly Maint. $
DISC DRIVE SPEED CHANGE (each drive) 1,500 RPM to 2,400 RPM (for Microdata 5 or 10MB drives; all drives must be same speed)	2,000	0
PRISM and PORT	3,500	15
OPEN TERMINAL PORT (Note Maximum of 32 ports total, including total in current configuration)	1,200	10



The NCR 299's simplicity and adaptability are demonstrated by the ease with which it can be programmed. A narrative Program Coding Form is filled in by the operator, and then is transferred to the bar-coded Program Assembly Card by means of a pencil. The marks on the Program Assembly Card are read by the optical scanner, which is shown in its reading position. The penciled marks are read by the scanner and converted to electrical impulses, which are then sent to the computer's memory and stored as a usable program.

OVERVIEW

The NCR 299 is a low-cost programmable accounting system or office computer designed as a general purpose financial record-keeper for businesses with fewer than 150 employees. Similar to the electromechanical accounting machine, the 299 offers functions such as: split-platen printing, keyboard arrangements, and data entry procedures to produce visible records (ledger cards). Along with these basic accounting features, the 299 offers increased power and adaptability, which enables it to handle office computer functions such as: accounts payable and receivable, cash sales, and payroll.

The 299 comes in two models. The 299-0100 is a stand-alone entry-level system which produces printed reports either directly from the keyboard or under program control. The 299-0200 allows for more complex processing as well as the recording of data on cassette. The recorded data can be printed locally or transmitted in batch mode over low-speed asynchronous communications lines to a distant computer. Working or user memory ranges from 10 "totals" (fields) on the smallest 299-0100 to 100 "totals"on the largest 299-0200. Program memory, which is separate, can accomodate 46 program steps on the basic 299-0100 to 126 program steps on the 299-0200. See Table 1 for system specifications.

Data entry on the 299 places more responsibility on the operator than does disc-based interactive small business systems. Because many of the disc-based systems can lead the operator through the entry process in a question-and-answer manner, data entry can be done by a relatively unskilled person. The NCR, however, provides aid for the operator only in the form of a series of indicator lights; therefore the operator must have some knowledge of the proper entry procedures. Despite this consideration, the large difference in price between the NCR 299 and a disc-based system makes the 299 system an inexpensive choice for small business accounting applications.

NCR has provided the small business (and perhaps novice) user with a somewhat unorthodox, but very easy-to-use programming method that enters instructions via preprinted mark sense cards. In addition, NCR offers a library of standard software which enables the NCR sales and support staff to generate turnkey systems for most general accounting applications without the need for a special software staff.

PERFORMANCE AND COMPETITIVE POSITION

The NCR 299-0100 was first delivered in February 1974, and the 299-0200 in December 1974. The company had projected delivery of 5,000 systems in 1974 and 50,000 by the end of 1979. Although they have not lived up to their 1974 projections, the company's long-range projection is not unrealistic. NCR has more than 375,000 carriage-type electromechanical accounting machines installed worldwide, probably more than any other single manufacturer.

The 299's low price, $7,200 to $9,350, enables it to compete with both small office computers and electromechanical accounting machines. Larger businesses with small branches can also use the 299, but these applications usually lend themselves more readily to intelligent terminals that communicate regularly and depend on a large computer system to perform more complex processing than the NCR 299 is capable of.

The 299's only significant competition comes from manufacturers with an established name in accounting machines. The low end of the well-established Burroughs L Series approaches NCR's beginning prices for programmable accounting computers, and at the same time is competitive in the scope of sales and service it can offer. The Burroughs L Series uses a small read/write memory (128 to 256 words), and utilizes more conventional (more complicated) programming techniques. A larger variety

Table 1. NCR 299: Specifications

CENTRAL PROCESSOR	
Word Size (bits)	64 (16 digits)
Capacity (bytes)	4, 8 and 16 K bits
Cycle Time (μsec)	448 (7 μsec/bit)
Working & Program Storage	Core
Microprogrammed	Yes
AUX STORAGE	Cassette
DATA OUTPUT	
Line Printer (lpm)	None
Serial Printer	Golfball (std), 15 cps
Card (cpm)	None
Paper Tape	None
Communications	Asynchronous
DATA INPUT	
Keyboard	Std
Card (cpm)	Mark-sense
Paper Tape (cps)	None
SOFTWARE	
Assembler	None (Not needed)
Operating System	Firmware
Compiler	None, not applicable

of peripherals are available for all models of the Burroughs L Series, including sizable auxiliary mass storage for the upper models of the series. NCR's recent introduction of cassette drives and asynchronous communications on the 299-0200 strengthens their competitive position, since previously the 299 had no mass storage or communications capability.

Litton, IBM, Singer, Friden, Philips and the Swedish Facit Addo also have some penetration of the electromechanical accounting machine market and, excepting IBM, all have automated their systems. NCR also has met the Wang 2200, a low-cost office computer that is an outgrowth of Wang's calculator business.

The competitive position is different in Europe, where a large variety of office computers (called visible record systems in Europe) are offered by Nixdorf, Kienzle, Olivetti, and Philips, as well as many smaller companies. Many European manufacturers also offer magnetic-stripe ledger cards, which are more popular in Europe than in the United States.

USERS' REACTIONS

Three users interviewed were small businesses with 100 to 175 employees. They included a construction company, a wholesale bakery and a water supply company in which the NCR 299 had been operative for 6 months to 1 year. The users were generally pleased with the way the system operated, and with its time and work saving features. Most of them were using the 299 to replace obsolete electromechanical accounting machines, and one user was replacing an old Burroughs accounting machine.

All of the users' comments indicated their lack of understanding of the 299's potential. This, of course, is not surprising at the bottom end of the market, and it suggests the need for some sort of stimulus by NCR to encourage users to explore the capabilities of their system. All had bought complete software packages from NCR; only one user thought he "might" try doing some of his own programming in the future.

All the users contacted had single systems. Most had accounts receivable, accounts payable, payroll and general ledger programs. All found that software worked with few modifications and that it was comparatively inexpensive, especially in comparison to estimates received on software for a Burroughs L series system.

On the whole, the users we contacted indicated that the 299 met their expectations in performance as well as cost, and that they received competent service from NCR.

CONFIGURATION GUIDE

The basic 299-0100 system includes keyboard, printer and optical scanning reader, combined in a single unit with the processor and 4K bits of read/write core memory. This system can accumulate 10 separate totals and handle programs of up to 46 steps. Options include additional memory up to 50 totals in increments of 20, programs of up to 63 steps, multiply/divide, check digit verification, and a continuous forms feeder

The 299-0200 system includes the same basic elements as the 299-0100, except that 63 program steps and 50 totals are included in the minimum system. The 299-0200 system can be expanded to 50, 70, or 100 totals, and 100 or 126 program steps. It also can attach a magnetic tape cassette drive and an asynchronous communications interface, as well as multiply/divide, check digit verification, and a continuous forms feeder.

As a potential preview of future NCR 299 enhancements, the program coding forms include standard codes for paper tape/edge-punch card reader/punches, cassette transports, magnetic ledger card processing, and communications. This suggests that paper tape readers, edge-punched card readers and magnetic ledger card read/write units are planned for the future.

MAINFRAME

The basic system combines an accounting machine keyboard, a golfball printer with split-platen, and a special mark-sense reader and processing unit all housed in a single desk-like unit. The golfball printer and optical scanner for the system are contained in a single mechanism which moves horizontally across the forms feeder. The serial printer prints the standard 88-character set at 15 characters per second on multiple part forms that may consist of an original and up to seven copies. The keyboard is typewriter-style with a 10-key numeric pad and nine control keys. A split-platen can handle one or two forms totaling 4 to 23 inches in width; 10 and 12 inch platen sections are standard, but other splits are available.

Central Processor

The central processor is a microprogrammed minicomputer which controls the system. The processor, which is modular and compact, is constructed of semiconductor circuitry. All control and arithmetic operations are programmed and executed from the system's nondestructive core memory. Read/write core memory of 4, 8, and 16K bits is available for user data and programs.

Data Structure. NCR expresses system storage capacity in terms of program "steps" and user "totals." Each program step is a one-word multifunction instruction which is 64-bits long. Totals are also one-word fields (8-bytes, or 16 digits) for storage of any type of data. Program and data storage are separated from one another.

Instruction Set. Most users undoubtedly will take advantage of NCR's inexpensive customized programming, but those who are interested in doing their own programming will find NCR's instruction set helpful.

The two classes of instructions, or "program steps," are "primary" and "secondary." Although the formats are similar, the fields in the 64-bit instruction word are interpreted differently, depending on the format flag setting (0= primary, 1=secondary). All except I/O instructions use the primary format; I/O instructions use the secondary format.

Table 2 depicts the layout of the 299 instruction format. The first field at the top of Table 2 corresponds to the leftmost field of the instruction word, the other fields follow in order of their position in the instruction word. Operations coded in field number 8 (prime operation) include Add, Subtract, Move, Multiply (optional), Divide (optional), Clear, Branch, Compare for Less Than and Greater Than, Compare for Equal To or Unequal To, Check Digit Verification, Distribution Code, Distribution Code Value In, Distribution Code Value Out, Input, Output, and Output Special.

The Distribution Code group of instructions allows totals to be accumulated separately by the type of part for sales analyses. The Output Special Instruction allows totals to be printed with a special indentification if they are not to be printed columns that automatically identify the type of total. The symbols, CR, and CR are used to identify reverse conditions, because carbon copies cannot print in two colors. The Source field provides for exceptions by branching for unusual cases.

PERIPHERALS

The only optional peripheral device currently offered with the 299 is the 761-299 digital magnetic tape cassette drive. The cassette drive can be used to record and enter both programs and data, or to store data for communications purposes.

COMMUNICATIONS

The Communications option for the 299 consist of the asynchronous communications adapter (M50-2 STD) together with the integrated modem (M51-2 STD). When these are added to a system, it can operate like a terminal in a poll/select environment over 4-wire leased lines or as a member of a point-to-point or multipoint network. The 299 communicates with a central computer or a facility that can operate like a central computer. It cannot communicate with another 299 or 399. The system transmits the 7-bit ASCII/ISO code asynchronously over half-duplex lines using NCR's native 270 discipline.

SOFTWARE

All software is available at an extra charge. NCR provides standardized packages at a flat fee of $300 and customized programming at $22 per hour. Programming is usually inexpensive because it takes little time. Frequently a salesman can gather data in the morning and return with a program in the afternoon.

Sample programs include the following:

- Accounts Payable—Bill and Charge. With automatic calculations of line items, trade and cash discounts, taxes, freight charges, per hundred and per thousand pricing; automatic date and invoice numbering, and automatic posting of customer statement ledger and sales journal.

Table 2. NCR 299: Instruction Formats

Field Number	Number of Bits in Field	Primary Statement Format	Secondary Statement Format
1	8	Print Positions	Same
2	2	, CR, or No Sign	Same
3	1	Black or Red Ribbon	Same
4	5	Maximum Output Length	Same
5	1	Currency Symbol	Same
6	1	Edit/Omit	Same
7	2	Decimal Places (2, 3, 5, or None)	Same
8	4	Prime Operation, Non-I/O Instruction: Add, Sub, Mul, Div., etc.	Prime Operation Input, Output, or Output S
9	1	Format Flag (Primary/ Secondary Statement Format)	Same
10	7	Source (10-Key or Branch Key)	I/O Device
11	1	Clear Source	Clear A-B Operands
12	7	Operand A	Same
13	1	Add/Subtract	Numeric/Alphanumeric
14	7	Operand B	Same
15	1	Add/Subtract or EOT	EOT
16	7	Operand C: 3-bit Output Device Code and 4-Bit Data Code Pointer	Same
17	8	Forms Handling Flags	Same (But "Additional Output" and "ERR Corr" Fields Omitted)
	64	Total Number of Bits	

- Accounts Receivable—Voucher and hold, voucher and pay, cash disbursements with invoices vouchered and checks printed, cash disbursements journal updated.
- Accounts receivable with sales distribution with amounts distributed for sales analysis, sales journal maintained, and automatic proofing.
- Payroll, with four to-date balances, for simultaneously creating payroll journal and check register, employees earning records, employees pay statements and payroll checks, with automatic proof.
- Trial balance age analysis of accounts receivable and balance transfer.

Packages include Accounts Receivable, Accounts Payable, Invoicing, Billing and Charge, General Ledger, Payroll, Job Costing, Wage Accrual, and so on.

MAINTENANCE

Maintenance is available through about 300 sales and service centers in the United States and 900 offices overseas. The standard contract provides for maintenance during any 8-hour period between 8 a.m. and midnight. Special arrangements can be made for other types of contracts, including 24-hour service.

PRICE DATA

Note that the 299-0100 cannot be leased, but that the 299-0200 can. Rental contracts are typically for 1 year with renewals from month to month.

DEVICE	MONTHLY RENTAL	PURCHASE PRICE $	MONTHLY MAINTENANCE $
299-0100 (10 totals, 46 steps)	NA	7,200	40
increase 10 to 30 totals	NA	400	2
increase 30 to 50 totals	NA	400	2
increase 46 to 63 steps	NA	400	3
299-0200 (30 totals, 63 program steps)	358	9,300	48
increase 30 to 50 totals	15	325	3
increase 50 to 70 totals	15	325	4
increase 70 to 100 totals	15	325	4
increase 63 to 100 steps	18	350	3
increase 100 to 126 steps	18	350	3
Options, Both Models			
Multiply/Divide	15	350	1.50
Check Digit Verification	10	300	1
Forms Feed	30	700	4
Options, 299-0200 Only			
Communications Adapter	23	750	3
Cassette Recorder	50	1,500	10.50

HEADQUARTERS

NCR Corporation
Main @ K Sts.
Dayton OH 45479

NCR CORP.

399 Accounting Computer

OVERVIEW

The NCR 399 Accounting Computer is a triple-threat entry in the small business systems market. The model can be configured, programmed, and arranged to serve as an electronic accounting machine, a small business computer, and an intelligent terminal. The 399's strongest appeal is as an entry-level computer system catering to companies upgrading their operation from a system based on NCR's more limited 299 visible record computer or an equivalent competitive device, an operation using a non-computer-based accounting device or even an operation with totally manual methods.

Recent additions to the line include two packaged 399 models, a new smaller-capacity disc cartridge model joining the previously announced disc cartridge model, and a low-speed line printer. In addition, NCR has announced a price reduction on the larger-capacity disc cartridge model. See Table 1 for a listing of the NCR 399 model specifications.

PERFORMANCE AND COMPETITIVE POSITION

The NCR 399, announced in 1972, began life as a component of NCR's distributed processing corps communicating with NCR's Century Series computers. However, since introduction of the 399, the market for small stand-alone accounting computers has blossomed, and the NCR 399 has achieved its greatest acceptance in that market.

The most direct competitors of the NCR 399 are the Burroughs L Series accounting computers. Indeed, the two companies seem to act and react to one another's product announcements and marketing strategies. Both companies have a long history of service to the business market, beginning with mechanical devices, and advancing to electromechanical, and electronic devices for accounting applications. Both companies also have a large installed base of older accounting equipment consisting of hundreds of thousands of devices. These bases are a natural prospect for upgrades to the newer small electronic accounting computers, so the financial stakes are high. Consequently, the competition for placements is fierce, and there is a high incidence of head-to-head comparison of the two series by users before the selection process is complete. Choosing between the NCR 399 and a Burroughs L Series system is not easy for a prospective buyer. Both systems offer many of the same components and features, and both manufacturers are highly visible companies with worldwide marketing and service. Equally equipped models tend to be similarly priced; therefore, the price differential, for the most part, is not an influencing factor. In many cases, the influencing factor in making a choice between a Burroughs and an NCR model appears to be the selling ability of the individual salesman.

For the moment, the greatest differences between the NCR 399 and the Burroughs L Series systems revolve around the 399's ability to host disc storage, and the L Series' lack of a disc storage unit capable of storing relatively large amounts of data. Conversely, the L Series' use of COBOL (as opposed to the 399's use of an Assembler language) as its programming language provides L Series users with greater portability of programs and more easily recruited programming personnel.

CONFIGURATION GUIDE

There are now three models of the NCR 399 — 399-100, 399-113, and 399-114. The original and basic unit is the 399-100. It is almost a totally configurable model with minimum components required. The 399-113 and 399-114 are packaged models, but they can employ the full range of 399 peripherals with the exception of the magnetic ledger card option.

A minimum NCR 399-100 consists of a processor and 8K bytes of main memory; a single magnetic tape handler

HEADQUARTERS

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Table 1. NCR 399 Model Specifications

Models	399-100	399-113	399-114
Characteristics			
Processor			
Memory Technology	Core	Core	Core
Memory Sizes (bytes)	8 to 32K	20 to 32K	20 to 32K
Word Size (bits)	16	16	16
Cycle Time (msec)	1.2/word	1.2/word	1.2/word
Microprogrammed	Yes	Yes	Yes
Software			
Operating System	Firmware	Firmware	Firmware
Language	Assembler	Assembler	Assembler
Aux Storage			
Mag Tape Cassettes	1 to 3	1 to 3	1 to 3
Mag Ledger Cards	Yes	Not avail.	Not avail.
Mag Disc Cartridge	9.8	4.9 or 9.8	4.9 or 9.8
Data Input			
Keyboard Type	Typewriter & numeric	Typewriter & numeric	Typewriter & numeric
Fully Electronic	Yes	Yes	Yes
Card Punch Reader	300 cpm	300 cpm	300 cpm
Paper Tape Reader	125 char/sec	125 char/sec	125 char/sec
Data Output			
Serial Printer	20 cps	20 cps	20 cps
Line Printers (lpm)	55 to 300	55 to 300	55 to 300
Card Punch	26 cpm	26 cpm	26 cpm
Paper Tape Punch	60 char/sec	60 char/sec	60 char/sec
Communications			
Line Facilities	Dial, leased	Dial· leased	Dial; leased
Line Speed (bps)	1,800 async; 9,600 sync	1,800 async; 9,600 sync	1,800 async; 9,600 sync
Synchronization	Sync, async, bisync	Sync, async, bisync	Sync, async, bisync

and cassette drive; dual electronic keyboards — typewriter and 10-key numeric; a serial printer; and a carriage for forms from 4 to 23 inches.

An NCR 399-113 consists of a processor with 20K bytes of main memory; an integrated disc controller with a 656-341 disc unit (4.8 mb); dual electronic keyboards — typewriter and 10-key numeric; a serial printer; and a carriage for forms from 4 to 23 inches.

The NCR 399-114 consists of a processor with 20K bytes of main memory; an integrated disc controller with a 656-341 disc unit (4.8 mb); a common trunk to attach free-standing peripherals; a 644 matrix line printer (55 lpm); dual electronic keyboards — typewriter and 10-key numeric; a serial printer; and a carriage for forms from 4 to 23 inches.

MAINFRAME

The mainframe of the NCR 399 is a floor model, printer keyboard console attached to a processor cabinet. The printer keyboard console and processor cabinet house the processor, main memory, serial printer, and console keyboards and controls, as well as the magnetic tape cassette handlers in the processor cabinet. All other peripherals are free-standing and cabled to the mainframe.

A maximum of eight free-standing devices can be attached to the NCR 399 through a common trunk. The trunk interfaces all free-standing devices, except the magnetic ledger feeder/reader and the cartridge disc. These two devices, although free-standing, use integrated controllers. There is only one slot for either controller, and the devices are mutually exclusive of one another.

Attachments to the common trunk are in a serial fashion. Devices attached to the trunk operate one at a time at transfer rates of up to 20,000 8-bit characters per second. However, operation of a device on the common trunk can overlap with operation of the integrated devices.

Central Processor

The processor used by the 399 is a general-purpose minicomputer microprogrammed with a language interpreter. The processor is available with models that feature 8K to 32K bytes of core memory in increments of 2K bytes. The interpreter arranges the execution sequence of the 399 program and the subroutines required to make the peripherals operational.

COMMUNICATIONS

All NCR 399 models offer a single-line communications adapter. The 399 can support asynchronous, synchronous, or binary synchronous communications disciplines through a combination of the hardware adapter and software packages which NCR calls On-line Communication Drivers (OCDs). The combination of the hardware and software makes the NCR 399 readily adaptable to communicate with NCR, and many non-NCR, host processors a 'd communications devices.

NCR offers support for both dial-up and leased circuits. Transmission speeds permitted are 1,200 to 1,800 bps in the asynchronous mode and 2,000 to 9,600 bps in the synchronous and binary synchronous modes.

PERIPHERALS

Peripherals for the NCR 399 include both integrated and free-standing devices. The free-standing devices are the

card punch, card reader, tape reader, tape punch, line printer, magnetic ledger feeder/reader, and the cartridge disc. The magnetic ledger feeder/reader and the cartridge disc are treated like integrated devices.

Magnetic Ledger Feeder/Reader

The hardware components of the device include a 1,000-card capacity feed hopper, a ledger card transport, a read station and a 1,000-card capacity receiving hopper. NCR 399 magnetic ledgers have a single vertical stripe one-half inch wide on the reverse side of a ledger. Both sides of a ledger have stripes if both sides of the ledger are used.

Data is read from and recorded on the magnetic stripes at a rate of 20 inches per second. A 12-inch card is fed and read approximately every 1.5 seconds. The right rear eject option, when used in conjunction with magnetic ledgers, automatically ejects and stacks them in sequence behind NCR 399.

Up to 157 bytes (314 digits) of data can be stored on a 6-inch-long ledger, the shortest that can be used; up to 782 bytes (1,564 digits) of data can be stored on a 16-inch-long ledger, the longest that can be used.

Magnetic Cartridge Disc

NCR offers two cartridge disc models for the 399. The higher-capacity model, the NCR 656 disc unit, can be attached to any of the NCR 399 models. The Model 656 disc drive is a single-spindle unit that has one fixed and one removable disc, each capable of holding 4.98 million characters. Transfer rate is 312,000 characters per second, and the unit's average access time is 47.5 milliseconds. In addition, the disc drive can be used with the NCR Century 101 and 151 small business computers. Disc packs are interchangeable between the NCR 399 and Century Series computers.

The new 656-341 disc unit is a hardware- and software-modified 656-301 disc unit. The 656-341 makes only half of the fixed and removable disc platters available for data recording, using the same techniques as the larger 656-301. The 656-341 can be upgraded to the full capacity of the 656-301. The new disc unit can be attached to the new NCR 399 models, the 399-113 and the 399-114. It is not available to the standard 399-100 System.

Magnetic Tape Cassette

The magnetic tape cassette is used for storing program or user data. A basic 399 is equipped with one cassette drive and, optionally, a second or third cassette drive can be added. User programs are stored and read only from cassette 1, but all three cassettes can be used for user data. Two cassettes are required to assemble or reassemble programs on the 399. Each cassette is capable of storing approximately 336,000 8-bit ANSI-, ECMA-, or ISO-compatible characters.

Card Reader

The card reader reads 80-column cards at a rate of 300 cards per minute. The hardware components include a feed hopper, card transport, photoelectric read station, receiving hopper, and an interface for converting Hollerith data code to 8-bit ASCII.

Card Punch

The card punch processes 80-column cards. The punch-only speed is 26 cards per minute, and the print/punch speed is 13 cards per minute.

Line Printers

The 399 offers four different line printers — 55-, 125-, 200-, and 300-line per minute models. Any of the line printer models can be attached to any of the 399 models. All models are 132 characters wide typeline with a 64-character print set printing 10 characters horizontally and 6 lines/inch vertically.

Tape Punch

The tape punch punches a maximum of 60 characters per second. It perforates an 8-bit character code on a standard one-inch tape.

Tape Reader

The tape reader uses a photoelectric read head of 5-, 6-, 7-, or 8-channel tape. It reads at speeds up to 125 characters per second.

Serial Printer

The serial printer uses a print ball which operates at 20 characters per second in the alphanumeric mode and 24 characters per second in the numeric mode. The standard typeline is 256 characters wide. Optionally, the typeline can be arranged for a width of 221 characters.

Keyboard Console

The alphanumeric keyboard features 48 electrically operated typing keys, system control keys, form control keys, branch keys, and system status indicators. Side-by-side with the alphanumeric keyboard is a separate 10-key numeric pad. The alphanumeric keyboard is used to enter data definitions and procedural statements during the program assembly process. During an application run, the keyboard can be used for entering descriptive data or for entering data into memory for later programmed recall.

Forms Handler

The forms handler holds and spaces cut forms. It consists of a front line guide, split and normal platens, a feed mechanism, and associated card guides and chutes. It can accommodate forms from 4 to 23 inches wide.

The basic forms handler has two chutes — one for rear-insertion of cut journal sheets and tally or journal rolls, and one for front-insertion of cut forms such as ledgers, statements, invoices, and vouchers. The standard platen is split 9 inches left and 13.1 inches right. Optional split configurations are available in increments of 2 to 17 inches left and 5.1 inches right.

Continuous Forms Feeder

The continuous forms feeder is used for feeding, holding, and spacing a continuous form. The feeder is equipped with a pair of pin-feed tractors accommodating widths from 4 to 23 inches.

SOFTWARE

NCR 399 customers are provided with a near-English language to prepare application programs. To facilitate arranging 399s in communications networks, NCR offers a variety of software routines for performing handshaking functions.

The near-English language offered with NCR 399 is a problem-oriented assembly language similar to NEAT/3 Level 1 used with the NCR Century Series. It is easy to use and self-documenting, permitting programs to be readily implemented and maintained. Customers with little or no prior programming experience should, with some training, be capable of programming their own applications.

For customers who do not want to prepare their own application programs, NCR offers a wide line of reasonably priced application packages. These packages — essentially converted versions of those used with earlier NCR accounting machines — will be modified and tailored to specific processing requirements for a fee.

Programs can be assembled on an NCR 399 and on an NCR Century Series system. Two magnetic tape cassette handlers and 8K bytes of core are required in order to assemble programs on an NCR 399.

In performing assemblies, a copy of the assembler is first loaded into core storage from a magnetic tape cassette. A cassette containing near-English statements is then inserted in one handler, and serves as input for the assembler. A blank cassette is inserted in the other handler and receives the results of the assembly.

NCR 399 is microprogrammed — it is equipped with a set of elemental (micro) operators that are used to (micro) program interpreter routines, which, in essence, serve as instructions. A library of preprogrammed interpreter routines (modules) is loaded into core storage prior to assemblies and, when a program is assembled, modules are selected and incorporated in the final program. Only those modules required by the job are selected; this conserves core requirements for the program and prevents customers from over-investing in core storage.

"Lead-through" programming techniques can be incorporated in application programs to train and assist operators. Instructions that cause directions for an operator to be printed on a message log are embedded at various points in a program. The directions can serve to "lead an operator through" a job. After the operator gains experience with the job, printing of the directions can be suppressed by depressing an option key on the 399 console.

PRICE DATA

Description	License Fee $	Purchase Price $	Monthly Rental (Incl. Maint.) $	Annual Maint. $
NCR 399-100				
399 Processor with 8K bytes of main memory		14,000	420	709
NCR 399-113				
399 Processor with 20K bytes memory, integrated disc controller, 656-341 disc unit (4.8 mb), 20 CPS ball printer		31,800	795	176
C399-113 System Substitution (added to base price)				
C656-301 Disc Unit (up to 9.8 MB)		3,000	75	21
NCR 399-114				
399 Processor with 20K bytes memory, integrated disc controller, 656-341 disc unit (4.8 mb), common trunk 644 matrix line printer (55 lpm)(132 print position, 64 char set)		35,750	925	214
C-399-114 System Substitutions (added to base price)				
656-301 Disc Unit (9.8 mb)		3,000	75	21
349-1 Line Printer (125 lpm)		5,000	120	- 3
349-2 Line Printer (200 lpm)		8,000	210	2
349-300 Line Printer (300 lpm)		12,000	300	7
PERIPHERALS				
314 Ledger Feeder/Reader		4,500	185	265
349-1 Line Printer (125 lpm)		10,000	280	384
349-2 Line Printer (200 lpm)		13,000	370	444
644-100 Line Printer (55 lpm)		4,995	160	38
349-300 Line Printer (300 lpm)		17,000	460	503
356 Paper Tape Reader		2,500	70	101
367 Paper Tape Punch		3,000	95	210
368-1 Card Punch Reader		4,500	150	263
378 Card Punch		5,300	215	315
Integrated Disc Controller (for 656-301/341)		2,500	50	19
656-301 Disc Unit, 9.8 mb (req. integ. controller)		12,500	375	97
956-1 Disc Pack		120	NA	NA
656-341 Disc Unit, 4.9 mb (req. integ. controller)		9,500	300	76
ACCESSORIES				
904-7 Continuous Forms Feeder – 1		700	25	45
904-8 Continuous Forms Feeder – 2		700	25	35
991-24 Paper Tape Assembly Cabinet		300	NA	NA
991-26 Junction Box		NC	NA	NA
Additional Memory (2,048-byte increments)		1,100	35	53
Expanded Memory – 4K byte increments (16 kb to 32 kb)		1,250	35	53
Expanded Memory Capability (required on systems 16 kb to 32 kb)		650	21	NA
Mag Ledger (requires ALF-R)[1]		4,800	145	121
Asynchronous Communications (price when ordered initially w/399)		750	15	79
Add-On Price for Field Upgrade		1,500	30	7(

PRICE DATA (Contd.)

Description	License Fee $	Purchase Price $	Monthly Rental (Incl. Maint.) $	Annual Maint. $
ACCESSORIES (Contd.)				
Synchronous Communications (price when ordered initially w/399)		750	15	79
Add-On Price for Field Upgrade		1,500	30	79
Cassette No. 2		1,850	50	63
ALF-R (Auto. Line Find-Right)		1,250	40	95
ALF-L (Auto. Line Find-Left)		625	15	38
ALF-L&R (Auto. Line Find-Left & Right)[2]		1,500	50	133
Rear Eject (requires ALF-R)[3]		400	15	32
Common Trunk		500	15	38
Cassette No. 3		1,850	50	60
Red Print		175	6	NA
SOFTWARE				
930-101 Payroll — Plan 1; 8K	1,050			
930-102 Payroll — Plan 2; 10K	1,500			
930-201 General Ledger — Plan 1; 8K	750			
930-301 Accounts Payable — Plan 1; 8K	900			
930-302 Accounts Payable — Plan 2; 10K	1,200			
930-401 Accounts Receivable — Plan 1; 8K	1,100			
930-402 Accounts Receivable — Plan 2; 10K	1,300			
930-501 Client Accounting	1,200			
Demo Billing	480			
Mag Ledger Payroll	1,245			
M/L Accounts Receivable	755			
Cassette Accounts Payable	900			
Payroll & Labor Dist (Cass/Cass)	1,550			
Bank Demand Deposit Accounting	375			
Savings	750			
Credit Union	1,200			
Mortgage Loans	675			
Commercial Loans	965			
Mortgage Loan Closing Demo	800			
Contractor Job Cost	1,950			
Client Write-Up	836			
Appropriation Accounting	1,000			
School Payroll	870			
Cassette Utility Billing	750			
In-Patient Accounting	1,850			
Mag Ledger Utility Billing	680			
Appropriation Accounting w/Student Accounting Activity	1,210			
Auto Dealer General Ledger	800			
Auto Dealership Accounting	1,650			

Notes:

[1]Mag Ledger including ALF-R, which is required: $6,050.

[2]When ordered and installed together.

[3]Rear Eject including ALF-R & Mag Ledger (required): $6,450.

NC — No Charge
NA — Not Available

NCR CORP.

499 Accounting Computer

OVERVIEW

The NCR 499 Accounting Computer is the latest entry of NCR into the small business systems market. The NCR 499 is the successor to the successful NCR 399 Accounting Computer and serves the same markets with more modern electronics and improved peripheral devices. The NCR 499 can be configured and programmed as an electronic accounting machine, as a small business computer, or as a programmable intelligent terminal system. Like the NCR 399, the NCR 499 is an entry-level computer system for companies upgrading their operations from older equipment, such as the NCR 399 or the more limited NCR 299 visible record computer, or an equivalent competitive device. Also, the NCR 499 can serve as an upgrade system for a company using a nonelectronic accounting device or manual methods.

The NCR 499 uses an assembly programming language, NEAT-AM, similar to that of the NCR 399, and also uses the same classes of application programs that are available for the NCR 399. The 499 can use most of the NCR 399 peripherals and includes a new 75-cps bidirectional matrix printer. The NCR 499 was announced in January 1976 and first deliveries were made in the first quarter of 1976. See Table 1 for a listing of the NCR 499 system specifications.

COMPATIBILITY

The NCR 499 has been designed as an easy upgrade for users of the NCR 399. Many of the 399's freestanding peripherals are directly usable on the 499, and cassettes prepared on the 399 and 499 may be interchanged. Software compatibility is also excellent, with all NCR 399 programs upward compatible onto the 499.

At the telecommunications level, the 499 can communicate with other NCR computers and mainframes of other manufacturers by use of an IBM 2780 binary synchronous emulation package.

PERFORMANCE AND COMPETITIVE POSITION

The NCR 499 is a straightforward upgrade of the older, successful NCR 399 Accounting Computer. The NCR 499's major improvement is its new integral printer, which operates at 75 characters per second and represents a substantial improvement over the 20-character-per-second golf-ball type printer of the NCR 399. In addition,

Table 1. NCR 499 System: Specifications

PROCESSOR	
Memory Technology	Core
Memory Size (bytes)	12K to 32K
Word Size (bits)	16
Cycle Time	1.2 msecs
Microprogrammed	Yes
SOFTWARE	
Operating System	Firmware
Language	NEAT-AM assembly
AUXILIARY STORAGE	
Magnetic Tape Cassettes	1 std, up to 4 opt
Magnetic Ledger Cards	Opt
Magnetic Disc	4.9 or 9.8MB opt
DATA INPUT	
Keyboard Type	Buffered, typewriter with numeric pad and function keys
Punch Card Reader	300 cpm opt
Paper Tape Reader	125 cps opt
DATA OUTPUT	
Serial Printer	Buffered, 75 cps with forms handler std
Line Printers	55 to 300 lpm opt
Card Punch	26 cpm opt
Paper Tape Punch	60 cps opt
COMMUNICATIONS	
Line Facility	Dial, leased
Line Speed (bps)	To 1,800 baud async; to 9,600 baud sync
Compatibility	NCR 499, NCR 399, IBM 2780

HEADQUARTERS

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the NCR 499 has magnetic disc storage designed for the system, rather than added onto an existing product, as it was with the NCR 399.

While the NCR 499 is advertised as a system that can be used both as an intelligent terminal and as a comprehensive small business computer, primary marketing emphasis is on the system's capabilities as a sophisticated accounting machine. In this market, the NCR 499 meets with strong competitors: the Burroughs L Series (the primary domestic entrant) and Nixdorf, the Olivetti Audit Series and Philips P300 as the international competitors. In Europe, where accounting computers (sometimes called visible record computers) are popular, the NCR 499 competes with Kienzle 2000 and 6000 Series, Insel Mael 2000 and 4000, and LogAbax LX 4000.

As an accounting machine, the NCR 499 compares well with most of its competitors. The new integral printer allowing higher throughput than the older NCR 399 and the magnetic ledger facilities and split platen allow for comprehensive ledger-based systems. In terms of storage media, the cassette storage of the NCR 499 will prove adequate for many applications, and it can be augmented by the large disc storage module for more complex applications.

By and large, choosing an accounting machine from Burroughs, NCR, Philips, Olivetti, or Nixdorf becomes a question of choosing the machine with the software or application system best suited to the user's needs. Here, NCR has been able to make use of the application library developed for the NCR 399. It now offers application packages at modest license fees in a wide variety of areas, including retail management (always an NCR strong point), local government financial management, and wholesale distributor inventory accounting. NCR is planning on giving greater emphasis to the disc storage capabilities of the 499, and plans to develop application packages to take advantage of this device.

An unusual feature of the NCR 499 compared with many of the devices in its class is its ability to be upgraded by adding telecommunications or disc storage. While a number of other competitors such as Burroughs and Olivetti offer these capabilities, the 499 is somewhat unique in its support of large disc storage. A word of caution may be appropriate here, because most of the turnkey applications for the NCR 499 are designed around cassette or ledger card media storage, and programming will be required to convert from the cassette media to make effective use of the disc.

As a disc-based small business computer, the NCR 499 will be competing with a different class of system. Here, devices such as the IBM System/32 and CRT workstation systems such as the DEC Datasystems or Basic/Four should be considered. With a disc, the cost of the NCR 499 begins to approach that of these larger systems, but the 499 cannot support multiple workstations (as can the larger DEC units), nor does NCR currently offer a wide variety of disc-based application packages (as IBM does for the System/32).

CONFIGURATION GUIDE

The NCR 499 is offered as a single model that may be configured with additional memory and a variety of peripherals. The basic system is an integral workstation unit consisting of the processor with 12K bytes of core memory; an operator console with media tray and side table; a data entry keyboard with a numeric pad, auxiliary controls, and indicator panel; a bi-directional, 75-character-per-second buffered matrix printer with a split platen forms handler; and one magnetic tape cassette drive.

A number of peripherals may be added to the basic unit.

- A magnetic ledger card reader allows ledger cards from 6 to 16 inches in size.
- A continuous forms feeder may be attached to the serial printer.
- An automatic line-find feature permits positioning to the proper posting line on either side of the split platen.
- A rear eject option allows for minimizing handling of magnetic ledger forms while retaining ledger order.
- Up to a total of four magnetic tape cassette drives may be installed within the basic system housing.
- Either synchronous or asynchronous communications adapters may be added.
- Processor memory can be increased in increments of 2K bytes up to a maximum of 32K bytes.

The NCR 499 also supports a number of freestanding peripherals that are available for the older NCR 399 systems. A variety of line printers operating at differing speeds are available, as are paper tape readers and punches and punched card readers and punches. A disc unit with a single fixed and single removable cartridge may also be attached to the system, for a total storage capacity of 4.9 or 9.8 million bytes of data.

MAINFRAME

The NCR 499 mainframe is integral to the operator workstation and is located under the keyboard/printer, in an attractively packaged unit. The magnetic cassette drives are located to the left of the operator work area within the main processor housing. Additional memory and communications interface logic is also housed within the main processor, but all other peripherals are freestanding and cabled to the mainframe.

A maximum of eight freestanding devices can be attached to the NCR 499 through a common trunk, which interfaces all freestanding devices except the cartridge disc, which uses an integrated controller. Attachment to the common trunk is in a serial fashion. Devices attached to the trunk operate one at a time at transfer rates up to 20,000 bytes per second. Operation of trunk peripherals may overlap operation of integrated devices.

Central Processor

The processor used by the 499 is a general-purpose minicomputer microprogrammed with a language interpreter. The interpreter arranges the execution sequence of the 499 program and implements input/output execution. The processor contains a minimum of 12K bytes of core memory, which may be increased in increments of 2K bytes up to a maximum of 32K bytes.

PERIPHERALS

Peripherals for the NCR 499 include both integrated and freestanding devices. The freestanding devices include the magnetic ledger reader, the card punch and reader, the paper tape punch and reader, the line printer, and the cartridge disc. The disc is treated as an integrated device.

Magnetic Ledger Reader

This device allows the reading and recording of data onto hand-entered magnetic ledgers, which use a single vertical stripe ½-inch wide on the reverse side of the ledger. Data is read from and recorded on the magnetic stripes at the rate of 20 inches per second. Ledgers can vary in size from 6 to 16 inches. The largest ledger can hold 1,564 digits (782 characters) of data, and an 11-inch ledger can hold 940 digits (470 characters) of data. The automatic ledger feed facility of the NCR 399 is not supported on the 499, but an automatic rear eject feature is available for stacking of ledgers to minimize forms handling.

Magnetic Disc

NCR offers two cartridge disc models for the 499. Both units make use of a single spindle containing a single fixed platter and a single removable platter. For both units, the data transfer rate is 312K bytes and average access time is 47.5 milliseconds. The larger unit, which holds 9.8 million bytes of data, is compatible with the NCR Century series computers. The smaller unit holds only 4.9 million bytes of data by making use of only half the available disc surface. The small disc unit may be upgraded to the larger size.

Magnetic Tape Cassette

The magnetic tape cassette is used for storing program or user data. A basic 499 is equipped with one cassette drive and, optionally, one to three additional drives can be added. User programs are stored and read only from cassette 1, but all four cassettes can be used for user data. Each cassette is capable of storing approximately 336,000 eight-bit ANSI-, ECMA-, or ISO-compatible characters.

Card Reader

The card reader reads 80-column cards at the rate of 300 cards per minute. The hardware components include a feed hopper, card transport, receiving hopper, and an interface for converting Hollerith data into eight-bit ASCII.

Card Punch

The card punch processes 80-column cards. The punch-only speed is 26 cards per minute, and the print/punch speed is 13 cards per minute.

Line Printers

The 499 offers 55-, 125-, 200-, and 300-line-per-minute printers. All of the printers make use of a 132-character printline and use a 64-character print set at 10 characters per inch and six lines per inch.

Tape Punch

The paper tape punch punches a maximum of 60 characters per second using eight channels on standard 1-inch tape.

Tape Reader

The paper tape reader uses a photoelectric read head. It reads five-, six-, seven-, or eight-channel tape at speeds up to 125 characters per second.

Serial Printer

The integral serial printer uses a dot matrix printing technique and operates at a rate of 75 characters per second. The printer is buffered and can print bi-directionally. It uses an 88-character set and can print up to 132 characters per line.

Keyboard Console

The alphanumeric keyboard features 48 electrically operated typing keys, system control keys, and system status indicators. To the side of the alphanumeric keyboard is a separate 10-key numeric pad. During an application run, the keyboard can be used for entering descriptive data; during assembly, it may be used for entry of data definitions and procedural statements.

Forms Handler

The forms handler holds and spaces cut forms. It consists of a front-line guide, split and normal platens, a feed mechanism, and guides and chutes. It can accommodate forms from 4 to 23 inches in width. The basic forms handler has two chutes: one for rear insertion of cut journal sheets or journal rolls, and one for front insertion of cut forms such as ledgers or invoices. The standard platen is split 9 inches left and 13.1 inches right. Optional split configurations are available in increments of 2 to 17 inches right.

Continuous Forms Feeder

The continuous forms feeder is used for feeding and spacing a continuous form. The feeder is equipped with a pair of pin-feed tractors accommodating widths from 4 to 23 inches.

DATA COMMUNICATIONS

For 499 configurations without magnetic ledger equipment, two communications adapters can be attached (only one for magnetic ledger machines). The user may choose two synchronous adapters, two asynchronous adapters, or one of each. As a terminal, the 499 can operate in either an on-line or remote batch mode.

Telecommunications is implemented by means of a combination of hardware adapters and software packages that NCR calls On-line Communications Drivers (OCD's). These allow the 499 to communicate with NCR and non-NCR host processors and communications devices. NCR offers support for both dial and leased lines, with transmission speeds of up to 1,800 baud (asynchronous) and 9,600 baud (synchronous).

SOFTWARE

NCR has currently developed some 15 comprehensive application packages to serve the needs of specific industry markets. These include packages for utility billing, payroll for government, education and construction, appropriation accounting, bill control for transportation, client-accounting, manufacturing inventory, construction job costing, hospital inpatient/outpatient systems, wholesale/distribution billing and inventory, and accounts payable and general ledger. The packages are all turnkey in intent, but NCR does offer customization services at additional cost. Most of the current software packages are designed around magnetic cassette rather than disc.

An example of the application packages offered by NCR is the Inventory and Accounts Receivable for Wholesale Distributors. Designed for a 499 system with 20K of memory and three cassettes, it is targeted at the small- or medium-sized distributor. The system is capable of handling up to approximately 6,000 inventory items and 700 customer accounts receivable. NCR estimates that some 250 five-line invoices can be prepared per day on the system. The inventory control portion of the system maintains the inventory master file and provides reports in a variety of formats, including out-of-stock, item profitability, reorder point listings, inventory sales reports, and price lists. The accounts receivable portion produces invoices, customer statements, and a complete aged trial balance report. The master file is maintained on cassettes and is supplemented by a (nonmagnetic) ledger card file for off-line customer record lookup.

In addition to the complete application packages, the NCR 499 may be programmed by the customer. The 499 uses NEAT-AM, a problem-oriented, self-documenting assembly language similar to that used with the NCR Century Series. Customers with little prior programming experience should (with some training) be capable of programming their own applications. Programs can be assembled on an NCR 499 or on a NCR Century Series system. Two cassette drives are required in order to assemble on the NCR 499.

Lead-through planning techniques can be incorporated into application programs to train or assist operators. After an operator gains experience with an application, printing of the operator instruction messages may be suppressed by depressing an option key on the 499 console.

The NCR 499 is microprogrammed with a set of elemental (micro) operators that are used to (micro) program interpreter routines that serve as instructions at the programming language level. A library of interpreter routines is used during the assembly process, with required modules incorporated into the assembled final program.

PRICE DATA

The NCR 499 is *not* available for rental, but freestanding peripherals may be rented.

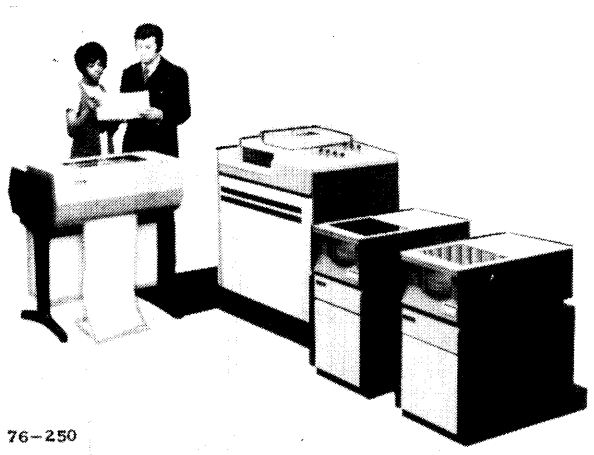
Description	Purchase Price $ (Maint. Not Incl.)	Monthly Rental $	Annual Maint. $
NCR 499-1101			
Console with 12K memory, 1 cassette, forms handler	17,900	–	996
NCR 499-1201			
Console with 12K memory, 2 cassettes, forms handler	19,500	–	1,056
NCR 499-1102			
Console with 12K memory, 1 cassette, forms handler, magnetic ledger	24,350	–	1,248
NCR 499-1202			
Console with 12K memory, 2 cassettes, forms handler, magnetic ledger	25,950	–	1,308
NCR 499-K008 Communications Adaptor	1,000	–	84
NCR 499-K004 Disc Controller	2,000	–	228
NCR 499-K021 Additional Cassette	1,600	–	60
NCR 499-P201 12K to 14K Memory Upgrade	1,100	–	60
NCR 499-P203 4K Memory Upgrade	1,500	–	60
PERIPHERALS			
6440-0101 Printer, 55 lpm	4,495	145	420
349-1 Printer, 125 lpm	10,000	280	384
349-2 Printer, 200 lpm	13,000	370	444
349-300 Printer, 300 lpm	17,000	460	504
368-1 Card Reader	5,000	150	263
378 Card Punch	5,300	215	315
366 Paper Tape Reader	2,500	70	101
367 Paper Tape Punch	3,000	95	210
656-441 4.9MB Disc	9,500	300	912
656-401 9.8MB Disc	12,500	375	1,164

PRICE DATA (Contd.)

Description	Fully Paid License Fee
Financial Management for Government — Utility	900
Financial Management for Government — Payroll	750
Financial Management for Education — Payroll	870
Financial Management for Education — Appropriation Accounting	1,000
Revenue Analysis for the Motor Freight Industry	1,200
Client Writeup and Reporting System	1,000
Manufacturing Inventory System	800
Construction Management System — Payroll	1,000
Construction Management System — Accounts Payable	900
Construction Management System — Job Cost	900
Construction Management System — General Ledger	700
Hospital Inpatient/Outpatient System	1,850
Wholesale Distribution Inventory System	1,250
Payroll and Labor Distribution System	1,550
Accounts Payable and General Ledger	900

NCR CORP.

Century 50 Mod I, 50, 75, 101, and 151



OVERVIEW

NCR's Century 50 Mod I, 50, 75, 101, 151 are a family of general-purpose small-business computers. They are the smaller members of NCR's Century Series, which also includes the medium-scale Century 200, 201, 251, and 300. The small Century models are designed primarily for batch processing, but are equally at home in mixed environments of batch and interactive processing.

The first small Century system (Century 100) was announced in 1968, and since then the series has developed into a mature product offering, complete with proven hardware, reliable operating systems, and numerous turnkey-oriented, business applications packages. At a time when other manufacturers' systems did not maintain compatibility within a family of products, NCR's Century Series offered upward compatibility from its smallest Century model to its largest Century model. The operating systems used by the small Century systems are subsets of the operating systems used by the medium-scale Century systems. While recompiling of programs is suggested for optimum use of hardware, it is not necessary for compatibility.

The Century 50 Mod I through 151 differ chiefly from one another in processing speed, peripheral configurations, and maximum main memory size.

- The two Century 50 models are batch oriented and have a maximum memory size of 16K-32K bytes, but the 50 Mod I is slower in overall processing speed than the 50. These two models are probably the least active and most dated models of the Century line. NCR is encouraging purchase of these systems, and it seems likely that the company will drop active marketing of them within the near future.
- The Century 75, the newest member of the series, is an entry-level system with up to 64K bytes of core memory. It is suitable for both batch and interactive applications.
- The Century 101 and 151 differ in the memory technology and the amount of main memory they offer. Both can support batch and interactive processing, and the B3 multiprogramming operating system, which was previously available only for the Century 200 and larger systems.

Application packages in more than 24 major categories are available, including software for applications in manufacturing, distribution, retailing, hospital patient-account management, life insurance applications, law enforcement packages for central information file and traffic-violation fine collection, and utilities billing. Before April 1976, Century application and system software was bundled into the hardware prices; however, NCR has made a significant change in policy which now calls for unbundled pricing on software program products.

NCR, founded in 1882, is one of the two largest manufacturers of electronic accounting machines and one of the six largest computer manufacturers. Maintenance is available through over 300 service offices in the U.S. and Canada and 900 offices in the rest of the world. The firm manufactures a full line of data processing equipment and offers related products and services. Century 100 was introduced in 1968, the Century 50 in 1971, and the 101 in 1972. The Century 50 Mod I and the 151 were announced in 1974, and the Century 75 in 1976. In Europe, the small Century models are marketed as the Century 75 and 150. Table 1 compares processor characteristics and peripheral offerings of the Century models.

Compatibility

All members of the Century Series are upward compatible at the object language level. However, because of the increased number of instructions available to compilers moving upward in the series, a program written for a lower member of the series should be recompiled to run on another larger member with maximum efficiency.

HEADQUARTERS

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Table 1. NCR Century Systems: Comparison

	50 Mod I	50	75	101	151
CENTRAL PROCESSOR					
Cycle Time, μsec	0.80	0.80	1.20	0.75	0.75
Main Memory, Min-Max K bytes	16-32	16-32	16-64	16-128	64-256
Word Size (bits)	8	8	8	8	8
Working Storage Technology	Rod (thin film)	Rod (thin film)	Core	MOS	MOS
PERIPHERALS					
Line Printers (lpm)	200-450	200-450	200-900	300-2,000	300-2,000
Serial Printers	30 cps	30 cps	—	—	—
Card Read (cpm)	560-750	560-750	300	300-1,200	300-1,200
Card Punch (cpm)	60-180	60-180	No	240	240
Paper Tape Read (cps)	1,500	1,500	No	1,000-1,500	1,000-1,500
Paper Tape Punch (cps)	200	200	No	200	200
Magnetic Tape	No	No	No	7/9 track	7/9 track
Magnetic Cards	No	No	No	Yes	Yes
Disc	Cartridge	Cartridge	Cartridge pack	Cartridge pack	Cartridge pack
MICR (doc/min.)	600	600	No	1,200	1,200

Downward compatibility within the series is limited by the more restrictive instruction sets of the lower-numbered processors, but software is available to allow the lower-numbered processors to simulate any instructions absent from its repertoire. The instruction-simulation procedure allows users to rely to some extent on smaller models for backup; however, for large complex tasks, it tends to make downward compatibility within the Century Series more theoretical than actual.

The Century systems are upward compatible with NCR's Criterion Series, providing that the B Series of operating systems are used by the Century model.

For program compatibility with current competitive systems, NCR Century COBOL and FORTRAN compilers conform to industry standards. For non-standard versions of COBOL, FORTRAN and BASIC, NCR offers conversion aids.

PERFORMANCE AND COMPETITIVE POSITION

Since the first small Century system was announced in 1968, the complexion of the small business computer market has changed, and the first time computer user tends to prefer display-oriented, interactive systems rather than card-based systems. For this market, NCR offers the Century 8200 and the Century 75. The Century 8200, which began life as the SPIRIT order entry system, is an interactive system which can support up to 7 on-line users. The Century 75 is the entry-level system for a mixed environment of batch and interactive processing.

In the batch-oriented small business market, the Century Series meets competition from the major mainframe manufacturers: IBM System/3 Models 10, 12, and 15(D); Burroughs B1700 Series; Univac Series 90 Model 90/30; and from England the ICL 2903 Range. This is a fiercely competitive group of systems, each playing one-upsmanship in price and performance offerings. Like NCR, the preceding manufacturers are attempting to make graceful conversions to interactive processing. Burroughs has introduced a text editor package and its TD 830 display as an operator console. IBM's offering to the interactive environment is the Model 12, which can support up to twelve local 3270-type terminals.

In a multiprogramming environment, the Century 101 and 151 are strong contenders, especially in light of NCR's significant price cuts on these models. The 101 and 151 use NCR's proven B3 multiprogramming operating system, which can accommodate up to nine fixed partitions. NCR's competitors are also actively marketing their multiprogramming capabilities: Honeywell has enhanced its GCOS operating system for the Series 60 Level 62, and is advertising that it can run a large number of interactive and batch tasks concurrently; Burroughs has its well-known MCP multiprogramming operating system; and IBM has introduced a System/3 Model 15D, which offers three memory partitions for multi-tasking.

USER REACTIONS

Users of the small Century systems differ greatly in their backgrounds. Installations range from those with no EDP personnel to others with more than a dozen personnel.

All Model 50 users interviewed were quite pleased with their systems. These users had the standard Model 50 configuration and found it very reliable. The common Model 50 applications were general ledger, accounts payable and receivable, inventory control, sales analysis, billing and order processing, and payroll. For these small systems, the majority of users program in NEAT/3, NCR's own business application language. One user who likes NEAT/3 admitted there is more documentation available on COBOL, however. Another user programs in both NEAT/3 and COBOL. Since both are available, this user prefers to stay active in both languages. A third user said NEAT/3 is easier to use than COBOL.

All 101 users indicated that the system's hardware is most satisfactory; the 101's extreme sensitivity to temperature is the other factor agreed upon by users. They have reported that if air conditioning problems cause the tem-

perature in the environment-controlled rooms to reach 80 degrees (only 8 degrees above the recommended 72 degrees), read/write errors occur on discs and in memory. Problems also occur if the temperature falls below 58 degrees.

Educational Institutions. A college specializing in business training has an NCR 101 and NCR 399. The 101 was chosen over a Burroughs B1700 because of price. Currently, the 101 has 32K bytes of main memory; an additional 16K bytes is planned. Other equipment includes two card units (card-or-tape COT reader and high-speed reader/punch); dual-drive 655 disc; and four terminals, two NCR 260s connected by standard telephone interface and two hardwired Western Union KSR 33s.

Students run BASIC 1 for three hours each day on the four terminals, during which time the system is dedicated. Batch programs, including NCR packages for payroll, accounts receivable, accounts payable, general ledger, inventory (ORBIT II), and class scheduling run afterwards for an average total of 20 hours daily, seven days a week. NEAT/3, COBOL, FORTRAN, RPG, and BASIC languages are used.

A second academic institution, a college, uses an NCR 101 alternately for on-line problem solving and batch processing. This user also considered an IBM System/3 Model 10 for the application; the price was about the same as the 101, but the performance of the 101 is superior to the Model 10's. The 101 has 32K bytes of main memory (an extra 16K bytes is on order); a two-spindle 655-disc drive, printer input/output writer, and card reader. Five Western Union KSR 33 terminals are attached, one to each of five integrated communication adapters.

Forty hours weekly are dedicated to on-line processing with BASIC 1, "an acceptable subset of Dartmouth BASIC." The college also runs programs written in COBOL and NEAT/3, including NCR's Budgeteering Package and Payroll Package.

The user is very pleased with the hardware, likes the software (which the college modified), but it is very unhappy with the service. This user acknowledges that the problem may be attributed to its location, which is in an outlying area. NCR's service also annoys this user by "continually discouraging" applications the user deems possible and reasonable.

Cooperative. A farming cooperative has an NCR 101 with 32K bytes of main memory (an extra 32K bytes are on order), a two-spindle 655-disc (two 657s are on order), three tape handlers (800 bpi), printer (450-900 lpm), card reader/punch (300 cpm), and communication multiplexor using two integrated adapters. The twelve people at the installation wrote COBOL packages for feed mix, cost analysis, and production reporting. They also collect data and send user reports to free-standing terminals in the area. This user had a Univac 1005 card processor before the NCR 101.

Airline. A commuter airline installed the 101 for a computerized reservation system to handle its more than 1,400 flights each week. The system has 64K-byte memory, disc (one controller and two drawers), input/output writer, card reader/printer, and almost 200 terminals connected via integrated multiplexor adapters. Bunker-Ramo supplied 36 of the CRT terminals, which are connected by four controllers to one of the integrated adapters. The other terminals are scattered throughout the airport and are connected to one port via telephone lines.

The airline is extremely pleased with the 101 and is proud of the speed with which the system was created and installed. This company had not evaluated competitive systems; the decision to go on-line was made very quickly, and NCR was contacted immediately because the airline had been an NCR customer for over 12 years. The combined efforts of NCR, Bunker-Ramo, and airline personnel had the system up and running in less than 4 months. NCR developed the software, I/O, and interfacing with Bunker-Ramo; the airline handled the user programming. The package, jointly developed by the three companies, is written in NEAT/3. The system runs under S2 (the dedicated on-line operating system).

CONFIGURATION GUIDE

The Century 50/Mod 1 is the smallest and lowest-priced member of the Century Series. It includes a 16K-byte memory, card reader, printer, and dual disc drive. It is similar to the Century 50, which also has a 16K-byte memory, 8.4M-byte disc, 300-cpm card reader, and 200-lpm printer, but Mod 1 has lower performance capabilities. See Table 1.

Century 50 configurations can be upgraded by any or all of the following steps: doubling main memory to 32K bytes; replacing the card reader with a 1,000-cps punched paper tape reader; replacing the 200-lpm printer with either a 300- or 450-lpm model (rates are for alphanumeric data — purely numeric data is printed at 600 and 900 lpm, respectively); replacing the original disc drive, which has an access time of 153 milliseconds, by a model with an access time of 65 msec. Further, an input/output typewriter console, a second disc drive, and a line printer can be added to the system.

The Century 75 is also an entry level member of the Century family. The basic configuration includes a processor with 16 bytes of main memory (expandable to 64K bytes of main memory), an operator's console with teletype I/O writer, 200-lpm integrated line printer, card reader, and 9.8 MB of disc storage. Included in the configuration are two I/O trunks for free-standing peripherals.

The Century 75 was designed to replace the older Model 100 in the NCR Century product line. About two times as fast as the 100, the 75 has a more expandable core memory, more instructions (34 plus 3 optional), and greater I/O simultaneity and throughput. It accommodates more integrated I/O units: card reader, control console, TTY I/O

writes for console messages (6-cps impact printer) and optional communication multiplexor for up to 10 lines.

The Century 101 basic configuration includes a processor with 16K bytes of main memory and control console; line printer (300 lpm); card or paper tape reader; and 9.8 MB of 656-101 disc file storage. The basic configuration also includes two I/O trunks, one multiplexor (low speed) and one selector (high speed).

The Century 151 system bridges the gap between the Century 101 and the 200. The 151 uses a 64K-byte MOS memory with a 750-nsec cycle time; main memory can be expanded to 256K bytes. The basic system also has a 10M-byte disc, 300-lpm printer, 300-cpm card reader and 30-cps console. In addition to the higher speeds for these devices, the Century 151 can attach the optional 658 disc with capacity of 100M or 200M bytes.

As standard hardware, the Century 151 has four peripheral trunks with speeds of up to 1,333 KB.

European Century systems are slightly different than U.S. systems in their basic configurations. The Century 75 (called the Century 150-656 in the U.K. and Scandinavia) has a dual-spindle master/slave of 656 disc storage unit with capacity of 9.96 MB standard, instead of the 4.9-MB master disc unit that is standard with the domestic 101. The Century 150 has 657-102 disc drives as standard. These IBM 2314-type discs have a capacity of 29.8 MB per disc pack, thus significantly increasing the basic storage capacity over that available for the 75.

CENTRAL PROCESSOR

The same central processor architecture is common to all models; it performs all command setup, execution, and logical decisions. It uses its own registers, flags, and indicators, plus reserved areas of main memory.

Data Structure. The basic unit of data is the byte, 8 bits plus 1 parity bit. Data formats can be eight-bit binary numbers, 4- or 8-bit binary-coded decimal numbers, or 8-bit NCR Century characters (ASCII characters).

Special Registers. Certain hardware registers are used to store the contents of main memory locations. The registers are used during command setup and execution. They allow accessing selected information without using a memory cycle.

Addressing Facilities. NCR permits four types of addressing. This includes direct addressing of all of memory with 262,144 bytes maximum. Up to five levels of indirect addressing are permitted. Each indirect address in the chain can be indexed or incrementally indexed. The last address in an indirect addressing chain can also be a 3-byte direct address (allowing direct addressing of all of memory in conjunction with an indirect addressing chain).

Each program has access to sixty-three 32-bit index registers implemented in main storage beginning with relative address zero of each active program. Conventionally, nineteen index registers are reserved for use by the operating system.

The addressing facilities of the 50 Mod I, 50, 101, and 151 are more sophisticated than those usually found on a small-business computer. This is due to their compatibility with the more powerful general-purpose processors higher in the Century Series. Flexible addressing is very beneficial in high data-movement applications such as those found in business environments.

Instruction Set. Each system's instruction repertoire is fully upward compatible with the full Century instruction set; it includes packed and unpacked decimal arithmetic instructions and hardware-implemented decimal multiply and divide. The following instructions are implemented: three fixed-point binary commands; nine decimal arithmetic commands; three move data commands; three logic commands; twelve transfer commands; and seven special commands used by software executives. The major additions to the 101's instruction set for the higher-numbered Century processors are the floating-point instructions (long and short) and word (instead of byte) binary operands. Software routines are available to perform these instructions on the smaller systems.

Interrupt Control. Interrupt operations are largely hardware-implemented, with interrupt control performed by the I/O control unit in the CPU. The processor is interrupted for I/O transfers each time the buffers are full or an end-of-block is reached. An optional interval timer can be set to interrupt the processor at set intervals.

Main Memory

The Century series makes use of three memory technologies: core (Models 75, 101), rod thin film (Model 50), and MOS (Models 75 and 151). Memory is byte-addressable; an attempt to access memory beyond the capacity results in an error signal.

The first 1,280 bytes of main memory are reserved for registers, control words, and resident executive. Parity is created during write operations and checked during read operations. Parity check failure causes an interrupt.

Memory forms a single integrated unit with a single access path and cannot be interleaved.

Input/Output Control

One or two channels can be added for a maximum of four channels (zero, one, six, and seven): two are low-speed and two are high-speed channels. Each channel has eight device positions available. Some positions are pre-assigned: position zero on trunk seven (high-speed) is dedicated to an integrated printer (optional). Positions zero through three of trunk zero (low-speed) are dedicated, respectively, to the integrated card or tape reader (COT); the console input switches; the input/output writer (optional); and the communication

interface (optional). All other positions can be used for freestanding peripherals; the only restriction is that the peripheral's transfer rate cannot exceed the channel (trunk) transfer rate.

All peripherals attach to the NCR processors via positions on channels. Some require control units; others have integrated controllers. For example, the first standard channel or "trunk," which is trunk zero, offers four integrated adapters for the COT, console, optional I/O write and optional integrated communication adapter (ICA) for 10 communications lines. These four adapters have separate ports on trunk zero's I/O control scanner; a fifth port is shared by four common trunk positions on the same channel.

The I/O control scanner gives trunk zero the characteristics of a multiplexor channel by allowing concurrent operation of all integrated peripherals (including up to 10 data communications transfers) and of one nonintegrated I/O peripheral connected to one of the four common trunk positions. On European Century 75 (150-656) systems, the 649 line printer is normally connected to one of the four common trunk positions. This arrangement serves to concentrate all slow I/O peripherals on trunk zero while allowing them to operate concurrently, subject to a maximum combined transfer rate of 166K bytes per second (120K bytes if the optional trunks one and six are also installed).

The second standard trunk, designated trunk seven, is a high-speed selector channel with a maximum 666 KB byte-per-second transfer rate, seven common trunk positions, and one integrated line printer adapter. The latter was used to connect a 640-102 or 640-200 printer to Century 101 and 150 systems ordered before the announcement of the new 640-300 and 649 nonintegrated line printers. It is not used on systems ordered since the beginning of 1973, including all Century 75 (150-656) systems. Integrated line printers connected to trunk seven can operate concurrently with one device connected to any one of the other seven trunks; otherwise only one transfer at a time can take place on trunk seven. A 656 or 657 disc subsystem always connects to trunk seven; magnetic tape subsystems also normally connect to this trunk.

PERIPHERALS

Slow-Speed Peripherals

CARD EQUIPMENT:
- 682-100 Reader — integrated, 300 cpm.
- 686-102 Reader/Punch — reads 800, punches 83-294 cpm (not for Model 50).
- 686-201 Reader — 750 cpm.
- 686-111 Reader/Punch — reads 560, punches 60-180 cpm.
- 680-201 Reader — 1,200 cpm (not for Model 50).
- 687-301 Punch (also reads) — 100 cpm (not for Model 50).
- 686-302 Punch — 83-294 cpm (not for Model 50).
- 686-311 Punch — 60-180 cpm.

PRINTERS:
- 640-102 (all models) — 450/900 lpm, 132 columns integrated.
- 640-200/210 — 1,500/3,000 lpm, 132/160 columns.
- 640-300 — 1,200 lpm, 132 columns.
- 640-205/215 — 750/1,500 lpm (OCR); 132/160 columns; 1,500/3,000 lpm; integrated (non-OCR).
- 649-150 — 150 lpm (127-character set), 132 columns; 127-character set print set 300 lpm (numeric only).
- 649-200 — 200 lpm, 132 columns; 64-character set.
- 649-300 — 300 lpm, 132 columns; 64-character set.
- 646-201 — up to 1200 lpm, 132 columns, 52-96 character set.
- 647-201 — up to 2000 lpm, 132 columns, 52-96 character set.

PAPER TAPE EQUIPMENT:
- 622-100 Reader — integrated, 1,000 cps.
- 660-101 Reader — 1,500 cps.
- 665-101 Punch — 200 cps.

MICR EQUIPMENT:
- 670-101 — 600 documents per minute, 11 pockets.
- 671-101 — 1,200 documents per minute, 18 pockets (not for Models 50 or 101).

OCR EQUIPMENT:
- 420-1 — 26 lps, up to 32 characters per line.
- 420-2 — 52 lps.

Accessing and transporting a card to the read/write heads requires 125 msec; average latency is 24.25 msec, peak transfer rate is 83K bytes per second.

Mass Storage Peripherals

- Model 633 Magnetic Tape. Seven-track (200/556/800 bits per inch) and nine-track (800 bits per inch) NRZI models at 50 inches per second; single nine-track PE transports (1,600 bits per inch) operate at 50, 90, or 150 inches per second and one dual nine-track PE transport (1,600 bits per inch). Controllers attach up to eight transports; NRZI units can be mixed on same controller.
- Model 655 discs are dual-spindle units with three-platter interchangeable disc packs. Model 656 discs, similar to the IBM 5444 discs, read/record on two surfaces of a single-disc pack with one optional fixed disc and one interchangeable disc pack. The 656-10 master unit interfaces to a common trunk position; the 656-102 unit is slave. The 656 discs can be connected to common trunk positions, or they can be intermixed on configurations with larger 657 discs. Model 657 discs are similar to IBM 2314, 2319, and 5445 discs; the controller attaches to position on trunk seven. Up to eight spindles can be connected per controller. The 657 controllers can attach to common trunk positions on trunk seven, and they can be mixed on the same configuration with 655 or 656 disc systems.
- Model 658-201 disc controller offers storage capacities of 100 and 200 MB and a transfer rate of 806 KB. One controller can handle up to sixteen single-disc pack drives. Disc packs contain ten platters with nineteen recording surfaces.

DATA COMMUNICATIONS

The processor uses either an integrated communication interface or a freestanding communication multiplexor (621-103). The integrated communication interface can support a maximum of 10 adapters; the freestanding unit can support 253. Adapters can be used for single unit lines (one terminal per line), polled systems (many terminals per line), and satellite processing systems.

The 6002 Integrated Communications Adapter (ICA) allows up to 10 communication lines to use trunk zero's I/O control scanning and multiplexing ability without inhibiting any other I/O transfers on trunk zero. Each active communication line must be terminated by an adapter, either a 692-600 Asynchronous Data Adapter or a 693-600 Binary Synchronous Adapter.

Communication lines can be also controlled by a 621-101 or 621-103 Communication Controller connected to a common trunk position. Both controllers have multiplexing facilities for the communication lines and adapters connected to them; they inhibit other data transfers on the trunk, however, because these trunks have no processor-controlled multiplexing facilities.

The 621-103 Communications Multiplexor can multiplex 253 remote telegraph or telephone lines into a common trunk interface on any Century processor. Each active line must be terminated by an adapter.

The hardware-assisted software queue (HASQ) maintains a pointer in memory that aids the software in identifying the terminal requiring service. The HASQ feature is most effective when there are 32 or more lines in use. The multiplexor also has a standard interval timer.

The 692-100 Asynchronous Character Adapter is used with private or dialup voicegrade lines (Bell System 100 or 200 Series data sets), or TWX prime or Western Union async modems; speeds from 45-1,800 bps; any 5- to 8-bit code with one start bit and one or two stop bits.

The 692-400 Polling Asynchronous Adapter was specifically designed for use with NCR on-line financial terminals and 795 Data Display Systems; it occupies two positions on a controller, one for I/O and one for polling.

The 692-600 Asynchronous Adapter can interface to the following terminals:

- NCR 260 Thermal Printer — 45, 50, 72, 72.6, 75 baud.
- NCR/270 Financial Terminal — 100, 110, 134.5 baud.
- NCR 280 Retail Terminal — 150, 165, 200 baud.
- NCR 399 Electronic Accounting Machine — 300, 600, 1,200, 1,800 baud.
- NCR 42 Window Machine.
- Data 100 Model 73 CRT.
- Teletype Models 33 and 35, ASR and KSR.
- Teletype Model 28.

The 693-200 Synchronous Adapter was specifically designed to interface Centufy systems to NCR 735 or 736 Model keytape encoders. Data communications rates of 1,200, 2,000 and 2,400 baud are available using 202C or 201A/B data sets.

The 693-300 Synchronous Adapter is used with sync (clocked) data sets such as Bell System 20AB (2,400 bps), 301 (40,800 bps), or 303 (50,000 bps); it is intended for communication with other NCR Century systems and IBM BSC terminals.

The 693-600 Synchronous Adapter is used for terminals with hardware and software developed to conform to the IBM BSC discipline; transmission speed is 600-50,000 baud.

SOFTWARE

All Century Series software is disc-based. Just as each larger processor model includes the instruction sets of the smaller ones, so too the operating systems for the series are upward extensions of each other. Thus, programs for a Century 101 running under the B1 operating system can also run on a Century 200 under the B2 operating system.

To use the larger instruction repertoire of successive models, users must recompile their programs for the larger machine.

Operating Systems

Basically, the operating systems for the NCR Century Series are very straightforward. While most scheduling responsibilities fall upon the user, the fundamental simplicity of the operating environments permits users to maintain tight logical control of the system. For example, multiple copies of the simplest operating system form the vertebrae of the more complex ones.

NCR offers three disc-based operating systems that can be used by the Century 50 through 151 models: B1, B2, and S2. B1 is a basic version, B2 is more sophisticated, and S2 allows the system to be dedicated to on-line processing. A fourth operating system, the B3, multiprogramming operating system, is available for use on the Century 101 and 151 systems only.

All versions use a segmented overlay technique; executive routines remain memory resident during the run while others are called from disc as needed. Nonresident routines are overlayed into memory areas set aside by the system monitor for operating system use. During processing, the system notes the frequency with which overlays are called and keeps those most frequently used memory resident. This substantially reduces operating system overhead.

When a user writes programs, he must divide them into logical segments. The operating system automatically links the segments (no link-edit step is required after

compilation) and calls segmented overlays into reserved memory regions during execution. The main advantage of this scheme is that programs can be made larger than the memory available to the system, like virtual memory. The disadvantage, however, is that application programmers must arrange programs into logical modules.

A roll-in, roll-out capability is missing from all versions of the operating system except B1. This lack is a definite drawback, particularly when emergency jobs must preempt processing jobs. Under the current setup, the operator must cancel running jobs. NCR claims that roll-in, roll-out is under development and will be incorporated into B2. Until such a capability becomes available, users can avail themselves of the system's checkpoint/restart feature to suspend jobs. At restart, the system cycles back to the last checkpoint, resets all files and registers, and resumes program execution.

B1. The B1 version is the basic operating system offered for the Century Series and can run on any Century system. It consists of an I/O executive; monitor system log maintenance; disc management; support for utility routines (such as the sort program generator); data utilities; source program utility routines (SPUR); object program utility routines (OPUR); an automatic flowcharting facility; symbolic debugging; and NEAT/3, COBOL, and FORTRAN compilers. All three compilers accept only disc input, so SPUR is used for program preparation prior to compilation.

The B1 system is equipped to handle batch jobs only; therefore most users will probably select it for the Century 50 or 100, or in some cases, the Century 200. It requires a minimum of 16K bytes of main storage, of which the resident executive requires about 4K bytes. All jobs running under B1 are stacked on disc; a job is a series of related programs or tasks. Jobs are scheduled for processing on a first-in, first-out basis, unless a branch option call, IF, is employed. In this case, the system stops processing jobs in the stream and branches to the label indicated. From that point processing continues serially using those programs associated with the branch-to label.

During processing, the operating system maintains a log of all hardware errors to aid in determining that components are going "soft."

B2. The B2 operating system is intended primarily for Century 75, 101 and 151. It requires a minimum of 32K bytes of memory (the resident executive uses a minimum of 5.5K bytes). B2 incorporates the basic software concepts of B1, but can handle on-line real-time operations.

The system operates in a dedicated mode (either on-line or batch) or in a dual programming mode. In the latter, the foreground partition serves the on-line applications and the background partition serves the batch jobs. Foreground programs have processing priority over background jobs in all cases. The background partition must be at least 16K bytes; foreground can be any size.

The optional Job Executive and Transport Satellite (JETS) package allows the B2 dual programming mode to be used for multiprogramming two pseudo off-line I/O conversions in the foreground partition with a batch processing stream in the background partition. I/O conversions take place between card or paper tape readers and line printers, on the one hand, and discs or magnetic tapes, known as System External Storage (SES), on the other. The appropriate SES areas or devices are automatically substituted for the slow I/O devices that they replace in the job scheduling of background batch jobs.

Jobs submitted are queued on disc and serviced first-in, first-out. Tasks within a job can be assigned processing priorities by the programmer, however. A job selected for processing runs to completion unless "aggressively" interrupted by events such as an emergency job. Emergency jobs require the operator either to cancel processing jobs (if sufficient resources to serve the higher-priority job are unavailable) or, if they have been written to utilize the checkpoint/restart feature, suspend them.

For on-line applications employing multiple terminals, B2 permits chaining instructions to eliminate the need to dedicate fixed size storage areas to collect multiple message segments. Users can also use dynamic storage and chain memory regions containing related segments to a particular terminal.

S2. A Century 101 with a minimum of 16K bytes of main storage can be dedicated to on-line processing through use of the S2 operating system. S2 incorporates the basic software capabilities of B1 with the added concept of on-line processing. Its operational capabilities as they relate to queuing, dynamic storage allocation, and message chaining, are the same as B2. However, S2 has no provision for multitasking, dual programming, or dynamic storage allocation for I/O areas.

B3. The B3 operating system can be utilized by the Century 101 and 151. It requires a minimum of 64K bytes of memory. The resident executive requires 16K bytes.

B3 employs a fixed-size memory partition, with a total of nine partitions permitted. Each partition must be at least 16K bytes; a 64K-byte machine, for example, can accommodate three partitions (plus resident executive). Resources can be dedicated for partition use, or they can be shared among partitions.

Jobs are queued by partition, and each job is serviced on a first-in, first-out basis by partition. No priorities can be assigned to jobs, but priorities can be assigned to partitions. B3 employs no time slices; however, a timeout feature prevents any job from monopolizing the system.

When a job gains control of the CPU, it retains it until an interrupt occurs or the job issues an I/O request. Once a job relinquishes the CPU, control is passed to the next highest-priority partition. As soon as an interrupted

higher-priority job is ready to resume processing, the lower-priority job is forced interrupted and the higher-priority job resumes processing.

The obvious advantage to this procedure is that high-priority jobs get the highest proportion of CPU time. The disadvantage, however, is that lower-priority jobs may have to wait an unacceptable amount of time (unless the operator intervenes) before they receive a reasonable "shot" at the CPU.

The spooling technique employed by B3 is quite sophisticated; it permits handling processing and hard-copy output asynchronously. In operation, data is spooled to a disc region associated with a particular partition. When a portion of a region is loaded, B3 outputs data to a printer associated with a disc region.

Language Processors

Language processors offered with Century Series systems are NEAT/3, FORTRAN, COBOL, BASIC, and RPG.

NEAT/3. Implementation of NEAT/3, the Century Series assembly language, is on three levels:

- One level relies on extensive use of macros and requires little knowledge of hardware characteristics for first computer users.
- A second level relies on some, but not extensive, use of macros and requires some knowledge of hardware characteristics — equivalent to RPG compilers for other systems.
- A third level avoids the use of macros and is closely aligned with hardware characteristics, for systems software programming.

FORTRAN. Two FORTRAN compilers are offered. Century Basic FORTRAN requires 16K bytes of memory; Century IBM 1130-compatible FORTRAN requires 32K bytes of memory. Both comply with the ANSI standards for basic FORTRAN.

Both compilers operate under control of one of the Century operating systems. The source program can be retained on disc for recompilation if desired. This is accomplished by using page and line numbers in positions 75 through 80 of the source statement. These numbers can be either programmer or compiler assigned. The object program is stored on disc for rerunning when desired. It can be executed in a mixed system of programs, for instance, COBOL, NEAT/3, and FORTRAN. FORTRAN floating-point operations are simulated in software.

COBOL. Century Series COBOL is divided into three stages, two of which can be used on Century 75, 101 and 151. Stage I is a subset of basic COBOL implemented for Century 75, 101 and 151 with 16K or 32K bytes of memory; Stage II is a comprehensive set of COBOL elements based upon the ANSI standard, and implemented for the Century 75, 101 and 151 with 32K bytes of memory.

BASIC. BASIC-I is a version of the popular Beginner's All-Purpose Symbolic Instruction Code developed at Dartmouth College. Data communication facilities are required for use of the Century Series BASIC-I system.

The initial implementation of BASIC allows communications between the computer and remote Teletype units via voicegrade lines. Only memory size influences the number of terminals that can be active at one time. The BASIC compiler is oriented for compilation speed.

In order that certain routines need not be generated in each object program, they are resident in either memory or overlays and are shared by all Basic object programs. The remote rapid compilation feature and language simplicity make Basic an ideal language for quick solutions to complex mathematical problems.

RPG. Minimum system requirements for RPG are a CPU with 16K bytes of memory, dual disc units, a printer, and a card reader.

An RPG to NEAT/3 Translator is available to aid in the conversion of IBM System/360 Model 20 RPG source programs to NCR's NEAT/3 source programs. The translator generates NEAT/3 source code for each valid RPG card; optionally, it produces a listing of the card images of the RPG and NEAT/3 cards.

Applications Software

NCR provides a wide range of utility routines and programs. Utility routines include a general sort program and operating system routines for disc maintenance and system log maintenance. A flowcharting package generates flowcharts for NEAT/3 programs. A program debugging package is also available.

The following is a partial list of application packages for the Century Series (see PRICE DATA for a listing of additional packages):

- *Emphasis I Inventory Management System* utilizes input derived from actual item demand on punched cards or magnetic tape.
- *Sales Auditing System* furnishes verification, sorting, recording, and distribution of statistical information accumulated during the course of business operations.
- *Tape Accounts Receivable System* consists of a series of communication programs designed to provide the consumer-oriented business with an automated accounts receivable system. It is intended primarily for businesses with 50,000 or more accounts receivable customers.
- *Central Information File (CIF) Systems* comprises Demand Deposit Accounting which provides overall central information file processing of the highest volume bank operation.
- *General Ledger Accounting* performs all file maintenance item processing, report preparations, and daily reporting functions. Daily, month-end, period-end, and on-request reports comply with internal ac-

counting and auditing standards established by the various regulatory agencies.

- *Installment Loan* is designed to perform the bookkeeping functions of a small loan operation.
- *On-Line Savings* handles a number of functions appropriate to on-line savings banking applications.
- *Hospital Accounts Receivable* provides for handling of hospital patient accounts after final bills have been prepared. It also handles outpatient accounts.
- *Student Scheduling/Grade Reporting* enables automated development of student schedules and grade reports.
- *Utility Billing* handles billing and collection for municipalities, investor-owned utilities, and REA offices; also handles electric, gas, or water billing in any combination.
- *Stewardship and Management Accounting* provides the means to collect, summarize, analyze, and report sources and uses of resources in monetary terms. The primary objective of Stewardship Accounting is to provide financial information to persons or groups outside an organization, such as governmental agencies, donors, loan funds, and creditors.
- *Hospital Inpatient Records* (IPR) is designed to process and report financial and administrative information about each patient in a hospital. IPR provides complete records and procedures for patient accounting; internal pricing of charges; insurance proration for up to four carriers; billing; revenue analysis; and extensive accumulation of statistics.
- *Building Contractors' Estimates* are used as a tool for the construction industry to analyze the critical item of labor cost and/or labor hours, material cost, and equipment for a job under consideration.
- *Production Scheduling* handles the information flow necessary to control the fabricating, machining, and assembly activity of a manufacturing concern.
- *Requirements Planning* provides the user with inventory status, bills of material, where-used lists, and production and/or purchase requirements.
- *General Input Validation* performs the necessary functions required of an entry program. It validates, balances, and distributes.
- *General Reporting System* provides a method for creating reports with minimum effort; such as extraction of information from files and reporting via the user's own program.
- *General Payroll* is a completely automated payroll accounting and labor distribution system which includes provisions for conversion, original implementation, and parallel operation.
- *Accounts Payable Applied Program* (Retail and General) performs timely, accurate administration of liabilities to vendors. Major functions of the program are preparation of vendor checks and itemized remittance statements, billing of debit balance accounts, distribution of costs to organizational units, and historical analysis of vendor activity.
- *Consumer Accounts Receivable* keeps current a master file from which the major part of a user's accounting reports can be produced. All financial transactions to the master file are posted and inserted in the file, yielding the current state of the master.
- *Order Billing* is designed for the distribution industries to provide wholesalers with the major processing functions to meet their requirements. It prepares the billing invoice in warehouse bin sequence by order.
- *Century Integrated Medical System (CIMS)* is a batch processing system comprised of five independent modules for in-patient records; out-patient accounting; medical audit and statistics; post discharge accounts receivable; and Medicare billing and logging. A single transaction can create the out-patient record, charge the patient account, and prepare the final bill.
- *Manufacturing Systems Inquiry Module* is an on-line inquiry system designed to provide manufacturers access to the files created by the NCR Bill of Material Application and the Inventory Material Control Application. Designed for a Century 101 or larger, the package provides access to such things as inventory status and master bill of material.

MAINTENANCE

Maintenance is available through about 300 service offices in the United States and Canada, and 900 offices overseas.

The standard service contract offers maintenance during any selected 8-hour period between 8 A.M. and midnight. Special arrangements can be made for 24-hour service at higher rates.

PRICE DATA

Model Number	Description	Monthly Rental (Includes Maint. for 1 Yr.) $	Purchase Price (Maint. not Included) $	Monthly Maint. $
	CENTURY 50			
	CENTRAL PROCESSOR & WORKING STORAGE			
	Basic System			
615-50/616-200	Processor (with 16 KB memory)	1,700	55,850	330
682-100	Card Reader (300 cpm)			
640-122	Printer (200 lpm)			
655-151	Disc Unit (8.4 MB; low speed)			
	Processor Options			
5621	Communications Package (6101 reqd)	425	19,500	75
5622	BASIC-1 Hardware Pkg (6101 reqd)	400	18,000	60
	Magnetic Tape			
624-119	9-Channel Control Unit (40 kc)	310	14,000	24
624-179	7-/9-Channel Control Unit (10/28/40 kc; 200/556/800 bpi)	315	16,500	24
633-117	7-Channel Control Unit (10/28/40 kc; 200/556/800 bpi)	330	17,000	76
633-119	9-Channel Unit (40 kc)	365	17,000	76
	Data Communications			
622-201	735/736 Encoder Adapter	185	8,250	12
	CENTURY 50/MOD-1			
	CENTRAL PROCESSOR AND WORKING STORAGE			
615-50/MOD-1				
616-300	Basic Processor (16 KB of memory)	1,385	47,000	347
682-100	Card Reader (300 cpm)			
649-125	Line Printer (125 lpm)			
655-151	Disc (8.4M bytes)			
	Alternates for Basic System			
616-300	Processor with 32KB	325	12,500	10
662-100	Paper Tape Reader (1,000 cps)	—	—	-15
640-122	Printer (200 lpm)	265	8,850	-14
640-132	Printer (300/600 lpm)	430	14,850	6
640-102	Printer (450/900 lpm)	640	20,850	22
655-101	Disc (8.4M bytes — high-speed)	165	5,000	41
	Processor Features			
6103	CRT Switch and Interface	45	2,000	9
796-101	CRT I/O	80	2,000	30
	CENTURY 75			
	CENTRAL PROCESSOR AND WORKING STORAGE			
615-75 w/7010	Processor (16-KB memory)	1,650	56,850	367
682-101	Card Reader			
640-122	Printer (200 lpm)			
656-102	Disk Unit (4.9 MB)			
6561	Disk Controller			
6562	Fixed Disk (4.9 MB)			
6101	Teletype I/O Writer			
615-951/953	Auxiliary Cabinet			
	Alternates for Basic System			
615-75/7020	Processor (24-KB memory)	135	5,000	12
615-75/7030	Processor (32-KB memory)	260	8,000	17
615-75/7040	Processor (48-KB memory)	460	16,000	29
615-75/7050	Processor (64-KB memory)	660	24,000	41
640-132	Printer (300 lpm)	100	4,000	30
640-102	Printer (450-900 lpm)	210	6,000	36
	Processor Options			
6001	Multiply/Divide	100	4,500	10
6010	Logic Command	50	2,350	—
6002	Integrated Communications	175	7,875	40
6012	Time-of-Day Clock	35	1,125	5
6113	CRT I/O Console Interface	25	1,000	2
	CENTURY 100			
	CENTRAL PROCESSOR & WORKING STORAGE			
	Basic System			
615-100/616-200	Processor (with 16 KB memory)	2,595	71,500	458
682-100	Card Reader (300 cpm)			
640-102	Printer (450-900 lpm)			
655-101	Disc Unit (8.4 MB; high speed)			

PRICE DATA (CONTD.)

Model Number	Description	Monthly Rental (Includes Maint. for 1 Yr.) $	Purchase Price (Maint. not Included) $	Monthly Maint. $
	Alternate Devices (for Century 100 Basic)			
626-101	Printer Control Unit (price included with printers)	—	—	—
640-200	Printer (1,500 lpm; 132 col) or	990	35,500	58
640-210	Printer (1,500 lpm; 160 col) or	1,090	39,750	58
640-300	Printer (600 lpm; 132 col)	720	25,450	29
640-205	OCR Printer (650/1,500 lpm; 132 col)	1,025	38,300	85
640-215	OCR Printer (750/1,500 lpm; 160 col)	1,125	42,550	85
	CENTURY 101			
	CENTRAL PROCESSOR & WORKING STORAGE			
	Basic System			
615-101 w/7001	Processor (16-KB memory)*	2,005	69,520	385
682-101	Card Reader			
649-300	Printer (300 lpm)			
656-102	Disc Unit (4.9 MB)			
6561	Disc Unit Controller			
6562	Fixed Disc (4.9 MB)			
	Alternate Devices			
615-101/7002	Processor (w/24K-byte memory)	190	5,000	12
615-101/7003	Processor (w/32K-byte memory)	325	8,000	17
615-101/7004	Processor (w/48K-byte memory)	475	16,000	29
615-101/7005	Processor (w/64K-byte memory)	625	24,000	41
615-101/7006	Processor (w/96K-byte memory)	825	32,000	53
615-101/7007	Processor (w/128K-byte memory)	1,025	40,000	65
656-102's	Disc Unit w/Attachment (9.98-MB capacity)	225	9,195	47
657-102/625-201	Disc Unit & Controller (60 MB; 315 KB)	1,220	57,605	40
	Processor Options			
6003	I/O Common Trunks 1 & 6	100	4,500	10
6102	Thermal I/O Writer w/Interface	150	6,250	15
615-951	Auxiliary Cabinet	25	800	—
6106	Alternates for Century 50, Century 100, and Century 101 Software Initiated Alarm	10	400	2
	CENTURY 151			
	CENTRAL PROCESSOR & WORKING STORAGE			
	Basic System			
615-151/7106	Processor (64K-Byte MOS memory*)	2,265	95,880	436
682-101	Card Reader (300 cpm)			
649-300	Line Printer (300 lpm)			
656-102	Disc Unit (4.9 MB)			
6561	Disc Unit Controller			
6562	Fixed Disc (4.9 MB)			
6102	I/O Thermal Printer w/Interface			
615-953	Auxiliary Cabinet			
6011	I/O Common Trunks 1 & 6			
	Alternates for Basic System			
615-151/7110	Processor (192 KB MOS memory)	800	30,000	42
615-151/7112	Processor (256 KB MOS memory)	1,100	42,000	63
615-151/7108	Processor (96K MOS memory)	250	10,000	11
615-151/7110	Processor (128K MOS memory)	500	20,000	21
646-201/961-201	Printer (1,200 lpm)	650	29,700	185
647-201/961-201	Printer (2,000 lpm)	1,025	45,500	295
655-201/625-101	Disc Unit and Controller (8.2 MB, 108 KB)	345	16,455	30
(Two) 656-102's	Gives Two Removable, No Fixed (9.8 MB — total disc system cap.)	225	9,195	47
657-102/625-202	Disc Unit and Controller (96 MB, 500 KB)	1,400	66,805	61
658-201/625-301	Disc w/Controller (100 MB, 806 KB)	1,320	62,155	
	Alternates for Century 101 and 151			
662-100	Paper Tape Reader (1,000 cps)	0	0	15
640-102	Integrated Printer (450–900 lpm)	150	10,100	5
640-102/626-101	Printer with Controller (450–900 lpm)	300	17,350	5
640-300	Integrated Printer (1,200 lpm)	575	23,800	30
640-300/626-101	Printer with Controller (1,200 lpm)	675	28,800	30
657-102/625-201	Disc Unit and Controller (60 MB, 315 KB)	1,200	57,605	40
	Processor Options			
6001	Multiply/Divide	100	4,500	10
6002	Integrated Communications Multiplexor	175	7,875	40

*Basic Systems are the minimum configurations that can be purchased. Prices for optional devices are added or subtracted from the basic price.

PRICE DATA (CONTD.)

Model Number	Description	Monthly Rental (Includes Maint. for 1 Yr.) $	Purchase Price (Maint. not Included) $	Monthly Maint. $
6006	640-102 Integrated Printer Controller	75	3,375	10
6007	640-300 Integrated Printer Controller	125	5,625	10
6010	Logic Command	50	2,350	10
9511	640 Integrated Printer Attachment	75	3,375	15
6104	Multiprogramming	100	4,700	15
6113	CRT I/O Console Interface	25	1,000	4
6012/6018	Time-of-Day Clock	35	1,125	5
	Discs			
656-102	Disc Unit (4.98 MB)	310	13,020	60
6561	Disc Unit Controller	150	6,750	25
6562	Fixed Disc (4.98 MB)	95	4,275	15
6563	Dual Disc Attachment	10	450	2

SOFTWARE PACKAGES

Feature Number	Description	Initial License Fee $	Monthly License Fee $
	Accounting		
8154-0101	General Payroll	250	5
8154-0102	Payroll/Cost, Labor Scheduling	250	5
8154-0201	Accounts Receivable — Commercial	250	10
8154-0301	Accounts Receivable — Consumer	250	10
8154-0401	Accounts Receivable — Tape	250	10
8154-0501	Accounts Payable	250	10
8154-0601	General Ledger	250	5
8154-0701	General Reporting System	250	5
8154-0801	General Input Validation	250	5
8154-0901	Accounting System Interface	250	5
	Financial		
8155-0201	CIF-Series "B" (All Modules)	3,250	135
8155-0202	DDA	1,200	50
8155-0203	General Ledger	250	10
8155-0204	Mortgage Loans	360	15
8155-0205	Installment Loan	480	20
8155-0206	Savings	480	20
8155-0207	Accrual Loan	480	20
	Retail		
8169-0201	Fashion Reporting	720	30
8169-0101	Retail Sales Audit	250	10
8169-0301	Pre-Edit Processing	430	20
8169-0501	Staple Stock Replenishment	530	25
8167-0101	ORBIT I	750	10
8439-0101	Pre-Edit Processing (IBM)	430	20
8169-0401	Common Trunk Interface for 725	250	5
	Wholesale		
8161-0201	ORBIT II	480	20
8161-0301	ORBIT III	480	20
8161-0101	Emphasis	250	10
8161-0401	SPIRIT (9)	530	25
	Medical		
8163-0101	Post Discharge Accounts Receivable	360	15
8163-0201	In-Patient Records	250	10
8163-0301	Medical Audit Statistics	250	5
8166-0101	275 TP Generator	250	5
	Education/Government		
8164-0201	Stewardship and Management Accounting	360	15
8165-0101	Utility Billing	360	15
8165-0201	Law Enforcement — Traffic	360	15
	Management Science Applications		
8153-0101	Statistics	250	10
8153-0201	Linear Programming	250	5
8153-0301	Project Network Analysis	500	60

PRICE DATA (CONTD.)

Feature Number	Description	Initial License Fee $	Monthly License Fee $
8153-0401	Coordinate Geometry	250	10
8153-0501	Vehicle Scheduling	250	5
	Manufacturing		
8159-0201	Requirements Planning	360	15
8159-0101	Production Scheduling	250	10
	Bill of Materials		
8159-0701	656	480	20
8159-0801	657	480	20
8159-0901	658	480	20
	Inventory Material Control		
8159-0101	656	480	20
8159-0201	657	480	20
8159-0301	658	480	20
	Inventory Material Requirements		
8159-0401	656	250	10
8159-0501	657	250	10
8159-0601	658	250	10
8159-1001	Manufacturing Systems Inquiry	250	10
	Languages		
8150-0113	RPG Compiler	0	40
8150-0108	NEAT/3 - COBOL 68 Compilers	0	90
8150-0109	FORTRAN Compiler - BASIC	0	20
8150-0112	FORTRAN Compiler - Educational	0	20
8150-0110	FORTRAN Compiler - Intermediate	0	40
8150-0111	FORTRAN Compiler - Full	0	75

NCR CORP.

Century 8200 Series

OVERVIEW

The NCR 8200 is a minicomputer-based processing system designed for multistation, interactive and batch commercial applications. First announced in 1974 as the SPIRIT (Sales Processing Interactive Real-time Inventory Technique) on-line order entry system, the 8200 has since had a number of important system upgrades. In addition to SPIRIT, NCR has also announced a number of new batch and interactive application systems for the 8200, which serve specialized industries such as hospitals, wholesale distributors, local governments, and educational institutions. Also, the 8200 now offers a general-purpose real-time operating system, IMOS (Interactive Multiprocessing Operating System), and COBOL 74.

The NCR 8200 is centered around a fast, 16-bit minicomputer with 32K to 128K bytes of memory, a cassette tape transport, a CRT/keyboard unit, a moving head disc and a printer. A variety of printers, two types of discs, an additional cassette tape, and a card reader can be attached to the system, as well as a total of seven CRT terminals.

There are two operating systems for the NCR 8200. The first one is the NCR Century 101 simulator. Programs, including SPIRIT and the batch-oriented accounting systems, for this operating system are written in NEAT-3, NCR's assembly language. The second (and newer) operating system is IMOS, which allows for the concurrent execution of up to seven independent tasks. All interactive application programs are run under the control of IMOS and are written in COBOL 74.

Both IMOS and COBOL 74 have been released to the field for customer use in selected pilot sites. The newly

HEADQUARTERS

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announced interactive turnkey systems which use both IMOS and COBOL 74 are also operational at pilot sites.

Before the release of COBOL 74, NCR sold the 8200 system only on a turnkey basis. However, with the availability of COBOL, NCR has changed this policy, and users may now write their own application program systems or contract with independent programming vendors (NCR will provide a list of recommended vendors). NCR has also modified its previous policy of bundling all the software associated with the 8200. Either the Century or the IMOS operating system is included in the basic system price; however, all system software and application packages are now separately priced.

Also available for the NCR 8200 is a package that allows the 8200 to emulate the IBM 2780 remote batch terminal. The 8200 can act as a remote job entry station to another NCR system or any mainframe that supports 2780 transmissions. The 8200 can communicate at speeds of up to 9,600 bits per second.

The basic price of an NCR 8200 system consisting of one terminal, a 4.9-megabyte disc, and a 173-character-per-second printer is $33,420; the system may be rented for $825 per month. Initial deliveries of the NCR 8200 were made in March 1975; to date, over 300 systems have been shipped. See Table 1 for system specifications.

COMPATIBILITY

The 8200 system is upward compatible with the larger Century computer line. A standard operating mode of the 8200 is that of Century 101 simulation, and 8200 programs, at the object code level, and disc packs are directly transferable to the larger Century machines. This policy of compatibility is carried through at the programming language level as well. The assembly language of the 8200 is NEAT-3, which is also used on Century equipment. The 8200's COBOL 74 is also upward compatible with that of the Century 101.

Telecommunications compatibility allows an NCR 8200 to emulate an IBM 2780 remote job entry terminal.

PERFORMANCE AND COMPETITIVE POSITION

With both the previously announced SPIRIT system and the newer integrated interactive application packages for the 8200, NCR is positioning itself in the minicomputer-based small business system and distributed data processing markets. The release of COBOL 74 and the "open" marketing policy offer potential users the option of either obtaining a turnkey system or performing their own application programming. And, by supporting NCR 101 simulation on the 8200, NCR is providing support for batch-oriented applications, as well as giving its users a clear upgrade path into the larger Century systems.

Up to now, the multi-terminal turnkey market has been the domain of such systems as Digital Equipment's Datasystem 350 and 500, Basic/Four, Four Phase Systems, and the various systems houses that make use of Data General, Digital Equipment or other manufacturers' minicomputers to build turnkey end-user systems. However, NCR has been one of the mainframe vendors active in this market. Packages for manufacturing, education, hospitals, local governments, and wholesalers should increase NCR's activity in areas where it could never offer turnkey software.

The 8200 is also an effective system for the small data processing user. In this area, the traditional competition from other mainframe vendors are the IBM System/32, IBM System/3 Model 4, the Burroughs B 730 Series, and, most recently, the Burroughs B 80.

While the System/32 cannot support concurrent real-time operations, the System/3 Model 4 (the low end of the System/3 family) has been introduced to handle exactly this function. The Model 4 can accommodate up to five local workstations (displays and/or printers) and is IBM's answer to the need for distributing processing power at remote user sites.

Table 1. NCR Century 8200 System: Specifications

CENTRAL PROCESSOR	
Word Size (bits)	16
Memory Size (bytes)	32K-128K
Cycle Time (μsec)	1.2
Memory Type	Core
AUXILIARY STORAGE CASSETTE	
Attach No. of Cassettes/Systems	1 std; 2 max
Device Capacity (bytes)	300,000
Transfer Rate (bps)	6,000
Rewind Speed (ips)	50
CARTRIDGE DISC	
No. of discs/Systems	1 std; 4 max
Average Access Time (msec)	47.5
Transfer Rate (bytes/sec)	312,500
Capacity (MB)	4.9 or 9.8
CRT/KEYBOARD TERMINAL	
Console Layout	Typewriter keyboard, numeric pad, special functions
Screen Size (in.)	12 diagonal
Lines	24
Characters/Line	80
No. of CRTs/System	1 std; 7 max
PRINTERS	
No. of Printers/System	1 std; 2 max
Speed	173 cps to 300 lpm
CARD READER	
No. of Card Readers/System	1 or 2
Speed (cards/min.)	300
COMMUNICATIONS	
Line Facility	Leased or switched
Line Configuration	Point-to-point, multi-drop, auto-answer
Line Speed (baud)	2,000 to 9,600
Transmission Mode	Binary sync
Transmission Code	ASCII, EBCDIC transparent
Emulation	IBM 2780
COMPATIBILITY	
Central Processor	Century 101
Languages	NEAT-3, COBOL 74
Terminals	IBM 2780

The Burroughs B 730 Series (an upgrade of the popular B 700 Series) offers concurrent batch operation and data entry capabilities via its B 9347-2 Direct Data Entry Stations (DDES). The B 730 Series does not offer a multitasking operating system like IMOS. It should be noted, however, that the B 80, a newcomer to the Burroughs line of small systems, can beat all the aforementioned systems in price, while offering a sophisticated operating system, Master Control Program (MCP), that handles multiprogramming and memory allocation.

USER REACTIONS

As IMOS and the interactive application packages were installed only at selected pilot sites, only users of the older SPIRIT order entry system were available for interviews. These users were either manufacturing or distribution companies, with an operating size from under $2 million to over $40 million.

All users had purchased the SPIRIT system for real-time maintenance of their inventory, as well as accounts receivable processing. All users found the 8200 and the SPIRIT package to be very reliable, with only rare hardware failures and infrequent software bugs, which were quickly corrected by NCR. All users also stated that the 8200 was quite easy for their operators to use, and that basic operator training was accomplished in a matter of a day or two.

Depending on the company size, single or multiple CRT stations were in use. The smallest company interviewed has a single CRT station that is used an average of three hours per day for inventory control, invoicing, receivables, payables, and general ledger functions. This user has complicated pricing and discount structure, which the SPIRIT system handles well. Originally, it began by using only standard SPIRIT modules, but NCR is in the process of customizing the company's software to meet its particular needs for special reports. This user previously had a Philips ledger card machine which handled office functions.

Another SPIRIT user is a corporation which also used larger Century equipment for its general data processing needs, and restricted the 8200 to the inventory and receivables functions. This user has three CRT stations which are typically used ten hours per day. The 8200 disc packs were transferred to the larger Century equipment for general data processing.

One user, who previously operated an NCR 395 accounting computer, is using two CRTs on the 8200 system. One CRT station is dedicated to billing functions, and the other one is used for inventory maintenance. An inventory of approximately 8,000 items is maintained, as well as an active receivables file of approximately 1,000 accounts. The CRT stations are used eight hours per day, and, typically, the processor is used about five hours per week for batch processing. NCR has implemented a special commission statement to meet the user's own specifications. This user is planning to implement NCR's sales analysis modules, as well as the payables and general ledger modules.

CONFIGURATION GUIDE

The basic NCR 8200 system consists of the 607-101-1 processor with 32K bytes of core memory, an integrated cassette drive, a common I/O trunk, an integrated disc controller, a single 796-101 CRT, a single 4.9-MB disc drive, a 173-character-per-second matrix printer (132 columns), and an asynchronous adapter for the CRT.

Memory can be expanded in increments of 8K bytes, up to a maximum total memory size of 128K bytes. When the system is running in Century 101 simulation mode, 16K bytes of memory are reserved for the simulator. The minimum memory required for systems operating under IMOS/COBOL is 64K bytes.

Two different disc drives are offered as 8200 peripherals: the 656-321, with a capacity of 9.8M bytes on two platters, one fixed and one removable; and the 656-331, a single removable platter device with a capacity of 4.9M bytes. The integrated disc controller will support four disc units in any combination, giving a maximum on-line disc storage capacity of 39.2 megabytes.

The CRT terminal operates at a rate of 9,600 baud through the asynchronous adapter. Up to a total of seven CRT terminals under IMOS and Century 101 simulation may be attached to a single system. Up to two line printers are available for attachment, with speeds ranging from 173 characters per second to 300 lines per minute. A second cassette drive, a synchronous communications adapter, and/or a card reader may also be attached to the system.

MAINFRAME

The 607-101-1 minicomputer, which is the central processor of the 8200 system, is an NCR-developed 16-bit CPU which is used in a number of NCR's systems, such as the NCR 499 and NCR 755. The 607 can support up to 64 devices via six direct memory access (DMA) channels, and up to 128K bytes of 1.2-microsecond core memory.

The processor communicates with its peripherals through either the single common trunk or one of seven dedicated I/O ports. The common trunk can connect up to eight free-standing peripherals, with only one trunk device being accessed at a time. For the I/O ports, one of the seven is dedicated to the disc controller; one to the cassette interface; one to the control console interface; and four to CRT interfaces, three of which are optional. A scanner I/O port is provided for system expansion up to seven CRTs.

Table 2 compares the effective throughput capabilities of the Century 101 and 8200 operating in simulation mode. Overall, the 8200 is about half as fast as the Century 101, due to simulation overhead.

PERIPHERALS

The NCR 8200 offers a full range of peripherals. It should be noted, however, that as a system designed

Table 2. Century 101 vs. Century 8200 (Simulation Mode) Comparison

Program	Time (sec) Century 101	Time (sec) NCR 8200	Speed Factor 101 vs. 8200
Sort/Merge	523	1,205	2.3 x
Printing	1,468	2,613	1.8 x
Compute	702	2,567	3.6 x
General Mix	684	1,304	2.1 x

primarily for on-line, interactive applications, its CRT offerings are rather limited. NCR supplies the user with only one variety of CRT terminal.

Magnetic Tape Cassette

The magnetic tape cassette drive is used on the 8200 primarily for loading the simulator program and simulating the NCR 636 cassette of the Century 101. The cassette handler is compatible with ANSI, ECMA, and ISO specifications. Transfer rate is 6,000 bits per second with a recording density of 800 bits per inch.

CRT Display

The 796-101 display contains 24 lines of 80 characters on a 12-inch diagonal screen. Characters are formed from a 5 by 7 dot matrix. Transmission between the display and the processor is at 300, 1,200, or 9,600 baud by means of the attachment of the 692-700 asynchronous adapter. One CRT display is standard on the 8200, and up to six additional units may be attached.

Line Printer

Three models of the 349 line printer are available with printing speeds of 100, 125, and 300 lines per minute. A 173-character-per-second matrix printer (6440-0101) is also available. All printers have a 64-character alphanumeric character set and a maximum line width of 132 columns, and are fully buffered.

Card Reader

The 368 card reader reads 80-column cards at a rate of up to 300 cards per minute.

Disc Unit

Magnetic disc units are standard components of the NCR 8200. The discs are used for the storage of operating system software, as well as random and sequential data files. The 656-321 is a single-spindle unit that holds one fixed two-surfaced disc and one removable two-surfaced disc. The capacity of both discs is approximately 9.8 million bytes. The 656-331 is a unit consisting of a single removable platter, with a storage capacity of 4.9 million bytes. Optionally, a second, third, or fourth disc unit may be attached to the 8200. All disc drives interface to the CPU via the integrated disc controller.

DATA COMMUNICATIONS

NCR offers a special module for the 8200 which allows it to operate as an emulator of the IBM 2780 for purposes of remote batch communication. In addition to communicating with other NCR computers, it is also capable of communicating with any device which supports 2780 transmission. The IBM 2780 package supports two- or four-wire half-duplex and four-wire full-duplex. Network connection may be point-to-point (switched or non-switched) or non-switched multipoint (CPU satellite). An auto-answer feature is also available.

ASCII, EBCDIC, and EBCDIC transparency are supported, as well as line speeds from 2,000 to 9,600 baud. In addition to the card reader and line printer as emulator peripheral devices, both the cassette and disc may be used as either input (card image) or output (print line) devices, allowing for processing of data prior to or subsequent to file transmission.

SOFTWARE

NCR offers two major operating systems for the 8200 — Interactive Multiprogramming Operating System (IMOS) and Century 101 simulation (see NCR Century report 140.5136.110 for a description of the Century operating system). Either operating system is provided without charge with the 8200; however, more than one operating system, utility programs, and applications systems are offered on a license basis.

IMOS

IMOS is a disc-based operating system consisting of a disc executive, a COBOL language processor, and a number of utilities. IMOS supports multi-tasking, with a maximum of seven concurrent tasks operating in dedicated memory partitions. IMOS controls all access to the disc data base and provides mechanisms for file sharing and data block protection. All user programs functioning under IMOS must be written in COBOL 74, which consists of an interpretive compiler and a run-time executive. COBOL 74 is identical to that used with the larger members of the Century line. COBOL programs may be compiled directly on the 8200, but a minimum memory configuration of 64K is required.

Under IMOS, NCR has introduced several interactive application packages. These include:

- Interactive Healthcare Information System, designed for small hospitals and clinics.
- Interactive Financial Management System, designed for local governments and educational institutions.
- Interactive Wholesale Distribution System.

These packages are implemented in COBOL 74.

The Interactive Wholesale Distribution System is designed for wholesalers, distributors, or any other businesses which must fill customer orders from stock. It uses a data base concept, where a single record group is estab-

lished and maintained for each data type required. This record group is accessible by any CRT station on the system. The package consists of six application modules:

- Order Processing/Sales Analysis.
- Inventory Control.
- Accounts Payable.
- Accounts Receivable.
- Payroll.
- General Ledger.

The order processing module accepts customer orders, validates them, applies the input to the data files, and generates necessary reports. The following functions are supported:

- One-Cycle Order Processing.
- Two-Cycle Order Processing.
- Back Order Processing.
- Invoice Processing.
- Sales History.
- Drop Shipments.

Outputs of the sales analysis module can include:

- Sales by Product Class.
- Sales by Customer Class.
- Sales by Salesman.

The inventory control modules maintain the product data base and prepare reports reflecting inventory status, replenishment requirements, and product movement history. Files are maintained for product identification, costing and pricing, and quantities on hand, on order, back ordered, and reserved for stock-keeping.

Century 101 Simulation

In addition to the well-known SPIRIT order entry system, NCR has a number of application packages operating under Century 101 simulation. Packages operating in batch mode include the:

- Manufacturing application system, which offers bill of material, inventory requirements, inventory control, and production scheduling modules.
- Educational institution system, which offers student scheduling and grade attendance modules and an automated school record-keeping system.
- Hospital application system, which offers in-patient record-keeping and post-discharge accounts receivable.
- Utility billing system.
- Budgetary accounting application for local governments.
- General accounting modules.

SPIRIT. NCR continues to market the SPIRIT order entry system in a turnkey fashion. This system consists of interactive packages for order entry, inventory control, and accounts receivable, and batch packages (operating in Century 101 simulation) for accounts payable, payroll, and general ledger. All software for SPIRIT is written in NEAT-3, the Century assembly language. SPIRIT is not designed to be user-programmable.

SPIRIT on-line programs allow the user to enter orders via the CRT keyboard; allocate inventory to the order; perform pricing, discounting, and taxing; total the order and authorize credit; update the customer account; and produce pick lists, packing slips, and invoices. Stock receipts, shipments, purchases, price changes, and customer payments are also processed on-line.

The on-line functions supported by SPIRIT software, but processed in batch mode, include order and inventory update and reporting, and accounts receivable update and reporting. Both involve updating, purging, and/or restructuring master files (on disc) used by the on-line program. These disc files can be used to produce a large variety of reports:

- Daily Orders Received/Shipped.
- Daily Back Orders/Order Cancellations.
- Back-Order Bin Tickets.
- Customer Change Register.
- Matrix Change Register.
- Vendor Change Register.
- Inventory Change Register.
- Out-of-Stock/Below-Minimum.
- Inventory File Listing.
- Buyer's Listing.
- Vendor File Listing.
- Customer File Listing.
- Matrix File Listing.
- Batch Corrections.
- Input Errors.
- Transactions Deleted.
- A/R Receipts Register.
- Master File Changes.
- Statements.
- Aged Trial Balance.
- Customer Status.
- Delinquent Accounts.
- Credit Exceptions.
- Inactive Customers.
- New Customer Listing.

The major master files include Batch Customer, Batch Inventory, Batch Vendor, Matrix, On-Line, and Order Status. The SPIRIT standard software has been designed for a 10-megabyte disc; disc files are accessed through both random and index-sequential methods.

The Century 101 batch packages are:

- General Ledger Accounting — performs file maintenance, item processing, report preparation, and daily reporting. Daily, month-end, period-end, and on-request reports comply with internal accounting and auditing standards established by various regulatory agencies.
- General Payroll — automated payroll accounting and labor division system with provisions for conversion, original implementation, and parallel operation.
- Accounts Payable — timely accurate administration of liabilities to vendors, preparation of vendor checks and itemized remittance statements, billing of debit balance accounts, distribution of costs to organizational units; and historical analysis of vendor activity.

MAINTENANCE AND SUPPORT

Maintenance is available through more than 300 service offices in the United States and Canada. NCR also has more than 900 service centers outside the United States. Like that of the larger Century Series, the 8200 system hardware is modular, with a high degree of circuit standardization so that repairs involve only replacement of a plug-in circuit board.

NCR's standard maintenance contract provides for on-site preventive and emergency maintenance during any 8-hour period between 8:00 a.m. and midnight. Rates depend partly on the distance from the service center. Special arrangements can be made for round-the-clock service at higher rates.

PRICE DATA

Model No.	Description	Purchase Price $	Monthly Rental (Maint. incl.) (1-yr) $/Mo.	Monthly Maint. $
607-101-1	Processor with 32K-byte memory, integrated cassette, common trunk, integrated disc controller, 692-700 asynchronous adapter.	17,425	415	73
6070	Additional 8K memory	2,000	65	5
796-101	CRT display station	2,000	85	20
692-700	Asynchronous adapter	1,500	45	5
656-321	9.8-MB disc (fixed, removable)	12,500	375	97
656-331	4.9-MB disc (removable)	9,500	300	80
6440-0101	Matrix printer, 173 cps	4,495	145	35
349-050	100-lpm Line printer	6,325	215	32
349-1	125-lpm Line printer	10,000	280	32
349-2	200-lpm Line printer	13,000	370	37
349-300	300-lpm Line printer	17,000	460	43
693-700	Synchronous adapter	2,250	80	8
603-6000-019	Second cassette drive	1,850	50	5
368-1	Card reader, 300 cpm	4,500	150	22

Rental prices are for the one-year plan. Three- and five-year plans are also available.

SOFTWARE Program System	Initial Charge $	Monthly License $
IMOS	0	15
NCR Century 101 Simulation (One operating system is free; a second is licensable.)	0	15
Interactive Healthcare Information System		
In-patient processing	350	20
Out-patient processing	250	15
Patient accounts receivable	350	20
Healthcare payroll	500	30
Healthcare general ledger	250	10
Healthcare accounts payable	250	10
In-patient processing extension	60	5
Interactive Financial Management System		
Fund accounting system	750	45
Financial management system payroll	500	45
Interactive Wholesale Distribution System		
Order processing/sales analysis	1,450	65
Inventory control	800	40
Accounts receivable	500	30
Payroll	500	30
Accounts payable	250	10
General ledger	250	10

	Service Package Price $
SPIRIT Distribution/Wholesale System	3,135
Manufacturing Application System	
Bill of materials	3,385
Inventory material requirements	3,135
Inventory material control	3,385
Material requirements planning	3,225
Production scheduling and control	3,225
Hospital Application System	
In-patient record accounting	4,265
Post-discharge accounts receivable	3,595
Educational Institution Application System	
Student scheduling	3,595
SCHOLARS	4,600
Utility Billing System	3,430
Budgetary Accounting System	3,010
General Accounting System	
Payroll	2,845
Accounts payable	3,510
General ledger	2,510

OVERVIEW

The Nixdorf Compactsystem 8835 is one of two new Nixdorf key display oriented disc processing computers for small businesses announced on April 16, 1975. It comprises a processor with 8K 18-bit words of fixed system and control memory and 4K 12-bit words of changeable memory for user programs, 6.2M bytes exchangeable disc drive, and a single console comprising a keyboard, 100 characters per second printer, 256- or 960-character CRT display, and one or two magnetic tape cassette drives.

Like the floppy disc processing System 8830 announced in February 1975, Compactsystem 8835 is primarily intended as a compatible upgrade system for System 820/15 visible record computer users. It uses the same processor as the 8830 and offers 4K 12-bit words of core memory to hold either 1,968 stored program instructions and 123 data words of 16 numeric digits, or 768 data words only—or any intermediate combination. It offers the same assembler and FIRM modular accounting package, as well as COSS, a proprietary Nixdorf systems-oriented language developed in the USA. Because Compactsystem 8835 offers a different range of peripherals from Systems 820/15 and 8830, a measure of source program conversion will be required, especially for programs written in assembly language.

Nixdorf markets Compactsystem 8835 directly through its own sales branches, and indirectly through the network of agents that have handled its System 820 office computers. Prices for 8835 systems sold directly by Nixdorf range from DM 92,500 ($37,000) to DM 102,150 ($40,860) for the hardware, and from DM 7,800 ($3,120) to DM 12,500 ($5,000) for the FIRM accounting package. The agents fix their own prices. See Table 1 for system specifications.

Table 1. Nixdorf Compactsystem 8835: Specifications

PROCESSOR	
Word Size (bits)	18 (instructions); 64 (data)
Capacity (words)	4K-5.9K (instructions); 128-768 (data)
Cycle Time (μ sec)	2.5 per 12-bit wide access
Working Storage	Core
AUXILIARY STORAGE	
Disc	Std; 6.2M bytes, 42.5 msec access, 156Kb/sec
Magnetic Tape	1-2 drives, 436 cps, 256K bytes
Magnetic Ledger	—
DATA OUTPUT	
Line Printer (lpm)	—
Serial Printer (cps)	100 cps std, 178 print positions
Display	256- or 960-char screen
Card (cpm)	—
Paper Tape (cps)	—
DATA INPUT	
Keyboard	Std
Card (cpm)	—
Paper Tape (cps)	—
SOFTWARE	
Assembler	Yes
Operating System	Yes
Compiler	COSS, as well as FIRM accounting package
COMMUNICATIONS INTERFACE	None

COMPATIBILITY

As the Compactsystem 8835 uses the same processor as the System 820/15 visible record computer and 8830 floppy disc system, it offers also a measure of upward compatibility with these systems at source program level. This is qualified, however, by the differences in the peripherals that the three systems support. Compactsystem 8835 does not support the ledger card front feeds, magnetic ledger card processing unit available on Systems 820/15 and 8830, nor the floppy discs available on System 8830. On the other hand, it includes as standard features larger capacity discs and a 256- or 960-character console display that are not available on the smaller system. Some source program and file conversion is thus necessary to transcribe MLC and/or floppy disc files to 7020 exchangeable discs, and to substitute file record outputs to the console display for the automatically visible ledger card records of the smaller systems.

These conversions will be easiest for users of the FIRM accounting package and of high-level COSS programs. The logical parts of these programs need only be recompiled or regenerated for running under the Compactsystem 8835 COSS or FIRM interpreter. Assembly source programs written for a System 820/15 or 8830 will, however, have to be extensively rewritten to run on Compactsystem 8835. The same goes for assembly programs written for System 820/25, 820/35 VRCs, and System 880/45 and 880/55 disc processing systems, all of which use compatible processors but offer different peripheral combinations.

Compactsystem 8835 offers no source or object program compatibility with the larger disc processing Systems 8870, 880/65, and 900. Upward conversion to one of these systems will entail a complete rewriting of all source programs, as well as disc file conversions.

COMPETITIVE POSITION

No one can accuse Nixdorf of not taking the challenge of IBM's System/32 seriously. Within nine days of that system's announcement in Europe, Nixdorf was announcing no less than two new key display disc processing small business computers: Compactsystem 8835 and the System-Computer 8870/2. But whereas the 8870/2 is primarily designed to capture new users from IBM by offering them much more than System/32 at roughly the same price,

Compactsystem 8835 is a much cheaper and less powerful system designed primarily to defend the perimeter of the Nixdorf System 820 visible record computer customer base. There are over 30,000 Nixdorf office computers in the field, including some 18,000 in West Germany itself. It is a user base worth defending.

Compactsystem 8835 offers Nixdorf 820/15 users 6.2M bytes of on-line disc storage — and any number of off-line 3.2M byte disc packs — to which they can transcribe their magnetic ledger card and/or magnetic tape cassette files; and a 256- or 960-character CRT display on which the contents of any file records can be displayed. Subject to the inevitable adaptation of source programs that such a file media conversion entails, Compactsystem 8835 offers them full upward source program compatibility at assembler, COSS, or FIRM accounting package level. Since Compactsystem 8835 also costs about 18 percent less than the IBM System/32, there is no reason why Nixdorf 820/15 users should desert the Nixdorf fold.

Does Compactsystem 8835 also have something to offer new users without an investment in Nixdorf 820 programs? At a base hardware price of DM 92,500 ($37,000), it is the cheapest disc processing system on the West German market, with the possible exception of the Datapoint 2200, and will also be among the cheapest on any other European market where it is announced. It offers an assembler, compiler, and a comprehensive modular accounting package that is better than the applications packages currently available on many competing systems, notably System/32.

Compactsystem 8835 cannot, however, be expanded and Nixdorf offers its users no upward compatible migration path. Users requiring additional on-line disc storage capacity or a second input console must convert to the Nixdorf System-Computer 8870/2, whose processor structure, source programming languages, applications packages, and even data formats are totally different. Unless a new user is very badly squeezed for money or is sure that his data processing requirements will never expand beyond Compactsystem 8835's capacity, he would do better to order immediately a Nixdorf 8870/2, with its long compatible upward migration path and industry compatible high-level programming languages.

CONFIGURATION GUIDE

The standard Compactsystem 8835 comprises a 3505 processor, console with keyboard, 100 characters per second serial printer, 3212 display with 256-character screen, 6230 magnetic tape cassette drive, and 7120 split exchangeable disc drive. The only allowed alterations to this configuration are the substitution of a 3213 display with 960-character screen for the 3212 display, and the addition of a 6231 magnetic tape cassette drive. All system components except the disc drive are integrated into a console pedestal desk.

Processor

Compactsystem 8835 uses the same 820 microprogrammed processor housed in a 3505 chassis as Systems 820/15 and 8830. This comprises a 12-bit parallel arithmetic and logical unit, 8K 18-bit words of program read-only memory (ROM), and 4K 12-bit words of core memory for both user instructions and data.

Data Structure. The 8835 data structure is identical to the Systems it will gradually supersede, including the System 820 and 8830 office computers and the System 880/45 and 880/55 disc processing small business computers. Apart from 160 12-bit scratchpad registers at the beginning of the core store, all data is addressable in 64-bit data words, holding a signed 15-digit decimal number, 10 6-bit BCD alphanumeric characters, or eight 8-bit bytes. Each 64-bit "data word" occupies 16 4-bit half-bytes in core memory. The first 123 words use the bottom four bits of 1,968 12-bit words in the lower half of core memory: this space can only be used for data. The remainder of the core store can be freely used for program instructions or data.

Special Registers. 160 12-bit words of core store are used as scratchpad registers. They include the accumulator, accumulator extension, instruction counter, five subroutine counters, line counters, and testable indicators; and eight index registers also frequently used as working registers. The remainder of the scratchpad store is used for input/output buffers.

Addressing Facilities. Addresses may be direct or indirect and/or indexed. Each 18-bit instruction includes an 11-bit address field, which may be used as a single 11-bit branch address to any of 2K instructions within a memory area, or as two or three "data word" addresses which may be a mixture of 3-, 4-, 7-, and/or 8-bit addresses. Three-bit addresses are used for the eight index/working registers; 7-bit addresses for the first 123 reserved "low order" data words; indexed 8-bit addresses or direct 11-bit addresses for "high order" data words beyond the first 123.

Instruction Set. Instructions are 18 bits long. A simple unpublished repertoire of microinstructions is used in microprograms implementing the more powerful macroinstruction set used in applications programs. Macroinstructions are also 18 bits long, and include a 6-bit op code, 1-bit indirect addressing indicator, and 11-bit address field. In instructions that do not require an address field or only a shorter one, some or all of the address field bits can be used to modify the basic 6-bit op code. This expands the basic 64 instruction repertoire into over 200 combinations of symbolic op codes in the assembly language. Instruction execution times are the same as on System 820/15.

Interrupt Control. The 8835 scratchpad store contains a number of testable indicators. The microprogram controlling the I/O channel to which peripherals

are attached sets one of these indicators when an external peripheral sends an interrupt signal. It is then up to the operating system to test indicators at specified intervals.

Main Memory

The 8835 memory comprises two 4K 18-bit word read-only memories (ROM) and a 4K 12-bit word core memory.

ROM Memory. Both ROMs have a two microsecond cycle time per 18-bit instruction. The first 4K word ROM holds the microprograms implementing the macro-instruction set and the I/O channel programs. Called the "microprogram ROM," it is permanently set at the factory. The other 4K word "macroprogram ROM" holds applications programs on exchangeable plug-in boards. On 8835 installations running either COSS programs or the FIRM accounting package, the macroprogram ROM will be used semipermanently to hold either the COSS interpretive compiler or the basic FIRM routines.

Core Memory. The 1607 core memory has a capacity of 4K 12-bit words with a 2.5 microsecond cycle time per 12-bit wide access. It is divided logically into two 2K word modules. 80 words in each module are used to form 160 scratchpad registers. The remaining 1,968 words in the lower module are divided into 4-bit and 8-bit portions. The 1,968 4-bit portions are chained into 123 64-bit "data words" and can only be used to hold data. The 1,968 8-bit portions of the lower module and the 1,968 12-bit words of the higher module can be used to hold either stored program instructions or data. Each 18-bit stored instruction uses an 8-bit lower module word for the op code and a 12-bit higher module word for the address part. 64-bit "data words" use eight consecutive lower module 8-bit word portions, or 5.3 12-bit higher module words. Total 1607 core memory capacity is thus 160 12-bit registers, at least 123 and up to 768 64-bit data words, and/or up to 1,968 stored 18-bit program instructions. Core memory is used mainly for short program overlays read from discs or magnetic tape cassettes.

Discs

Compactsystem 8835 uses the same 7120 exchangeable disc drive as System 880/45 which it replaces in the Nixdorf catalogue. This is a modified IBM 2311-type exchangeable disc drive, holding two superimposed 3-platter exchangeable disc packs instead of a single 6-platter disc pack. Data is recorded on the four inside surfaces of each 3-platter pack on 203 concentric tracks, including three spare ones. The combined 6.2M byte capacity of both disc packs held on the drive at any one time cannot be expanded, as no additional drives are allowed on Compactsystem 8835.

Console

The 8835 console comprises a standard Nixdorf input keyboard, 100 characters per second serial matrix printer, one or two MT cassette drives, and a rotating CRT display.

Keyboard. The new standard Nixdorf electronic keyboard is the main input medium for variable transaction data as well as operating instructions. Source programs and alphanumeric text are entered on a normal typewriter keyboard in QWERTZ, AZERTY, or any other national layout. All-numeric data are entered from a 12-key single-handed numeric keypad. 29 function keys are available for program selection and operating control, some of which are associated with status indicator lights. The meaning of some keys is application program dependent. All keyboard inputs are transmitted character-serially into main processor memory, where they are buffered. The applications program determines which inputs should be output back to one of the console output devices and when.

Display. A rotating CRT display on the left hand side of the console is a standard Compactsystem 8835 feature. It is normally programmed to provide the operator with a visual feedback of his keyboard inputs, real-time format guidance masks, validation and/or error messages, and other system messages. The standard display is the model 3212 with a 256-character screen capacity arranged as eight lines of 32 characters. This may be replaced optionally by the model 3213, which displays up to 960 characters as 12 lines of 80 characters.

Printer. All printed output is under program control, and takes place exclusively from main processor memory. The operator can thus delay printed output until he is certain all data for a line have been entered correctly. Compactsystem 8835 uses the same 100 characters per second serial matrix printer as the recently announced 8820 Data Entry Terminal and 8864 Multi-Job Financial Terminal Computer. It can print multiline outputs alternately forwards and backwards and can have a printable character set of up to 128 characters and special signs, including full upper- and lowercase alphabetics. Maximum line width is 178 print positions spaced 10 to the inch. Two continuous form feeds with adjustable margins are standard, but there are no facilities for front fed ledger cards.

Magnetic Tape Cassettes. A single 6230 MT cassette drive and controller is standard on Compactsystem 8835 for initial program loading. A second 6231 drive can be added optionally for MT cassette file processing and/or data exchange with other Nixdorf systems. The 6230 and 6231 drives read/record ECMA 34 0.15 inch cassettes bit-serially at 800 bits per inch and 436 characters per second. Maximum cassette capacity is 256K bytes on each side.

SOFTWARE

Compactsystem 8835 software includes an operating system, assembler, compiler, and accounting package.

Operating System

The operating system is held in microprogram ROM store and is responsible for all I/O peripheral control. It

includes a disc input/output control system (IOCS) that is responsible for all reading and writing to and from discs. User programs initiate IOCS routines by macro-instructions that address data held on disc by file and record names, leaving the IOCS to find the physical location of the appropriate files and records by means of look-up tables. Each 3.1M byte disc pack can hold up to 62 random or sequential files or up to five indexed sequential files.

Languages

Users and software houses can program Compactsystem 8835 in an assembly language or COSS (Commercially Oriented Software System). The assembler is the same as that used on System 820 and 8830, with extensions for the control of display formats and layouts.

COSS is a proprietary Nixdorf system-oriented language developed by the company's US branch. COSS source programs are translated into an intermediate level pseudocode that is executed interpretively at run time by the COSS interpreter held in the 4K instruction macroprogram ROM.

Applications

Compactsystem 8835 offers a version of the same FIRM modular accounting package offered also on System 820/15 and 8830 magnetic ledger card processing systems. FIRM is a series of program modules for order entry, invoicing, sales ledger, stock recording and control, materials scheduling, purchase ledger, production scheduling and control, payroll, general ledger, and branches of statistics required by management. Compactsystem 8835 users can select any required combination of modules, which can be adapted to their own requirements by filling in standard Nixdorf questionnaires, which are then input to a standard Nixdorf FIRM program generator. The generated programs are in a pseudocode that is executed interpretively at run time by a FIRM program board held in the 4K word macroprogram ROM.

MAINTENANCE

Nixdorf and its agents maintain all rented 8835 systems and are prepared to sign maintenance agreements for purchased systems. Nixdorf standard maintenance terms provide for quarterly preventive maintenance during working hours and on-call availability at other times. The Nixdorf network of sales and service centres is sufficiently dense to allow engineers to reach most user sites within two hours of the receipt of an emergency call. In West Germany, there are Nixdorf sales and service centres in 32 cities and West Berlin, and Nixdorf agents with their own service facilities in 17 cities.

HEADQUARTERS

(World)	(USA)
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NIXDORF COMPUTER

System-Computer 8870 Model 1 (U.S.)

OVERVIEW

System-Computer 8870 International Model 1 was announced in the United States, France and the United Kingdom in September and October 1975. It is a real-time transaction processing system that supports multiple (up to four) workstations. While the System-Computer 8870 International Model 1 is a member of the 8870 family, it is not compatible with the West German members — the Models 2, 4, and 6.

PRICE DATA

Listed below is the basic price data for the International Model 1 as it is marketed in the United States. It should be noted that some of the U.S. specifications are different than those listed for the basic International Model 1, and that, in the U.S., the Model 1 is refered to as the 8870/10. This is not an uncommon practice for Nixdorf or other European-based companies that market internationally; prices, specifications and names differ from country to country.

Model Number	Description	Purchase Price (maint not included) $	Maint $
	Basic 8870/10; 64K, real-time clock, 10M char. disc drive (5MB fixed/5MB removable), 165 cps matrix printer	39,990	250
8300	Video Terminal (1990 char)	5,950	37
8310	Video Terminal Standalone Workstation	6,450	37
8400	Disc Drive, 10MB	12,000	75
8500	Line Printer, 60-100 lpm	7,950	50
8510	Line Printer, 300 lpm (only as a second printer)	14,000	87
8520	Line Printer, 600 lpm	22,000	138
8600	Magnetic Tape, 1600 bpi	11,500	72
8601	Controller (for 4 mag tape drives)	5,500	35
8700	Punch Card (80 col)	5,450	34

Note: Rental plans are not available.

HEADQUARTERS

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NIXDORF

System-Computer 8870 (International Model 1)

OVERVIEW

System-Computer 8870 (Models 2, 4 and 6), marketed in West Germany, is a batch-oriented, multi-keystation disc processing computer. For a system emerging from the stable of Europe's leading visible record computer manufacturer, it is unexpected to find that these models utilize on-line key-display stations for on-line data entry and file inquiries, while file updating takes place essentially in a batch mode. These systems are described in Report 140.7610.220 in your service, and remain available on the West German market only.

It is a very different System-Computer 8870 that Nixdorf introduced in the United States, France, and the UK in September and October 1975. Known as the International Model 1, the only features that it shares with the West German version are its name, its price range, its ability to control one to four key-display workstations located approximately 230 feet from the central processor, and its general physical appearance. In all other respects, including hardware and software, the International Model 1 8870 version is different.

The International Model 1's distinguishing feature is its true multistation real-time transaction processing capabilities. Real-time updating of files on the basis of keyboard inputs under the Commercial Time Sharing System (COMET) is the rule rather than the exception. User programs can also be entered and developed interactively and in real-time; for this purpose the International Model 1 8870 offers Business BASIC as a programming language, instead of the batch-oriented RPG II and COBOL compilers offered on the West German systems.

The hardware to implement these facilities has been assembled by Nixdorf's U.S. subsidiary from OEM sources: DCC's D-116H processor with 48K or 64K bytes of 960-nanosecond memory, one or two IBM 5444-type fixed/exchangeable cartridge disc drives, and one to four Hazeltine 2000 key-display stations. Only the printers are the same as those used on the West German model 8870/2 — a choice of a 150-cps serial matrix printer and/or a 300-lpm drum line printer. Optional additions to the system include a 1,200 to 9,600 bps synchronous data communications line adapter, and/or one or two nine-track 800/1,600 bpi magnetic tape drives. Systems delivered in France and the UK will, however, be assembled in Paderborn, West Germany from units built under license from their U.S. designers.

At press conferences launching the international version of the 8870 in France and the UK, Nixdorf representatives explained that the differences between the West German and international versions were due to the differences between existing Nixdorf customer bases. Nixdorf's West German customer base includes many large users, who order Nixdorf systems for distributed data processing. To meet their needs, the West German 8870 had to provide for batch processing of data entered on-line (either on the 8870 itself or on a central IBM System/370 or other EDP mainframe), as well as an upward-compatible growth path to the larger Nixdorf Systems 880/65 and 900 that are not marketed actively outside West Germany. Nixdorf's customer base outside West Germany comprises mainly VRC users, and it was felt that their needs were best met by a direct transaction processing system with programming in Business BASIC.

Small to medium businesses using VRCs also represent more than half of Nixdorf's West German customer base, however. To meet their needs, Nixdorf is considering introducing the international version to the West German market, some time in 1976, as the 8870/1. If it does so, the marketing of two different systems under the same family label in the same country will cause considerable confusion. See Tables 1 and 2 for the main system specifications.

COMPATIBILITY

The international version of System 8870 is not compatible with any other Nixdorf office or small business computer at source program or machine code level, not even the West German Models 8870/2, 8870/4 and 8870/6. Using the DCC D-116H minicomputer as central processor, it is, however, machine code-compatible with any other system based on the same processor, including the Entrex 480 key-to-disc data entry system that is marketed in continental Europe as the Nixdorf 620 and in the UK as the Redifon

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Table 1. Nixdorf System-Computer 8870/1: Mainframe Characteristics

CENTRAL PROCESSOR	**DCC D-116H**
General Purpose Registers	4
Addressing (wds)	
Direct	256
Indirect/Indexed	32K
Instruction Set	202
Decimal Arithmetic	No
Priority Interrupt Levels	16
MAIN STORAGE	
Type	Core
Cycle Time (μsec)	0.96
Bytes/Access	2
Capacity (bytes)	
Minimum	48K
Maximum	64K
Increment	8K
Parity	No
Protect	Std
ROM	Yes
Use	Executive programs
Capacity	Alternative to core: 256, 512, and 1K wd modules
I/O CHANNELS	
Programmed I/O	Yes
DMA Channels	1
SOFTWARE	
Operating System	NIROS/1 interactive virtual memory
Assembler	No
Compiler	Business BASIC: multi-user interpreter
Applications	COMET commercial interactive SORBAS statistical evaluation

SEECHECK. The DCC D-116 processor has in turn been designed to be compatible with the Data General Nova series.

The main programming language for the international Nixdorf 8870 is Business BASIC, an extended version of the Dartmouth College time-sharing language. The international 8870 thus offers a measure of source program compatibility with other Business BASIC-oriented small business computers, notably the Basic Four, Datapoint 2200 and 5500, DEC Datasystems 350 and 500, and other systems based on these. System 8870's eight-bit byte-oriented data and file structure is based on a current international standard, and offers data and file exchange compatibility with a wide range of computer systems of all sizes, via data communications lines or nine-track magnetic tape.

COMPETITIVE POSITION

Like the West German Model 8870/2, the basic price of the International Model 8870/1 has been pitched to be directly competitive with IBM's System/32. It is, however, much more powerful than this system. It offers a 1,998-character screen capacity on its workstation (compared to 256 characters on System/32), 5M bytes of fixed and 5M bytes of exchangeable disc storage (5M bytes of fixed disc storage only on System/32), and the facility for expanding not only the on-line disc storage, but also the number of on-line workstations (on-line IBM 3741 data entry stations can be added to System/32 only when attached to the bi-sync communications adapter).

Whereas the West German 8870/2 and 8870/4 follow IBM's philosophy of on-line data entry followed by batch processing, and offer the same RPG II programming language, the International 8870/1 is modeled rather on the Basic Four 350 and 400. Its one to four workstations are designed to be used mainly in interactive transaction processing, and its main programming language is Business BASIC. With a current maximum of four on-line workstations, the International 8870/1 is not yet as expandable as the Basic Four, but a more advanced version of its NIROS/1 operating system that will be able to accommodate up to eight workstations — like the Basic Four 500 — is due to be released toward the end of 1976 or early in 1977.

As a BASIC-oriented transaction processing system, the International Nixdorf 8870 invites comparison also with the DEC Datasystems 350 and 500, and the other DEC PDP-11 based commercial transaction processing systems marketed in various countries, such as the MBM 7400 and Systime 5000 series in the UK. The basic prices for single workstation configurations of these systems are competitive with Nixdorf 8870/1 and with IBM System/32, but they are much more expandable (to a current maximum of 64 terminals on DEC Datasystem 570 and Systime 5700). The recently announced DCC D-616 processor is, however, as expandable (to 2M bytes of main memory) as the DEC PDP-11/70 and compatible with the D-116H used in the International Nixdorf 8870. The 8870 can thus be expanded further, if user demand should justify it.

CONFIGURATION GUIDE

The international version of System-Computer 8870 is known internally at Nixdorf as the 8870/1, and may be released under this label on the West German market in 1976.

A basic System 8870/1 comprises a DCC D-116H processor with 48K-byte storage, one fixed/exchangeable cartridge disc drive offering 5M + 5M bytes capacity, a 1,998-character CRT key-display workstation, and a 150-cps serial or 300-lpm line printer.

The following options are available:

- Processor memory expansion to 64K bytes.
- A second 5M + 5M byte fixed/exchangeable disc drive, raising on-line disc capacity to 20M bytes.
- Up to three additional key-display workstations, located individually at up to 70 metres (approximately 230 feet) cable length from the central control group.
- A second printer of either model.
- One or two 800- or 1,600-bpi nine-track magnetic tape drives.
- A synchronous data communications adapter interfacing with an EIA RS232C or CCITT V.24 1,200 to 9,600 bps modem.

Table 2. Nixdorf System-Computer 8870/1: Peripherals

Peripheral Device	Performance Characteristics	Comments
Fixed/Exchangeable Disc Drive	5M-byte fixed + 5M-byte exch disc per drive, 49.5 msec average access time, 312K bytes/sec transfer rate	1 or 2 drives per system, maximum on-line capacity 20M bytes
Video Display Workstation	CRT screen – 27 lines, 74 chars – A/N typewriter kybd, num keypad & function keys	1-4 workstations per system, up to 70m cable length
Serial Printer	150 cps, 132 print positions	1-2 printers per system, either model
Line Printer	300 lpm, 132 ppl, 64 chars	
Magnetic Tape Drive	9-track, 800-bpi NRZ 20Kbs or 1,600-bpi PE, 40Kbs	1-2 drives/system optional
Communications Adapter	1,200-9,600 bps sync	

When the NIROS/2 operating system is released at the end of 1976 or early in 1977, it will be possible to add up to seven additional key-display workstations for a combined total of eight.

MAINFRAME

System-Computer 8870/1 uses the Digital Computer Control's D-116H minicomputer as mainframe. This is a microprogrammed system, offering a basic instruction set of 202 instructions, 16 bits long. It offers four 16-bit accumulators, two of which can also be used as index registers. It can address up to 256 16-bit words directly or in self-relative mode, and up to 32K words (64K bytes) indirectly with or without indexing. It incorporates one interrupt line and a 16-bit programmable mask register that establishes 16 priority levels.

Main memory has a 960-nanosecond cycle time per 16-bit word access. 8870/1 software requires a minimum 24K word (48K bytes) capacity. This can be expanded in 4K word increments to the current maximum of 32K words (64K bytes).

The D-116H offers both a programmed I/O channel and a DMA channel as standard features. High-speed auxiliary stores, like the discs, are connected to the DMA.

PERIPHERALS

Table 2 describes the peripherals available on the 8870/1. The disc drives are IBM 5444-type fixed/exchangeable disc drives, holding a 5M-byte fixed disc and a 5M-byte exchangeable cartridge disc. Average access time is 49.5 microsecond, and the instantaneous transfer rate is 312K bytes/second. A second drive is optional, giving a current maximum on-line capacity of 20M bytes.

The workstations have a separate alphanumeric typewriter keyboard, numeric keypad, and function keys. Their display screens have a capacity of 1,998 characters arranged as 27 lines of 74 characters, and a 64-character set. The first workstation is integrated in the system console together with the CPU and the discs. Up to three additional workstations may be located at up to 70 metres (230 feet) cable length from the central control group.

Two printer models are available: a 150-cps serial matrix printer with 132 print positions/line, and a 300-lpm line printer with a 132-position print line. Up to two printers may be connected to the system.

One or two nine-track magnetic tape drives may also be connected optionally to the system.

DATA COMMUNICATIONS

A single-line synchronous data communications adapter is optionally available on System-Computer 8870/1. This can interface to a synchronous 1,200, 2,400, 4,800 or 9,600 bps modem with EIA RS232C or CCITT V.24 interface, and provide point-to-point on-line communications in batch mode with another 8870/1 or an EDP mainframe. Nixdorf says laconically that any line control procedure can be implemented, which is the normal euphemism for saying that none has yet been implemented. DCC has, however, already implemented an IBM 360/370 interface for local connection.

SOFTWARE

System-Computer 8870/1 runs under the NIROS/1 (Nixdorf Interactive Real-Time) Operating System. This is a disc-resident virtual memory operating system that can support up to four foreground interactive and one background batch processing user programs. It is dialogue-oriented and allows each of the four workstations to call for and execute a different program from the others, or two or more workstations to share a common program in reentrant fashion. Each workstation can also initiate a background batch job to be added to the background job queue.

Other NIROS/1 features include:

- Dynamic disc allocation on demand.
- Sequential, indexed, random, and text file access and processing modes.
- Automatic blocking and deblocking of data records.
- Automatic task scheduling.
- Program chaining.

The NIROS/2 operating system scheduled for release in late 1976 or early 1977 will support up to eight foreground interactive and one background batch processing jobs.

Languages

Nixdorf offers Business BASIC as the standard user programming language for System-Computer 8870/1. A Single User or Multi-User BASIC Interpreter allows one to four workstation users to write and debug programs interactively, and execute them in either Normal or Intermediate (Calculator) mode. It is upward compatible with Dartmouth BASIC, with extensions that include decimal arithmetic, a PRINT USING instruction, data files, signaling, chaining, error branching, many special functions, and provisions for unlimited strings and arrays. It also includes the more common BASIC extensions, such as string processing, matrix algebra, and the CALL statement.

Applications

Nixdorf has developed two modular applications packages for the 8870/1, which can be customized by questionnaire programming to individual users' requirements.

COMET (COMmErcial Time-sharing system) is a comprehensive package providing for interactive processing of the most common accounting functions: order entry and invoicing, stock control, general ledger, financial accounting, payroll, statistics, and forecasting.

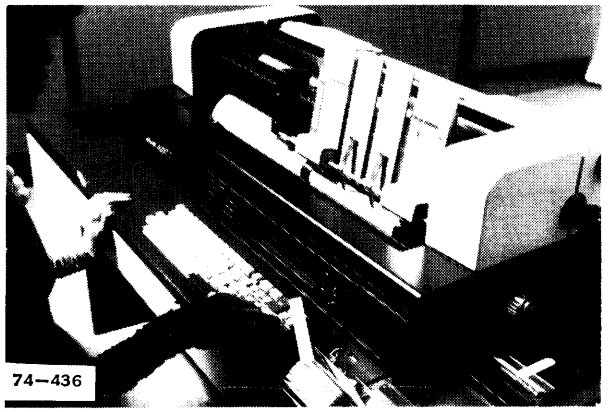
SORBAS (Standardized Organization-oriented Report and Business Analysis System) is a statistical evaluation package. It allows any workstation to call for the submission of a specified selection of disc-held files and records the specified analysis and evaluation programs. The results of the evaluations are then displayed on the operator's screen. Typical analyses are sales statistics by product and/or customer, turnover statistics, and stocks analyses.

MAINTENANCE

Nixdorf maintains all rented systems and is prepared to sign maintenance agreements with purchasers. Standard maintenance terms provide for quarterly preventive maintenance during working hours and on-call availability at other times. In the main industrial areas, a Nixdorf engineer can generally reach most user sites within 2 hours of the receipt of an emergency call.

OLIVETTI CORP.

A Series



OVERVIEW

The Olivetti A Series, consisting of A4, A5, (A5/20, A5/30), A6, and A7 (A7/80, A7/85, A7/90), is a family of keyboard-oriented office computer systems that has been growing steadily since its debut in late 1974. The series now spans a performance range from a small 312-byte accounting machine to a fairly powerful dual-programming disc processing system with 16K bytes of main memory and 39M bytes of on-line disc storage. A Series systems are designed both for the stand-alone processing tasks of small and medium-sized businesses and, with the aid of their intelligent remote batch capabilities, for the distributed processing applications of larger firms such as banks and financial institutions. See Tables 1 and 2 for A4, A5, A6, and A7 System specifications and configurations.

Strong points of the A Series systems are their low entry-level prices, the economical storage medium they use, their expandability, and their ability to print large numbers of different documents simultaneously and advance them at different speeds in the same run.

All A5, A6, and A7 models use an economical program storage/entry medium — an 80-column card with a magnetic stripe that holds 256 bytes of program instructions and/or data. A magnetic card reading unit is on all A5, A6, and A7 systems; on A5/20 and larger systems, the magnetic card unit can also write to magnetic cards for the updating of user files.

All systems (except the A4) can print up to four sets of documents simultaneously and advance them at different speeds under program control. An optional split platen provides two friction feeds for separate journals. An optional front feed (manual or automatic) provides facilities for handling ledger cards or savings passbooks. Sixteen-character-per-second impact printers (64 or 96 characters) are used to ensure legibility on all four sets of documents. Optional matrix printers, with speeds ranging from 100 to 175 are also available. See Table 2 for A Series Console specifications.

All A Series models (except A4 and A5/10-1) support single-line communications up to 4,800 bps in synchronous or asynchronous mode.

Olivetti has developed modular applications packages for the most important user industries and has adapted them to each country's currency, accounting customs, and laws. APCO (APplication COnfigurator) allows each package to be customized to individual users' requirements on the basis of keyboard instructions.

Users can program the A5, A6, and A7 systems in the Basic Assembly Language (BAL), which includes powerful I/O macros and random and sequential addressing of floppy disc and disc files. The A7 system can also be programmed in Mini-PL/1, a subset of the IBM-defined language for which there is a cross-compiler on IBM Systems/360 and 370.

COMPATIBILITY

All A5 and A6 models are also upward compatible at machine and source-code level. A5 and A6 systems cannot be field-upgraded to A7 specifications, and are not machine or source-code compatible.

A5, A6, and A7 data communications line procedures allow these models to be used as on-line RJE terminals to each other, to any IBM System/3, 360, or 370 mainframe, or to any mainframe that implements IBM 2780 BSC procedures (such as the Honeywell Series 60 Level 61 or the ICL 2903). A7 systems can also be equipped with soft line control procedures compatible with any other EDP mainframe or terminal.

HEADQUARTERS

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Table 1. Olivetti A Series: System Specifications

SYSTEM	A4	A5	A6	A7
CENTRAL PROCESSOR				
Word Size (bits)	8	8	8	8
Working and Program Storage	MOS/RAM	MOS/RAM	MOS/RAM	MOS/RAM
Capacity (bytes)	312	512-2K	2K-4K	4K-16K
Cycle Time (μsec)	0.8	0.8	0.8	0.8
AUXILIARY STORAGE				
Discs	None	None	240K-480K	40K-39.3M
Magnetic Tape Cassettes	1 opt	1-3 opt, 256K	1-3 opt, 256K	1-4 opt, 256K
Magnetic Ledger Card Unit	None	None	512-byte opt	512-byte opt
Magnetic Card Unit	None	256-byte std	256-byte std	256-byte std
DATA OUTPUT				
Display (chars/screen)	1	None	None	16
Serial Printer (cps)	16	16 std; 100-175 opt	16 std; 100-175 opt	35-40 std; 100-175 opt
Line Printer (lpm)	None	None	None	300 opt
Card Punch (cpm)	None	None	None	40 opt
Paper Tape Punch (cps)	20 opt	20 opt	20 opt	20 opt
DATA INPUT				
Keyboard	Numeric	Alphanumeric	Alphanumeric	Alphanumeric
Card Reader (cpm)	None	40, 300 opt	40, 300 opt	40, 300 opt
Paper Tape Reader (cps)	None	20 opt	20 opt	20 opt
COMMUNICATIONS				
Line Speed (bits/sec)	None	600-4,800	600-4,800	600-9,600
Terminals Emulated	—	IBM 2780, 2848	IBM 2780, 2848	IBM 2780, 2848, others
Host Computer System	—	IBM 3, 360, 370	IBM 3, 360, 370	IBM 3, 360, 370, Burroughs, ICL, Honeywell, etc
SOFTWARE				
Assembler	No	Yes	Yes	Yes
Operating System	No	Firmware	Firmware	Firmware
Compiler	No	None	None	Mini-PL/1

All A4, A5, A6, and A7 models (except the A5/10-1) can send data off-line on paper tape or ECMA 34 cassettes to another A Series system, an Olivetti DE 523 or DE 525, Honeywell Series 60 Level 62, Philips P450, and most other European office computers. A5/30, A6, and A7 systems can also read data received on these media or on 80-column cards from other systems.

A6 and A7 systems can exchange data off-line via IBM 3741-compatible diskettes with IBM Systems/3, 32, 360, 370, and 3741, Honeywell 61/40 and KDS 7255, Olivetti DE 525 and TCV 270, and a growing number of other office computers and data entry systems.

PERFORMANCE AND COMPETITIVE POSITION

"Olivetti Launches Pike Into VRC Pond" was the headline with which a German computer magazine greeted the announcement of the A5 and A7 to the German market in February 1975. The appearance of the A6 in September 1975 strengthened the lines position as the most expandable office computer family with the lowest entry-level prices available on either side of the Atlantic.

At $4,900 the Olivetti A5/10-1 is not the lowest-cost alpha-numeric office computer available on the European or U.S. market, but it is the lowest-cost field-expandable system with a byte-addressable main memory. Competing systems in the same price range, such as the Hohner 505 or Triumph-Adler TA 10/1, are nonexpandable, with fixed-length register systems. The entry-level systems of competing office computer families — the Burroughs L Series, Insel Mael 2000 and 4,000, Kienzle 2,000 and 6,000 Series, LogAbax LX 4000 Series, NCR 299 and 399, Nixdorf 800 Series, Philips P300 and P350 Series, and Triumph-Adler TA 1000 — all cost two to four times more than a basic Olivetti A5/10-1. These do offer larger memories on their entry-level systems than the 8K-byte ROM and 512-byte RAM of an A5/10-1, because in most cases they cannot fit normal invoicing and accounting programs into less than 4K bytes of live memory. Olivetti's ability to fit these routines into smaller systems is a tribute to the designers' ingenuity, which pervades the entire A Series. Cassette tape and floppy disc files can be processed and program overlays read on the 2K-byte A5/30 and A6 systems respectively; competing systems need 8K bytes of memory for these tasks.

The A7 (orginally Audit 7) is not quite the formidable competitor in the medium-sized office computer market as the A5 is at entry level. At $11,400, a basic 4K-byte A7/80 costs less than a basic LogAbax LX 4300 or NCR 399, but more than a basic 4K-byte Kienzle 2000 or Triumph-Adler TA 1000, and roughly the same as a Philips P310. The A7/80, using an impact printer for legibility purposes, limited to 40 cps against the 120- to 180-cps printing speeds

Table 2. Olivetti A Series: System Configuration Differences between Models

	Transfer Rate (bytes/sec)	No. of Slots	No. of Devices per controller	A4	A5/10-1	A5/10-2	A5/20	A5/30	A6	A7/80	A7/85	A7/90
SYSTEM suitable for:												
Local Invoicing				X	X	X	X	X	X	X	X	X
Magnetic Card File Processing				–	–	–	X	X	X	X	X	X
Magnetic Ledger Card File Processing				–	–	–	–	–	X	X	X	X
Cassette Tape File Processing				–	–	–	–	X	X	X	X	X
Floppy Disc File Processing				–	–	–	–	–	X	(X)	(X)	(X)
Cartridge Disc File Processing				–	–	–	–	–	–	–	–	X
Data Entry Terminal to EDP Mainframe				–	–	X	X	X	X	X	X	X
Data Output Terminal from EDP Mainframe				–	–	–	–	X	X	X	X	X
MAINFRAME												
Read-Only Memory (ROM), capacity (bytes)					8K	8K	9K	10K	16K-18K	16K	16K	16K
Read-Write Memory (RAM), capacity (bytes)				312	512	2K	1K-2K	1K-2K	2K-4K	4K-16K	8K-16K	8K-16K
Addressable Channels/PCUs				2	3 (2)	5 (2)	5 (2)	9 (2)	12 (2)	16	16	16
External Adapter Slots					–	2	2	2	4	9	9	9
AUXILIARY STORAGE												
DAS 7100 Fixed Disc	290,000	2	1-4	–	–	–	–	–	–	–	40K-160K	40K-160K
DCU 7200 Fixed/Exch Cartridge Disc	316,000	2	1-2	–	–	–	–	–	–	–	–	9.8M 39.3M
FDU 5/7600 Floppy Disc	31,250	1	1-2	–	–	–	–	–	240K-560K	240K-1.2M	240K-1.2M	240K-1.2M
CTU 5/7400 Cassette Tape	1,000	1	1	1	–	1 opt	1 opt	1 opt	1 opt	1-2	1-2	1-2
usable for:												
Data Output				X	–	X	X	X	X	X	X	X
Data Files I/O				–	–	–	–	X	X	X	X	X
Program Overlays				–	–	–	–	X	X	X	X	X
ACU 5409 Automatic Cassette Loader	1,000	1	1	–	–	X	–	–	X	X	X	X
CTU 1000 Cassette Tape	1,000	IPSO	1-2	–	–	1-2	1-2	1-2	1-2	1-2	1-2	1-2
usable for:												
Data Output					–	X	X	X	X	X	X	X
Data Files I/O					–	–	–	X	X	X	X	X
MLCU 5/7300 Magnetic Ledger Card Unit (512 bytes/stripe)		1	1-2	–	–	–	–	–	1	1-2	1-2	1-2
Integrated Magnetic Card Unit (256 bytes/card) for:		–	1	–	1 std	1 std	1 std	1 std	1 std	1 std	1 std	1 std
Program Loading				–	X	X	X	X	X	X	X	X
Data Files I/O				–	–	–	X	X	X	X	X	X
with hopper/stacker				–	–	–	–	–	–	X	X	X
SERIAL I/O PERIPHERALS												
LN 20 Paper Tape Reader	20	IPSO	1	–	–	–	–	X	X	X	X	X
PN 20 Paper Tape Punch	20	IPSO	1	X	–	X	X	X	X	X	X	X
PR 1220 Auxiliary Printer	100	IPSO	1	–	–	–	–	X	X	X	X	X
PR 1230 Auxiliary Printer	175	IPSO	1	–	–	–	–	X	X	X	X	X
SV 160 Auxiliary Printer	165 (lines/min)	IPSO	1	–	–	–	–	X	X	X	X	X
LP 300 Line Printer	300 (docs/min)	IPSO	1	–	–	–	–	–	–	X	X	X
CR 300 Card Reader	300	IPSO	1	–	–	–	–	X	X	X	X	X
ULS 50 Card Reader	50	IPSO	1	–	–	–	–	X	X	X	X	X
PSK 40 Card Punch	40	IPSO	1	–	–	–	–	X	X	X	X	X
CMC 7340 MICR Cheque Reader	230-730	IPSO	1	–	–	–	–	–	–	X	X	X
IPSO Interface Adapter		1	4	–								
for: output devices					–	X	X	X	X	X	X	X
input & output					–	–	–	X	X	X	X	X
DATA COMMUNICATIONS												
LCU 5/7800 Line Control		1	1									
Unit for: transmission				–	–	X	X	X	X	X	X	X
reception				–	–	–	–	X	X	X	X	X
No. of Procedures				–	–	1-2	1	1	1-2	1-n	1-n	1-n
incl: IBM BSC 1-2-3				–	–	X	X	X	X	X	X	X
IBM 2848 Async				–	–	X	X	X	X	X	X	X
Others				–	–	–	–	–	–	X	X	X
Max Line Rate (bps)				–	–	4,800	4,800	4,800	4,800	9,600	9,600	9,600

of most of its competitors in the same price range. Unlike the Datapoint 2200, Insel Mael 2000 and 4000, LogAbax LX 4400, and Triumph-Adler TA 1000, the A7/80 does not offer a full-screen CRT display, just a single-line 16-character display for operator feedback.

SYSTEM DESIGN

The Olivetti A Series currently comprises nine models numbered A4, A5/10-1, A5/10-2, A5/20, A5/30, A6, A7/80, A7/85, and A7/90. See Table 2 for the types of local processing and terminal activity for which each model is suitable.

The A4 is a numeric accounting machine with a 15-key numeric input keyboard, eight function keys, a 16-cps numeric printer, and a programmable processor with a 312-byte live MOS/RAM memory, allocated and used as follows:

- 192 program bytes for instructions and/or constants, loaded from exchangeable 93-byte "program drums", up to three of which may be held together.
- 32 bytes usable either as additional stored program steps or as four temporary storage registers for signed 15-digit decimal numbers.
- 88 bytes used as seven accumulator and four temporary storage registers for signed 15-digit decimal numbers.

The keyboard's eight function keys can be used manually or in programmable mode. In manual mode they provide four basic arithmetic operations and four other common desk calculator functions. In programmable mode, three keys are used as Start keys, two as program selection keys, and three remain unused.

All A5, A6, and A7 models include a stored program processor, magnetic card unit, buffered keyboard, operator guidance indicators, and buffered serial printer integrated into a console that can also be equipped with a number of forms feed options. A5 and A6 models differ only in their processor storage capacities and the forms feed options available on each. See Table 2 for A5, A6, and A7 configurations.

Processor

A Series processors are equipped with MOS/LSI Read-Only Memories (ROM) to implement the instruction set and I/O control routines, and with live MOS/RAM memories for user program instructions and data. See Table 2 for ROM and RAM capacities on each model. In RAM live memory, both instructions and alphanumeric data are organized as variable-length multiples of ISO-8 (ASCII-9) eight-bit addressable bytes. Numeric data is processed in fixed-length eight-byte (64-bit) numeric registers that hold signed 15-digit decimal numbers.

Magnetic Card Unit

A Magnetic Card Unit (MCU) is standard on all A5, A6, and A7 systems. It can read 256 bytes of program instructions, constants, or data from a magnetic stripe on an 80-column-type card (inserted manually by the operator on A5 and A6 models, or fed from a 100-card input hopper on A7 systems). On A5/20 and larger models, the MCU can also be used to record programs or data on a magnetic card, but not in the same pass in which it is read. The MCU should not be confused with the Magnetic Ledger Card Unit (MLCU) option for A6 and A7 systems. The MCU can be used as an MLCU substitute on A5/20 and larger models for a simple form of magnetic card file processing, in which a 256-byte magnetic card is associated off-line with an ordinary printed ledger card and filed within it. At processing time, the operator takes the magnetic card out of the ledger card and inserts it into the MCU just before inserting the ledger card into the console front feed. After both cards have been updated by the system, the operator files them away together.

Keyboard

The console keyboards are divided into alphanumeric keyboard, numeric pad, and control fields. The A/N field has 47 character keys in ECMA typewriter layout, plus space bar and shift keys. The numeric pad has 15 keys including figures 0-9, 00, and 000, minus sign, decimal point, and clear. Characters entered on either keyboard field initially are recorded only in the keyboard's 16-byte input buffer. Pressing one of the Start keys in the control field transfers buffer contents to the main memory. It also defines the type of field the buffer contents represent, and activates a format-checking subprogram. The A5 and A6 keyboards have six Start keys and four Program Selection keys. The A7 keyboard has seven Start keys and eight Program Selection keys.

Operator Guidance

A5 and A6 consoles are equipped with 15 indicator lights for illuminating standard messages, including three error conditions, three waiting statuses, one manual operating mode, and eight programmable conditions for which the user can define the message.

The A7 console is equipped with seven similar indicator lights for standard messages. It also has a 16-character alphanumeric line display for the contents of the keyboard buffer, for system messages sent by the processor about format or errors in the last keyed field, guidance about the next field to be keyed, or any other program-defined message. On A7 systems equipped with disc backing storage, the display can also show system answers to file inquiries.

Printer

The console printers are serial impact printers with 64- or 96-character printheads in OCR-B font. The 96-character printheads are selectable; they include both upper- and lowercase alphabetics. Katakana printheads (128-character) are also available for the Japanese market. Both system printers are buffered. The lookahead buffer allows the printheads to tabulate to the next addressed

Table 3. Olivetti A Series: Console Specifications

System	A4	A5/10	A5/20, 30	A6	A7
Keyboard					
A/N Keys, excl Shift, Space	–	47	47	47	47
Numeric Pad Keys	15	15	15	15	15
Start Keys	3	6	6	6	7
Program Select Keys	2	4	4	4	8
Buffer Size (bytes)		16	16	16	16
Operator Guidance					
Indicator Lights		15	15	15	7
A/N Display (char)	1	–	–	–	16
Printer					
Type	Rotating wheel	Exch ball	Exch ball	Exch ball	Rotating wheel
Printable Characters	16	64, 96*	64, 96*	64 or 96*	64 or 96*
Legible Copies (bond paper)	1 + 6	1 + 8	1 + 8	1 + 8	1 + 7
Printing Speed (chars/sec)	16	16	16	16	35-40
Tabulation/Skipping Speed (cps)		180	180	180	330
Max Print Positions/Line splitable:	No	34 + 146 or 91 + 89 or 148 + 32	34 + 146 91 + 89 148 + 32	34 + 146 91 + 89 148 + 32	90 + 166 120 + 136 150 + 106
Look-Ahead Buffer Size (bytes)		22	22	22	48
Forms Feeds					
No. of Friction Feeds (platen)	1	1-2	1-2	1-2	2 std
No. of Tractor Feeds for multipart business form sets	–	1 opt	1 opt	1 opt	1-2
No. of Front Feeds (ledger cards, etc) chosen from:	1	1 opt	1 opt	1 opt	1-2
MFF Manual Front Feed	Std	Std	X	X	–
with passbook feed	–	Opt	Opt	Opt	–
AFF Automatic Feed, with optical line finding facility	–	–	X	X	1-2
MLCU Magnetic Ledger Card Feed and read/write unit	–	–	–	X	1-2

* 128-character Katakana printheads also available for Japanese market.

printing position in either direction at high speed without first returning to the left-hand margin.

Document Feeds

All A5, A6, and A7 models can control separate feeds for two or three layers of documents that may partly or wholly overlap each other. The bottom layer is the platen split between friction feeds for two separate single-part audit trails, system message logs, and other internal documents. The middle layer is a set of multipart continuous business forms, advanced by a program-controlled tractor feed with adjustable margins. A second tractor feed is optional on the A7. The top layer is represented by optional front feeds:

- One Manual Front Feed (MFF) with or without a savings passbook insertion facility on the A5/10-1 and A5/10-2.
- One MFF or Automatic line-finding Front Feed (AFF) on the A5/20 and A5/30.
- One MFF, AFF, or magnetic-ledger-card front feed (MLCU) on the A6.
- One or two AFFs or MLCUs, or one AFF and one MLCU, on the A7.

PERIPHERALS

All models except the A5/10-1 can be equipped with some peripheral options, as determined by that model's I/O microprogram. The number of devices connected to any system depends on the number of available external adapter slots on the mainframe. The number of adapter slots required by each device is listed in Table 2.

Slow-Speed I/O Devices

All models except the A5/10-1 can be equipped with an IPSO adapter that occupies just one mainframe adapter slot but provides four IPSO (Olivetti Standard Peripheral) interfaces. Any of the standard Olivetti peripherals supported by the model's I/O microprogram can be connected to each interface.

The A4, A5/10-2, and A5/20 support only character-serial output devices; paper tape punch and/or the CTU 1000 cassette tape unit (used only for recording data to be transmitted off-line to another system). The A5/30 and A6 support the full range of character-serial input and output devices, including both card and paper tape readers and punches, and character-serial auxiliary printers. The A7 also supports parallel I/O devices such as the MICR document reader and a line printer. See Table 2.

Magnetic Cassette Tape. ECMA 34 single-track 0.15-inch magnetic Cassette Tape Units (CTUs) play a dual role on the Olivetti A Series: as serial output devices instead of (or in addition to) the paper tape punch on the A5/10-2 and larger models, to transfer data off-line to an-

other computer system or store it temporarily on-line before transmitting it to a host computer; or, the A5/30 and larger systems, as input and auxiliary storage for data received from another computer or from user files, program libraries, and overlays. This dual role provides alternative ways of connecting cassette tape units to A Series systems. The CTU 1000 single- or dual-drive controller has an IPSO interface like other serial I/O devices and can share a single mainframe adapter slot with up to three other IPSO devices via an IPSO adapter. The CTU 5400 (for A5 and A6 systems) and CTU 7400 (for A7 systems), on the other hand, are integrated peripherals connected directly to a mainframe adapter slot. The CTU 5400 is a single-drive controller; the CTU 7400 is a dual-drive controller.

On the A5/10-2, A6, and all A7 models the CTU 5400 or CTU 7400 may be replaced by an ACU 5409 or ACU 7409 Automatic Cassette Unit (ACU). The ACU is a tray holding up to 20 ECMA 34 cassettes that can be loaded automatically into the read/write unit and unloaded in sequence without operator attention. (The loading/unloading operation takes approximately 10 seconds.) The ACUs on A5/10-2, A6, and A7 systems serve as unattended remote batch input and/or output terminals to a host EDP system during off-peak hours.

Magnetic Ledger Card Unit. A magnetic ledger card unit (MLCU) option can be used with any A6 or A7 model. It consists of a magnetic ledger card front-feed attachment and a head that reads up to 512 bytes from a magnetic stripe on the card and writes up to 512 bytes of updated information on the same stripe. The MLCU 7300 for A7 systems controls one or two MLC front feeds, allowing two magnetic ledger cards to be processed in parallel using only one mainframe adapter slot. The MLCU is used in addition to the Magnetic Card Unit (MCU) that is standard equipment on all A5, A6, and A7 systems.

Discs

Most A6 systems use the FDU 5600 floppy disc unit as main auxiliary storage. This unit includes a controller and two drives, each of which accommodates an IBM 3741-compatible 77-track diskette on which two tracks are reserved for system user and two are spare, leaving 73 tracks for programs and/or data. Two sector formats are available for the 73 data tracks:

- IBM 3741 format of 26 addressable 128-byte sectors per track, giving each diskette a maximum capacity of 1,898 sectors totaling 242,944 bytes.
- Olivetti/ECMA (European Computer Manufacturers' Association) format of 15 addressable 256-byte sectors per track, giving each diskette a maximum capacity of 1,095 sectors totaling 280,320 bytes.

Average latency within a track is 139 milliseconds to a 128-byte sector and 155 milliseconds to a 256-byte sector; the instantaneous transfer rate is 31.2K bytes per second.

The FDU 7600 floppy disc unit for A7 systems will be announced in the first half of 1976; it will include a controller with up to four drives and will be available for all A7 models.

The A7/85 includes 40K to 160K bytes of DAS 7100 high-speed fixed-disc auxiliary storage integrated into the system console. The disc controller occupies two adapter slots on the A7 mainframe. The fixed discs are used primarily for program overlays, and/or temporary storage of data requiring either further processing or on-line transmission to another computer system over the data communications link. Data is addressed in fixed-length 256-byte sectors with an average access time of 10 milliseconds.

The A7/90 can be equipped with two disc controllers: either two DCU 7200 fixed/removable cartridges, or one DCU 7200 and one DAS 7100 fixed-disc cartridge. Maximum on-line capacity for an A7/90 with two DCU 7200 controllers is 39.3 bytes. Each DCU 7200 can also control one or two free-standing IBM 5440-type fixed/removable cartridge disc drives (4.9-byte capacity per cartridge).

DATA COMMUNICATIONS

All A Series models except the A4 and A5/10-1 can support a data communications Line Control Unit (LCU) connected directly to a mainframe adapter slot.

The LCU 5800 for A5 and A6 systems interfaces to an unclocked 600 to 1,200 bps or clocked 1,200 to 4,800 bps modem. It is available in five submodels, firmwired at the factory with one or two of the following line control procedures, with or without unattended device operation facilities:

- Olivetti 11E (IBM 2848-compatible) asynchronous polling/selecting with ISO/ASCII line code.
- IBM BSC 1, 2, or 3 synchronous with ISO/ASCII line code.
- IBM BSC 1, 2, or 3 synchronous with EBCDIC line code.

Two of the submodels support IBM BSC procedures with both ISO/ASCII and EBCDIC line codes, but these can be used only on A5/10-2 and A6 systems.

On A5/10-2 and A5/20 systems, the LCU 5800 can be used only for data transmission to another computer system. On A5/30 and A6 systems, it can be used for both data transmission and reception.

The LCU 7800 for A7 systems uses an Intel 8080 programmable microprocessor to execute data communications concurrently with processing or I/O operations. It can interface to an unclocked 600 to 1,200 bps or clocked 1,200 to 9,600 bps modem to load "soft" line control procedures from the system disc or cassette. Timing can be varied to permit operation under any line procedure for which control programs have been prepared. Olivetti has developed programs (available throughout the world) for the same range of IBM and Olivetti procedures as that prepared for LCU 5800. National Olivetti sales organizations can write other line control programs tailored specifically for local markets. Some of those prepared to date include:

- Honeywell 6000- and Series 60-compatible procedures in France.
- Burroughs TC 500-compatible procedures in the U.K.

SOFTWARE

Olivetti offers A Series users a choice of operating systems tailored to different processor sizes and peripheral configurations, two user programming languages, and a wide range of standard applications packages.

All operating systems include an Executive held in ROM firmware for controlling I/O operations; other system programs can be called from the main program storage medium.

Basic Operating System (BOS). BOS is used on A5/10 and A5/20 systems as well as small A7/80 configurations without auxiliary storage. All source programs are entered from the console keyboard; all object programs (including compilers) are entered from 256-byte magnetic cards. There are no provisions for program overlays, but I/O macros are available to address data files on any sequential storage medium supported by the model.

Cassette Tape Operating System (CTOS). CTOS, used on A5/30 systems and small A7/80 configurations without discs, allows programs to be segmented and distributed between magnetic cards and cassette tape storage. Basic program segments are entered from magnetic cards, and overlay segments from cassette tape. Data files can be accessed on any sequential storage medium supported by the model.

Floppy Disc Operating System (FDOS). FDOS is used on A6 and A7/80 systems with floppy disc backing storage to maintain a program library. Both program segments and data files can be accessed on floppy disc directly (at random) or sequentially. FDOS also supports all sequential storage and I/O media.

Extended Operating System (EOS). EOS is used on all A7/85 and A7/90 systems to maintain a program library on DAS 7100 or DCU 7200 disc backing storage, and a data management system to access program segments and data files directly (at random) or sequentially. EOS calls programs and overlays from magnetic cards, cassette tape, floppy discs or the system disc, and supports all peripherals.

Languages

User programming languages include an assembler for all A Series models and Mini-PL/1 for the A7 only.

Basic Assembly Language (BAL). BAL is a one-for-one assembler for all A5, A6, and A7 system models. It includes I/O macros, program segmentation, and file definition facilities. The translator is held on each operating system's main program library storage medium (magnetic cards, cassette tape, floppy disc, or disc). It accepts source program statements from the input keyboard and/or 256-byte magnetic cards and translates them into machine-code modules that are then stored in main memory and/or in the main program library. A reverse translator can take any machine-code module and translate it into BAL for listing and/or recording on 256-byte magnetic cards.

A BAL cross-assembler is also available on IBM Systems/360 and 370, but its machine-code object programs are usually too large to run on any but A7 systems.

Mini PL/1. Mini PL/1 is a subset of the IBM-defined language, with a limited number of Olivetti-defined extensions to make it suitable for programming keyboard-oriented programs. Source programs are currently cross-compiled on IBM System/360 or 370 for A7/80 systems with floppy disc backing storage for a native compiler A7/85 and A7/90 systems with 16K bytes of processor main memory is in preparation and should be released sometime in 1976. Mini-PL/1 object programs can run only on A7 systems with at least 8K bytes of processor main memory.

APPLICATIONS

Olivetti expects to program the majority of its A5, A6, and A7 users' programs. It has developed a wide range of standard applications packages for each of the main user industries and groups, adapted in turn to each country's language, currency, accounting customs, and tax laws. The packages are modular, and are tailored specifically to the requirements of each individual user by APCO (APplication COnfigurator). APCO selects the required standard program modules and the required features of each program module on the basis of A5, A6, or A7 keyboard instructions.

Banks and Other Financial Institutions. Standard A5 and A7 programs are available for current account maintenance, direct credit transfers, savings accounts, foreign exchange, inter-branch accounting, and cash balancing. Programs are also available for investment portfolios, stocks and bonds, and discounted cash flow.

Insurance. Programs are available for policy issuing and file maintenance, actuarial and financial calculations, cash balances, and statistics.

Public Administration. Tailor-made applications packages have been developed for local, regional, and central government authorities; school boards; hospitals; and public utilities.

Industry. Programs and packages have been developed for general ledger accounting, accounts receivable, accounts payable, stocks movement recording and control, production scheduling and control, cost analysis, manpower scheduling, payroll, and statistical analysis.

Distributive Trades. Programs are available for order entry, invoicing, payments to suppliers, cash balances, sales statistics, commission accounting, accounts receiv-

able, VAT declarations, stock management and control, stock reordering, accounts payable, general ledger, sales analysis and forecasts, and payroll.

Service Trades. Programs have been prepared for invoicing, accounts receivable, payroll, cash balancing, and statistics.

MAINTENANCE

Olivetti markets and services its computer systems directly through a worldwide network of sales and service centers. There are 85 offices in the U.S. and additional centers in most important European cities. Maintenance is priced separately from purchase price but is included in rental fees.

PRICE DATA

Model Number	Description	Purchase Price $ (Maint. not Included)
	A4	
	Basic system with 312 bytes of main memory, 15-key numeric keyboard, 16-cps printer, option board, and memory expansion kit	2,395
CTU 1000	Magnetic Cassette Unit	1,900
PN 20	Paper Tape Punch Unit	1,595
SF 4300	Sprocket Feed	300
IPSO 4500	IPSO Interface	135
	A5	
A5/10	Basic system with alphanumeric keyboard, magnetic card unit, 16-cps printer, and processor with	
-A	512 bytes MOS/RAM memory, 2 adapter slots	4,900
-B	2K bytes MOS/RAM memory, 2 adapter slots	5,500
A5/20	Basic system plus	
-A	1K-byte memory	6,250
-B	2K-byte memory	6,850
A5/30	Basic system plus	
-A	1K-byte memory	6,900
-B	2K-byte memory	7,500
LCU 5801	Line Control Unit	1,200
CTU 5400	Single Cassette Unit	1,500
CTU 1000	IPSO Cassette Drive and Controller	1,900
CTD 1000	Second IPSO Cassette Drive	934
IPSO 5500	IPSO Interface	500
SF 5304	Sprocket Feed	500
MFF 5301	Manual Front Feed	175
MFF 5302	Manual Front Feed Passbook	175
AFF 5303S	Automatic Front Feed	740
	A6	
	Basic system with magnetic card unit, buffered alphanumeric keyboard, buffered 16-cps printer, and processor with	
A6-B	2K bytes of MOS/RAM main memory	7,920
-C	4K bytes of memory	8,820
FDU 5600	Floppy Disc Drive and Controller	2,800
FDU 5602	Dual Floppy Disc Drive and Controller	3,750
MLCU 5306	Magnetic Ledger Card Unit	3,000
AFF 5303	Automatic Front Feed	740
	A7	
	Basic system with magnetic card unit, 100-card hopper and 200-card stacker, alphanumeric keyboard, and processor with	
7904	4K RAM Memory	12,500
7908	8K RAM memory	13,500
7916	16K RAM memory	15,500
CTU 7401	Single Drive Cassette Subsystem	1,900
CTU 7402	Dual Drive Cassette Subsystem	3,400
DCU 7201	10Mb Disc Drive and Controller	10,000
DCU 7202	20Mb Disc Drive and Controller	17,600
DAS 7104	160Kb Disc Auxiliary Storage System	4,000
CR 300	Punched-Card Reader	4,000
SV/160/1	High-Speed Printer (165 cps)	5,100
SV/160/2	High-Speed Matrix Printer (330 cps)	5,400
AFF 7303	15-in. Automatic Front Feed	750
AFF 7305	18-in. Automatic Front Feed	750
MLCU 7306	Single Magnetic Ledger Card	4,000
MLCU 7307	Dual Magnetic Ledger Card	5,000

PHILIPS

P-300 Electronic Accounting System

OVERVIEW

The Philips P-300 series is a family of keyboard-oriented office computers manufactured by Philips-Electrologica of the Netherlands and marketed in Europe under the Unidata 300 Series label. The Unidata 300 and the Philips P-300 series are identical in all respects.

This report details the models and configurations and pricing available in the U.S. market under the Philips P-300 label.

The Philips P-300 systems are available in two model groups, the P-310 printing ledger models and the P-320 magnetic ledger models. Within these two groups, the configurations are further delineated by the number of front-feed ledger units and continuous stationary units. See Table 1 for a listing of the model configurations.

Table 1. Philips P-300 Model Configurations

Model No.	Configuration No.	No. of Front Feed Units	No. of Continuous Stationary Units
Printing Ledger Models			
P-310	0	0	1
P-310	1	1	1
P-310	2	2	1
P-310	4	1	2
P-310	5	2	2
Magnetic Ledger Models			
P-320	1	1	1
P-320	2	2	1
P-320	4	1	2
P-320	5	2	2

HEADQUARTERS

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Woodbury NY 11797
(516) 921-9310

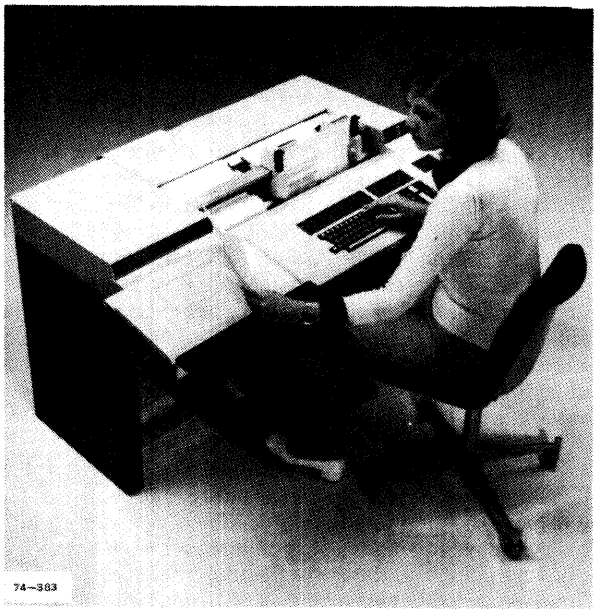
PRICE DATA

The following is a list of the basic system prices. For a more detailed list of prices, including those for peripherals, contact Philips U.S. headquarters or a local Philips dealer.

Model No.	Configuration No.	Main Memory Size (bytes)	90-Day Guarantee Purchase Price $	1-Year Guarantee Purchase Price $	Annual Maint. $
P-310	0	8K	8,300	8,715	550
P-310	1	8K	9,200	9,650	600
P-310	2	8K	9,900	10,385	650
P-310	4	8K	10,300	10,825	700
P-310	5	8K	11,200	11,765	750
P-320	1	8K	14,600	15,310	950
P-320	2	8K	15,600	16,350	995
P-320	4	8K	15,800	16,590	1,050
P-320	5	8K	16,600	17,425	1,100

PHILIPS-ELECTROLOGICA

P300 Series Office Computers



OVERVIEW

The Philips P300 Series is a family of keyboard-oriented office computers with byte-addressable main memories that are used for both stored programs and data. They have been designed primarily to meet the bookkeeping requirements of small firms, but may also be used as intelligent remote batch terminals to an EDP mainframe. Modular accounting packages have been developed for the P300 Series that can be tailored to a country's language and accounting customs. Order entry, invoicing, inventory control, plus payroll, general ledger, and receivables are the applications offered. Programs written in PHOCAL for the Philips P350 Series are source compatible with the new P300 Series.

Currently, the Series comprises two models. The P310, announced in September 1974, is an invoicing and visible record accounting computer available from DM 23,800 ($9,500). The P320, announced in April 1975, is a magnetic stripe ledger card accounting computer available from DM 43,200 ($17,300). Both were announced under the Unidata label and marketed jointly by CII, Philips, and Siemens. With the dissolution of the Unidata consortium on December 1, 1975, Philips assumed full responsibility for marketing and servicing the Unidata 300 Series, and changed its name to the P300 Series.

The basic configuration of either model includes: a maximum of 8K bytes of main memory, a stored program processor, input keyboard, console printer with single continuous forms feed, and a program cassette reader. A ledger card front feed is optional on the P310 and standard on the P320, where it is equipped with a magnetic stripe read/write unit. The P310 may also be equipped with a second continuous forms feed and a second ledger card front feed. Either system may be equipped with a paper tape punch, a card punch, and/or a data communications line adapter. As yet, the only additional input device offered for either model is an ECMA 34 magnetic tape cassette unit.

The P300 Series is manufactured in Eiserfeld, West Germany by the General Systems Division of Philips-Electrologica, which also manufactures the well-known P350 Series. It is marketed throughout Europe and many other countries including the United States. Table 1 lists detailed specifications.

COMPATIBILITY

The P300 Series office computers are fully compatible with each other at all levels, subject to availability and use of the same peripherals.

They are also source program compatible with the older Philips P350 Series at the level of the PHOCAL assembly language, although their machine code and internal data structure are quite different.

As byte-addressable computers, the P300 systems are data compatible with the larger P450 and P1000 Series systems, with the IBM System/3, 360 and 370, and with many other EDP systems on the market. They can exchange data with these via on-line data communications

HEADQUARTERS

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Table 1. P300 Series: Specifications

	P310	P320
CENTRAL PROCESSOR		
Word Size (bits)	8	8
Capacity (bytes)	6K, 8K (2-4K user)	8K (3K user)
Cycle Time (μsec)	0.6	0.6
Working and Program Storage	MOS/RAM	MOS/RAM
AUXILIARY STORAGE		
Disc	NA	NA
Magnetic Tape Cassette	750 bps opt	750 bps opt
Magnetic Ledger Card	Opt	Std: 128 bytes/stripe
DATA OUTPUT		
Display	NA	NA
Line Printer (lpm)	NA	NA
Serial Printer (cps)	50-60 cps, 239 ppl	50-60 cps, 239 ppl
Card Punch	50 cols/sec opt	50 cols/sec opt
Paper Tape	50 cps opt	50 cps opt
DATA INPUT		
Keyboard	Std	Std
Card Reader	NA	NA
Paper Tape	NA	NA
SOFTWARE		
Assembler	Yes, PHOCAL	Yes, PHOCAL
Operating System	Yes	Yes
Compiler	No	No
Other	Varial 310 acctg package	Varial 320 acctg package

NA = Not Available

links in either direction, and transmit data to them off-line on ECMA 34 cassettes, paper tape, and 80-column cards.

PERFORMANCE AND COMPETITIVE POSITION

The P300 Series is one of four entry-level office computer families now available on the European market that offer byte-addressable main memories for stored programs and data, and whose basic prices start at, or just below, the DM 25,000 ($10,000) level. The others are the Triumph-Adler TA 1000 Series that has been available since 1973, the Olivetti Audit 5 and 7 announced simultaneously in the autumn 1974, and the Kienzle 2000 announced in April 1975 simultaneously with the P320.

At DM 23,900, the basic 6K-byte Unidata 310 (with a 2K-byte user memory) offers a faster print speed (50-60 cps) and broader print line width (239 pp) than the Olivetti Audit 5/30 (15 cps, 180 pp) and Triumph-Adler TA 1000/2 (18 cps, 170 pp) available at the same price. The TA 1000 is available with a 140-cps printer, but costs substantially more than a basic P310, as does the basic Olivetti Audit 7, which offers a 50-cps printer and an even broader 256-pp print line width. On the other hand, for only DM 2,000 more, users can get a basic Kienzle 2000 that will offer twice the user main memory space (4K bytes) and twice the print speed (120 cps bidirectionally), albeit with only 144 print positions per line.

At DM 43,200, an 8K-byte P320 magnetic ledger processing system costs a good DM 10,000 less than the basic Olivetti Audit 7 and Triumph-Adler TA 1000/3 MLC processing configurations, and slightly more than a basic 8K-byte Kienzle 2000-3 MLC system, whose magnetic stripes offer twice the capacity of the P320 stripes, and whose flat desktop ledger card feed has a number of operating advantages.

All of the P300 Series' byte-addressable competitors offer a greater number of peripheral options. They can all be equipped with up to three or four ECMA 34 MT cassette drives instead of only one, and thus can be used for MT cassette file processing. A CRT display is optional on the TA 1000, while a single-line 16- or 32-character display is a standard feature of Olivetti Audit 7 and Kienzle 2000 consoles, respectively. The Audit 7 and TA 1000 can also be equipped with a card and paper tape reader as well as punches, and their main memories are expandable to 16K and 40K bytes, respectively. The P310 and P320, like the Kienzle 2000, are limited to a maximum of 8K bytes, including 3K-4K bytes usable by applications programs and data.

The restrictions on P300 main memory and peripheral handling capacity are almost certainly temporary, and are due more to marketing than to technical considerations — to discourage too many users of the older P350 Series from "downgrading" to the more flexible but less costly P300. But they are nonetheless real for the time being, and there is no knowing when Philips will feel safe to relax them.

CONFIGURATION GUIDE

Only two models have been announced to date in the P300 Series: the P310 office computer, and the P320 magnetic ledger card computer.

Processor

P300 Series processors use a common byte-addressable MOS/RAM main memory for holding both stored program instructions and data. Both instructions and operands are variable length.

The P310 processor has a basic main memory size of 6K bytes, which may be field-expanded in two 1K-byte increments to a current maximum of 8K bytes. The first 4K bytes are used by the operating system, leaving 2K to 4K bytes for user instructions and data.

The P320 processor has an 8K-byte main memory, of which the first 5K bytes are used by the operating system, leaving 3K bytes for user instructions and data.

Keyboard

The console keyboard is entirely electronic. It has a 32-character input buffer, ensuring two-key rollover. The keyboard has two key clusters: the main alphanumeric section has 51 keys in ECMA typewriter layout plus space

bar and backspace key. On the right side are a 26-key numeric pad and function key cluster with 12 numeric keys, including 00 and 000; four arithmetic function keys for plus, minus, decimal point, and clear; and 10 control keys. A row of 16 indicator lights above the keyboard displays system messages on error conditions or system status.

Printer

The console printer is Philips-designed and manufactured. It is a serial matrix printer with an instantaneous print speed of 50 to 60 characters per second. The fixed carriage is 70 centimeters (28 inches) wide, with up to 239 print positions per line.

The basic P310 version has a single continuous forms sprocket feed with adjustable margins. It may be optionally equipped with:

- A second continuous forms sprocket feed under separate program control from the first, allowing two sets of forms to advance at different speeds.
- A single or dual ledger card feed that can also be used for single form sets.

The basic P320 version is equipped with both the first continuous forms feed and the first ledger card feed as standard features. The ledger card feed is equipped with a magnetic stripe read/write unit.

Magnetic Ledger Card Unit

The P320 magnetic ledger card unit can read on insertion and record on ejection up to 128 bytes or 256 numeric digits on a magnetic stripe on the left-hand margin of a ledger card. Ledger cards may be imprinted with a magnetic stripe on each side of each card, allowing cards to be reversible.

Magnetic Tape Cassette

A peculiarity of the P300 Series is that it offers two distinct types of cassette drives for different purposes.

A program cassette reader is standard on all P300 Series consoles for reading in stored programs. This reads Philips Compact Cassettes at a speed of 200 characters per second. A separate cassette will normally be used for each program, although it is also possible to record a number of different short programs on each cassette.

In addition, both the P310 and the P320 office computers may be equipped with a cassette drive for reading/recording larger cassettes conforming to ECMA 34 standards. These are 0.15 inches wide and record data bit-serially at 800 bpi and at 750 bytes per second. Each cassette side has a maximum capacity of 256K bytes. The purpose of the optional ECMA 34 cassette drive is to record data entered and/or preprocessed on a P310 or P320 office computer, for later processing on the same system or a larger Philips P450 or other computer.

Other Peripherals

Other peripherals that may be connected to either the P310 or the P320 include a 50-cps paper tape punch and a 50-columns-per-second card punch. These allow data to be transmitted to a general-purpose EDP system with no ECMA 34 cassette reader among its peripherals.

DATA COMMUNICATIONS

A CCITT V.24 voicegrade communications line interface and adapter are optional. Line procedures have not yet been published, but these will certainly allow compatibility with the Unidata 7.000 Series and probably also the IBM System/360 and 370. Unidata 300 systems connected on-line to a larger EDP system will be used as intelligent remote batch terminals, capturing by-product data on ECMA 34 cassettes during processing, and transmitting the contents of the cassettes in batch mode to the main EDP system at the end of the work day.

SOFTWARE

Philips offers an operating system, macroassembler, and modular accounting packages on the P300 Series.

Operating System

The operating system controls all I/O transfers including applications program loading from cassettes, and supervises keyboard inputs. It occupies 4K bytes of main memory on the 310, 5K bytes on the 320.

Assembler

Philips offers the same PHOCAL Philips Office Computer Assembly Language on the Unidata 300 Series as on the older P350 Series. This includes powerful single-, two-, and three-address instructions for branching, and for logical and arithmetic data manipulation.

Applications

Modular accounting packages have been developed that can be tailored to a country's language and accounting customs. In West Germany, the Varial 310 and Varial 320 packages offer three distinct program suites that may be ordered separately or together:

- Order entry and invoicing, with concurrent accumulation of sales statistics in main memory during the main invoicing run. At the end of the day, the accumulated sales totals for each product can also be used for inventory control and stock reordering. In the Varial 320 package, these programs are part of a more comprehensive sales ledger program suite that also includes automatic checking and updating of customers' magnetic accounts receivable ledger cards.
- General ledger, with automatic posting of credits and debits to multiple accounts.
- Payroll, with automatic calculation and accumulation of local, regional, and national taxes.

MAINTENANCE AND SERVICEABILITY

P300 systems are maintained by the extensive Philips-Electrologica servicing network built up to service the Philips P350 Series. Diagnosing faults is greatly aided by the automatic diagnostic test procedures built into central processor logic.

PRICE DATA

Model No.	Description	Purchase Price DM	Monthly Maint. DM
	P310		
P310 02	Basic Philips 310 Office Computer comprising processor, 6K bytes MOS memory (2K-byte user area) console, 50-60 cps printer, program cassette reader	23,800	161
	Additional main memory capacity:		
03	1K bytes (giving 3K-byte user area)	2,500	17
04	2K bytes (giving 4K-byte user area, which is current maximum)	5,000	34
FF 1	First Ledger Card Front Feed	3,000	20
FF 2	Second Ledger Card Front Feed	2,500	17
CS 2	Second Continuous Form Feed	2,900	20
V310-2K	VARIAL 310 – 2K Applications Package for Philips 310 Office computers with 2K-byte user area:		
	Invoicing	1,550	
	General Ledger	1,350	
	Payroll	1,350	
	Total Package, incl all above	3,900	
V310-4K	VARIAL 310 – 4K Applications Package for Philips 310 office computers with 4K-byte user area:		
	Invoicing	2,050	
	General Ledger	1,550	
	Payroll	1,550	
	Total Package, incl all above	4,800	
	P320		
P320 13 128	Basic Philips 320 Magnetic Ledger Card Processing Computer, comprising processor,8K-byte MOS memory (3K-byte user area), console with keyboard, 50-60 cps printer, 1 ledger card front feed equipped with MLC read/write unit 128 bytes/stripe	43,200	NA
V320-3K	VARIAL 320 – 3K Applications Package:		
	Invoicing/Stock Control	2,050	
	General Ledger	1,450	
	Payroll	1,450	
	Total Package, incl all above	4,500	
	Peripherals:		
P300 C	Magnetic Tape Cassette Drive	7,000	57
P3130	Paper Tape Punch	9,900	108
P3161	Card Punch	19,000	180
DFU	Data Communications Line Adapter	5,000	41
	Support Services		
	Operator Training Courses (3 days)	300	
	Site support, per man-day	480	
	Carriage, delivery and installation on site:		
	Per basic system	610	
	Per optional peripheral device	415	
	Field Conversion Costs of Installed Systems:		
	Electronic (addl memory, MLC read/write unit)	750	
	Cont. Form/Ledger Feeds	290	

PHILIPS-ELECTROLOGICA

P300 Series Office Computers Report Update

Philips-Electrologica has announced enhancements to its byte-addressable P300 Office Computer family.

Core Memory. The original MOS/RAM memory has been replaced by a more traditional ferrite core memory, which can be expanded from a basic 10K to a maximum of 16K bytes. Of this, 8K bytes is reserved for the operating system, and the remaining 2-8K bytes are available for user programs. Cycle time is 1.8 microseconds per 8-bit byte-wide access. User memory was previously restricted to a maximum 4K bytes on invoicing systems and 3K bytes on magnetic ledger processing systems.

Floppy Disc Option. Both the P310 invoicing/visible record accounting and the P320 magnetic ledger card processing computer may now also be equipped with two or four floppy disc drives. Each drive holds a diskette on which 256K bytes are recorded in 128-byte fixed-length sectors. Diskettes can be used for holding program libraries and/or data files.

Line Printer. The 70-lpm P3310 matrix comb line printer already available on the Philips P450 Series small business computers has now been released on the P300 Series. It facilitates the use of a P310 or P320 as intelligent remote batch terminal; mainframe output data can be printed from the communications line or from the ECMA 34 magnetic tape cassette drive to the P3310. Printing can take place simultaneously with disc or magnetic ledger card processing.

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PHILIPS-ELECTROLOGICA B.V.
P350 Series

OVERVIEW

The Philips P350 Series is a family of keyboard-oriented office computers manufactured at Eiserfeld, West Germany. First announced in April 1969, over 25,000 systems have been installed worldwide by Philips-Electrologica and its Philips Data Systems and Philips Business Systems subsidiaries.

While the P350 Series has enjoyed an enormously successful history as a Visible Record Computer (VRC), it is quietly being surpassed in capability by the Philips P300 Series of office computers. The P300 Series was introduced over a period of two years in a series of successive announcements that were carefully planned so as not to impact the P350 market. While the P350 is still being sold to existing P350 users, new users are being attracted to the more flexible P300 Series.

The P350 Series currently comprises six basic models, P352 to P359, each of which is available in five variations marked by the suffixes C, D, S, T, and CT. All models offer a stored program processor, 200 to 800 16-digit words of core storage, a program card reader, input keyboard, and a 22.5-cps printer integrated into a common console. The six basic models differ in the width of the console printer carriage (which has 164 print positions on Models P352 to P355 and 256 print positions on Models P356 to P359); in the magnetic ledger card processing units they are equipped with; and in auxiliary storage and data communications options.

All P350 models may be equipped with up to eight external input and eight external output devices. These may include 9K to 28K bytes of mass core storage for program and working area overlays, 256K to 9.2M bytes of disc backing storage, one to three magnetic tape cassette drives, 50- to 200-lpm auxiliary line printers, punched and marked card readers and punches, paper tape readers and punches, and an automatic magnetic ledger card feed or high-speed MLC card reader. See Tables 1 and 2 for the basic P350 mainframe and peripheral configurations.

Philips equips all models with an operating system microprogram adapted to each configuration's I/O devices. All models can be programmed in the powerful three-address Philips Office Computers' Assembly Language (the older PAL or the newer PHOCAL), which can be compiled on 800-word P350 Systems or IBM Systems/360 and 370. Each national sales organization offers a range of magnetic ledger card processing applications packages tailored to the country's accounting customs and taxation laws. The company also offers turnkey systems, with all applications programs written by Philips or by an approved software house under contract.

COMPATIBILITY

All P350 Series systems except P350S models are program and data compatible with each other, subject to availability of any of the optional external peripherals required by the program. The P350S models (marketed only in the Netherlands and West Germany) offer some additional floating-point instructions that are not available on P350 models.

The P350 Series is not machine-code compatible with the new Philips P300 Series office computers or any other computer series. Source programs written in PAL are source-code compatible with the PHOCAL assemblers available both on the P300 office computers and the larger P410 disc processing small business computer. The P410 can also be equipped optionally with a magnetic ledger card processing unit allowing P350 users to transfer their MLC card files to the P410, and gradually convert their programs to disc.

Philips P350 office computer systems can process ECMA 34 magnetic tape cassette input data and files recorded on Philips P171 or P172 data recorders, and exchange them with P300 Series office computers and P410 and P450 Series small business computers, as well as many other European-designed data entry and small business computer systems. They can also exchange data on 80-column cards and/or paper tape with any general-purpose EDP system on the market.

Philips P350T and P350CT systems can exchange data on-line with other P350T, P350CT, P300, P410, P450, and P1000 systems, as well as IBM Systems/3, 360, and 370, and Siemens Systems/4004 and 7.000.

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Table 1. Philips P350 Series: Basic Processor and Console Facilities

Characteristics		Model Nos. P351	P352	P354	P355	P356	P358	P359
MAIN MEMORY								
Word Length:	64 bits = 16 digits	Std	Std	Std	Std	Std	Std	Std
Capacity:	200 words = 1.6K bytes	Std	–	–	–	–	–	–
	400 words = 3.2K bytes	–	X	X	X	X	X	X
	600 words = 4.8K bytes	–	X	X	X	X	X	X
	800 words = 6.4K bytes	–	X	X	X	X	X	X
CONSOLE								
Keyboard (44 A/N, 12 num, 9 funct)		Std	Std	Std	Std	Std	Std	Std
Printer (22.5 cps print, 160 cps skip)		Std	Std	Std	Std	Std	Std	Std
Print Positions/Line		164	164	164	164	256	256	256
Continuous Form Feeds		1	1	1	1	2	2	2
Ledger Card Front Feeds		1-2	1-2	2	2	1-2	2	2
Magnetic Ledger Card Processing Unit		–	–	Std	Std	–	Std	Std
4-bit Digits/Stripe		–	–	192, 336 or 672	1,344	–	336 or 672	1,344
P 132 Automatic Magnetic Ledger Card Feed		–	–	Opt	Opt	–	Opt	Opt

Notes:
X = Available
– = Not Available

PERFORMANCE AND COMPETITIVE POSITION

When it was announced in April 1969, the P350 was the cheapest and most cost-effective visible record computer on the European market. It also offered a number of design advantages over its leading competitors. Unlike the Nixdorf System 820, and the Hohner and Ruf Practor Series, its applications programs were not firmwired on plug-in ROM boards but were read into processor main memory from a console card reader. A powerful three-address instruction format gave its Assembly language the character of a high-level RPG. Unlike the Burroughs L Series, it used an immediate access core store as main processor memory instead of a disc with all the attendant latency problems. All these factors, plus the financial strength and marketing power of the Philips group, explain why the P350 Series rapidly became the second most widely used visible record computer on the European market (after the Nixdorf System 820).

Like the other office computer systems designed in the 1960s, the P350 still has a fixed-word data structure of 16 numeric digits. This meets numeric processing requirements efficiently and inexpensively, but it complicates the handling of alphanumeric texts. Its internal arithmetic speeds are rather slow, with a 2-millisecond add time and an average 10-millisecond multiplication time. System speed is adequate, however, for a system restricted to keyboard input of variable transaction data and punched card or magnetic ledger card file storage, but can become restrictive in some disc processing applications. That is also why Philips does not market the P350D Series, which supports disc, in all P350 markets.

Because of the preceding limitations, the P350 Series is not as cost-effective as the more recently designed office computers of the 1970s. Newer office systems feature stored programs and byte-addressable main memories with variable operand lengths. Competing systems with these features include the Compudata 500S, Diehl-CTM 70, Datapoint 2200 and 5500, Hermes Data System 211, IME 100 Series, Insel Mael 2000 and 4000, Kienzle 2000 and 6000, LogAbax LX 4000, NCR 399 and 499, Olivetti A Series, and Triumph-Adler TA 1000 Series. In order to compete with them, Philips launched the byte-addressable P300 Series in 1974 (originally under the name, Unidata 300 Series). The P300 is gradually being expanded to offer most of the memory sizes and optional external peripherals available for the P350. Most likely, P350 systems will be sold mainly as upgrade and multiple systems to existing P350 users rather than to new users.

CONFIGURATION GUIDE

The P350 Series is currently available in six basic models numbered P352 to P359, which are distinguished by console carriage widths and the type of magnetic ledger card unit supported. The models are also available in two or more variations each, denoted by the presence of one of the suffixes: C, D, S, CT, or T. See Tables 1 and 2 for basic system configurations.

Table 2. Philips P350 Series: Peripherals and Other Options

Device	P352 to P359 Model Variations					
	Basic	C	CT	D	S	T
PROCESSOR						
Decimal Arithmetic	Std	Std	Std	Std	Std	Std
Floating-Point Arithmetic	–	–	–	–	Std	–
CONSOLE PERIPHERALS						
Program Card Reader (72 cpm)	Std	Std	Std	Std	Std	Std
MT Cassette Drive (integ)	–	Std	Std	–	–	–
Data Communications Adapter 600/1,200 bps	–	–	Std	–	–	Std
EXTERNAL PERIPHERALS						
P 135 Mass Core, 1.2K, 2.4K or 3.6K Wds (9K-28K bytes)	X	X	X	X	X	X
P 140 Disc Controller + 1 Drive(1) 32,000 Wds = 256,000 Bytes	X(2)	–	–	Std(3)	–	–
P 141 Addtl 32,000 Drives	0-4	–	–	0-4	–	–
P 142 Disc Controller + 1 Drive(1) 4.6M bytes	X(2)	–	–	X(1)	–	–
P 143 Addtl 4.6M-byte Drive	1 opt	–	–	1 opt	–	–
P 145 MT Cassette Drives	0-3(2)	0-3	0-3	–	–	0-3
INPUT DEVICES						
P 115 Card Reader, 80-col (270 cpm)	X	X	X	X	X	X
P 117 Mark Sensing Card Reader (250 cpm)	X	X	X	X	X	X
P 125 Paper Tape Reader (50 cps)	X	X	X	X	X	X
P 130 H.S.Magnetic Ledger Card Reader (80 cpm)	X	X	X	X	X	X
OUTPUT DEVICES						
P 110 Card Punch, 80-col (50 cps)	X	X	X	X	X	X
P 120 Paper Tape Punch (50 cps)	X	X	X	X	X	X
P 150 Auxiliary Printer, 128 Print Positions (50 to 140 lpm)	X	X	X	X	X	X
P 152 Line Printer, 132 print positions/line (200 lpm)	X	X	X	X	X	X

Notes:
(1) The P140 and P142 Disc Controllers are mutually exclusive
(2) A basic P352 to P359 may be equipped with a disc controller or with 1-3 magnetic tape cassette drives, but not with both
(3) A P142 Disc Controller can be substituted
X May be optionally connected to this system
– Not available on this system

P352. This is an invoicing and visible record accounting computer with a medium-width fixed carriage and maximum print-line width of 164 print positions spaced 10 to the inch. A single continuous forms tractor feed is standard. Optionally it may be equipped with one or two ledger card front feeds.

P354. This is a magnetic ledger card processing computer with the same 164-print-position carriage and single continuous forms feed as the P352. Two ledger card front feeds are standard features, and one of these is equipped with a read/write unit for reading 192, 384, or 672 four-bit numeric digits from a magnetic stripe on the card's insertion, and recording the same amount of updated information on the card's ejection.

P355. This is a magnetic ledger card processing computer able to read 1,344 four-bit numeric digits from each card stripe on insertion and record the same amount on its ejection. In all other respects it is identical to the P354.

P356. This is a wide-carriage invoicing and visible record accounting computer with a maximum print-line width of 256 print positions spaced 10 to the inch. Two independently programmed continuous forms tractor feeds are standard. One or two ledger card front feeds are optional.

P358 and P359. These are wide-carriage magnetic ledger card processing computers with the same 256-print-position carriage width and two continuous forms feeds as the P356. Both are equipped with two ledger card front feeds as standard features, including one MLC feed with a read/write unit for magnetic stripes. The P358 can process 384 or 672 digit stripes like the P354, and the P359 can process the same 1,344 digit stripes as the P355. Both the P358 and P359 require a minimum main memory of 400 words.

P352C to P359C. These six models differ from the six basic models in that their consoles have an integrated

magnetic tape cassette reader/recorder. It can read/record up to 256K bytes on each side of a single-track, 0.15-inch magnetic tape cassette in ECMA 34 format and can be used as an alternative to the program card reader for loading stored programs held on cassettes, for dumping store contents at breakpoints, and/or for recording data to be processed further by the same computer or a different system in a later run.

P352D to P359D. These six models include an integrated P140 or P142 disc controller and drive (see Table 3) and a special control microprogram that uses the first 256K bytes of the P140 or P142 disc drive as a virtual memory of 32,000 words for program overlays and working areas. These models are marketed only in Western Europe.

P352S to P359S. The six P352S to P359S models use a special microprogrammed ROM that implements floating-point arithmetic instructions. These systems can be used as desk calculators in addition to their normal invoicing and visible record processing functions. The S Series is marketed only in the Netherlands and West Germany.

P352T to P359T. The six P352T to P359T models include an integrated data communications adapter and CCITT V.24 modem interface. They can be connected to a switched or leased point-to-point or multidrop voicegrade line via an unclocked modem; transmission speed is switchable between 600 to 1,200 bps. Line control microprograms are available for implementing ISO (ASCII), IBM 2780 BSC, or Philips P1000 synchronous line protocols. The integrated communications line adapter can be added in the field to any but the oldest P350 Series models.

P352CT to P359CT. These six models include both an integrated console MT cassette drive and an integrated data communications adapter. In all other cases, the C, CT, T, D, and S features are mutually exclusive.

Common Characteristics

All P350 models and variations use a desk-type console with integrated keyboard, card reader, processor, and printer.

Processor. The processor is microprogrammed. It has a fixed word length of 64 bits. Each word can store one three-address instruction, or a signed 15-digit decimal number, or eight alphanumeric eight-bit characters or bytes. The instruction code and basic operating system are implemented in a 200-word read-only memory. User programs and data are held in a read/write core memory with a 3.2-microsecond cycle time; core capacity ranges from 200 to 800 words (1.6K to 6.4K bytes) on P352 to P356 models and from 400 to 800 words on the P358 and P359.

Keyboard. The electronic input keyboard is divided into three fields. The main alphanumeric field has 44 character keys in standard ECMA typewriter layout, three shift keys, a tab key, and a space bar. The numeric field has 12 digit keys for figures 0–9, 00, and 000, as well as a Clear key. The control field has eight keys for program selection, supplemented by four additional push buttons on the side of the carriage. Twelve lamps indicate various machine status modes.

Program Card Reader. The integrated console program card reader reads 80-column cards at 72 cpm. It can be used only to read stored programs into the processor main memory.

Table 3. Philips P350 Series: Disc Backing Storage

MODEL NOS.	Controller and First Drive	P 140	P 142
	Additional Drives	P 141	P 143
CHARACTERISTICS			
Number of Drives/Controller/System		1-5	1-2
Number of Discs/Drive		1 exch	1 fixed and 1 exch
Capacity	16-Digit Words/Sector	10	30
	Bytes/Sector	80	240
	Sectors/Track	32	24
	Tracks/Cylinder	1	2 + 2
	Cylinders/Discpack/Drive	100	200
	Bytes/Exchangeable Disc	256,000	2,304,000
	Bytes/Drive	256,000	4,608,000
	Bytes/System: Max	1,280,000	9,216,000
Average Access Time (msec)	Head Positioning	410	40
	Latency	40	12
Maximum Transfer Rate (bytes/sec)		30,000	300,000

Printer. The console printer is a moving-head impact printer with a peak printing speed of 22.5 cps and a forward skipping speed of 165 cps in an average processing speed of 40 cps. At the end of a print line, the print head returns to its left-hand margin starting position at 330 print positions per second.

PERIPHERALS

In addition to the integrated I/O devices that form part of the basic system, all models can be equipped optionally with up to eight external input and up to eight external output devices. Some models may be equipped with certain magnetic backing storage controllers that require both an input and an output device interface on the basic system. See Table 2 for peripheral restrictions.

Mass Core Storage. All P352 to P359 models and all their variations can support 1,200, 2,400, or 3,600 words (9K to 28K bytes) of mass core storage to hold program overlays and additional working areas. This additional core storage is treated by the central system as an immediate access external peripheral. Programs cannot be executed directly from mass core storage; they must be transferred into the main core memory for execution.

Magnetic Tape Cassettes. One, two, or three P145 magnetic tape cassette reader/recorders can be connected as external peripherals to any P352 or P359 model of the basic, C, CT, and T Series. On P352C/CT and P359C/CT models, up to three external MT cassette drives may be added to the integrated MT cassette drive on the console. Thus, these systems have a maximum of four drives. The basic P350 and P3501 models are restricted to a maximum of three MT cassette drives. The P350D and P350S Series models cannot support cassettes; they are mutually exclusive with discs.

Discs. Two types of discs can be connected to P352 and P359 models in the basic and D Series. The small disc used on the P140 and P141 drives has a capacity of 256 bytes on each side, but only one side can be read at a time because the drives have a single read/write head. The P142 and P143 drives (IBM 5440-type), on the other hand, have read/write heads for each side of the exchangeable and fixed disc; thus four tracks of data are available from each head position. Table 3 lists disc characteristics.

Generally speaking, discs are used on the P350 Series only to hold data files addressed directly. To hold program overlays as well, the central processor must be equipped with a special microprogram. Systems with this microprogram are denoted by the D suffix in France and some other European countries. Discs are mutually exclusive with MT cassette drives and the data communications adapter, and cannot be connected to C, CT, S, and T Series models.

Card. The integrated program card reader that is a standard console feature on all models can only be used for loading stored programs and constants. In order to also read data files held on 80-column cards, the P350 models must be equipped with a P115 card reader (270 cpm) or a P117 mark sensing card reader that can read punched columns or pencil marks on 80-column cards at 250 cpm. The P110 card punch can output data at 50 columns per second.

Paper Tape. The P120 paper tape punch and P125 paper tape reader both function at 50 cps.

Magnetic Ledger Cards. The integrated magnetic ledger card processing unit on all P354, P355, P358, and P359 models requires manual insertion and collection of each card by the operator. It may be optionally complemented, however, by two devices for automatic card feeding.

The P132 Automatic Ledger Card Feed sits on top of a P354, P355, P358, or P359 console. On depression of a button by the operator, it feeds a magnetic ledger card automatically from an input hopper into the P354, P355, P358, or P359 console MLC front feed for processing. On the card's ejection, it then stacks it automatically in an output stacker.

The P130 High-Speed Magnetic Ledger Card Reader is a separate device. It can both feed and read batches of MLC cards automatically at up to 80 MLC cpm, and transmit their stripe contents to the CPU like any other external peripheral device.

Auxiliary Printers. All P350 Series models can be equipped with either of two auxiliary printers for high-speed output printing runs. Such runs can take place simultaneously with a console-initiated processing program, except when the latter uses P130 magnetic ledger card reader inputs.

The P150 auxiliary printer is a dual printhead matrix printer with up to 128 print positions per line. Lines are printed character-serially two characters at a time. The first head prints in columns one to 64; the second prints in columns 65 to 128. Effective print speed depends on the length of the print line. Full lines of 128 characters (or 64 characters in either half) print at 50 lpm, but shorter lines can be printed at speeds up to 140 lpm.

The P152 line printer is a matrix comb line printer that prints lines of up to 132 print positions from the top down at 200 lpm, each character being formed as a 9 by 9 dot matrix. It is equipped with a single continuous forms tractor feed with adjustable margins, and can print an original and up to five legible copies.

SOFTWARE

P350 systems are equipped at the factory with a basic microprogrammed operating system in ROM that controls all input/output functions.

Languages

User programs can be written by Philips, an approved software house, or the user himself in the Philips Assembly Language (PAL), which offers a number of systems-oriented macro facilities. These include library facilities for handling peripherals and for tracing and debugging programs. PAL source programs can be compiled directly on P352 to P359 systems with 800-word core memories or cross-compiled on IBM System/360 or 370.

Philips offers Dutch and West German users of the P350S Series a choice of three languages for scientific and mathematical programs: PAL-S, BASIC, and CALCULA. PAL-S is a PAL superset that includes a number of two-address floating-point instructions. BASIC is the Dartmouth-College-defined language. The P350S Series BASIC compiler translates BASIC commands into one or more two-address PAL-S instructions. CALCULA is a proprietary language that simulates desk calculator operations. The compiler translates its single-address commands into PAL-S two-address instructions.

Applications

Philips offers standard applications packages for P354, P355, P358, and P359 magnetic ledger processing systems for payroll, stock control, invoicing, accounts receivable, accounts payable, general ledger, and similar accounting functions. These packages are written by each national Philips marketing organization and are adapted to each country's currency, accounting customs, and tax laws.

MAINTENANCE

Philips-Electrologica maintains a network of sales and service centres in all major European conurbations and in some North American cities. Maintenance agreements are separately priced.

PHILIPS-ELECTROLOGICA

P410

OVERVIEW

The Philips P410, which was announced on April 28, 1976, is a keyboard-oriented disc processing computer for small businesses and handles the decentralized data processing operations of large corporations. It offers 16 to 64K bytes of core main memory, 5 to 20M bytes of fixed/exchangeable cartridge disc backing storage, one to four ECMA 34 magnetic tape cassette drives, one or more printers with speeds ranging from 100 cps to 200 lines per minute, as well as optional card readers and punches. Up to five local teleprinter and/or A/N display terminals can be interfaced to the P410 for data entry and file enquiries. The P410 can communicate with an IBM, Philips or Siemens mainframe via a 600 to 9,600 bps synchronous communications line.

For users upgrading from magnetic ledger card Philips systems to disc based systems, the P410 system acts as a bridge, with an office computer console with an alphanumeric and numeric keyboard and a 100 cps serial matrix printer. Although two continuous forms feeds are standard on the console printer, it can be optionally equipped with one or two ledger card front feeds. Another bridging facility that Philips offers is PHOCAL (Philips Office Computer Assembly Language) which permits P300

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and P350 users to retain their current (PHOCAL) programs, while gradually rewriting programs in BASIC or COBOL.

The P410 runs under the same DOS 400 operating system as the larger Philips P450 and P455 disc processing small business computers. DOS 400 can multiprogram up to four different user procedures, subject to the availability of adequate main memory space. For creating, updating and querying files, Philips provides the IDEAL disc file data management system.

The P410 is built at Eiserfeld, West Germany, and is fully compatible with the larger P450 and P455 systems designed and built at Apeldoorn in the Netherlands. It is marketed throughout Europe, North America and in many overseas countries. Table 1 outlines mainframe specifications.

Table 1. Philips P410: Mainframe Specifications

PROCESSOR	
Microprogrammed	Yes
No. Registers	32 general-purpose, 32 special-purpose
Addressing (no. bytes)	16M
Instruction Set	54
Decimal Arithmetic	7 instructions
Floating Point	None
Instruction Length	Variable, 2-11 bytes
Control Store	MOS/ROM
Capacity	6K wds of 40 bits
MAIN MEMORY	
Type	Ferrite Core
Capacity (bytes)	16K-64K
Cycle Time (microsecs)	1.5
Width of Access (bytes)	1
Basic Addressable Unit	8-bit byte
INPUT/OUTPUT	
No. I/O Channels	1 integrated, 1 external
Max No. I/O Devices	9 console, 16 peripheral
Max I/O Throughput Rate	312K bps
INTEGRATED CONSOLE	
Kybd	51 A/N typewriter, 12 num keypad, 9 function keys
Display	32 chars single line
Printer	Serial matrix, 100 cps, 312 print positions/line, 64 char set, 2 cont form feeds std, 1-2 ledger card front feeds opt
Magnetic Tape Cassette	1-4 drives, ECMA 34, 1-tr, 800 bpi, 750 bps

COMPATIBILITY

The Philips P410 is fully machine code compatible with the larger P450 and P455 disc processing small business computers. It offers PHOCAL source program compatibility to the smaller Philips P300 and P350 series office computers, and can process both their magnetic tape cassette and their magnetic ledger card files via optional console attachments.

The P410 synchronous data communications line procedures allow it to exchange data on-line with IBM Systems/3, 360 and 370, ICL 2903, Philips P300, P350, P410 and P450 series, and Siemens Systems/4004 and 7.000.

PERFORMANCE AND COMPETITIVE POSITION

At a basic price of DM 97.000 ($38,800) for a 16K byte processor and 5M bytes of disc, the new Philips P410 is fully price-competitive with the IBM System/32 while being as powerful and expandable as the more expensive IBM System/3 Model 4, Honeywell 61/40 and ICL 2903/20. It is also price competitive with the equally expandable Digital Equipment Datasystem 350, Dietz 600/34 and Nixdorf 8870/1 and 8870/2. However, the P410 remains more expensive and not quite as expandable as the new Burroughs B80.

The Philips P410 does offer both BASIC and COBOL compilers, while most competing systems offer either BASIC or COBOL compilers. The P410 will, therefore, appeal strongly to users who require both interactive scientific/mathematical program development and execution, and commercial batch and transaction processing.

The P410 is unique among disc processing systems in its price and performance range. It offers an office computer console with two independently advanced and programmed continuous forms feeds as a standard feature and facilities for connecting one or two ledger card front feeds as an option. The P410 is thus the natural step for Philips P300 and P350 office computer users who wish to upgrade to disc processing.

SYSTEM DESIGN

A basic P410 configuration comprises a desk-top console with built-in processor, 16K bytes ferrite core memory, keyboard, single-line display, 100 cps serial printer, and one ECMA 34 magnetic tape cassette drive. A standalone 5MB fixed/exchangeable cartridge disc drive is also standard.

Main memory is expandable in 8 and 16K byte increments to a maximum of 64K bytes. Up to three additional magnetic tape cassette drives can be added to the console. The console printer can be equipped with one or two ledger card front feeds, one of which can be a magnetic ledger card front feed with a read/write unit for 384 or 768 bytes per card stripe.

Up to three additional cartridge disc drives can be added to the system, for a maximum of four, with a combined on-line capacity of 20 million bytes. Up to 12 other external peripheral devices can be added from among the card reader and punch, line printers, teleprinters, A/N display terminals, and data communications single-line controller (Table 2.) Up to five local A/N display terminals can be connected to the system for direct data entry and/or on-line file enquiries.

Table 2. Philips P410: Peripherals

Model	Description
DISCS	
P 3433	Fixed/Exchangeable Cartridge Disc Drive, 2.5M+2.5M bytes, 40 ms avg. access, 312Kbs, 1-4 drives=20Mb max on-line capacity
MAGNETIC TAPE	
Console	ECMA 34 MT cassette drives, 1-tr, 800 bpi, 750 bps, 1-4 drives
MAGNETIC LEDGER CARDS	
Console	Opt 384 or 768 bytes/stripe, 500 bps
PUNCHED CARDS	
P 3143	Card Reader (80-col), 300 cards/min
P 3161	Card Punch (80-col), 50 cols/sec
PRINTERS	
Console	Serial matrix, 100 cps, 312 print pos/line, 64 char set, 2 form feeds
P 3310	Line printer, 70 lpm, 132 print/pos/line, 64 chars, 1 form feed
P 3320	Line printer, 200 lpm, 132 print/pos/line, 64 chars, 1 form feed
TELEPRINTERS	
P 2720	Serial matrix, 50 cps, 80 print/pos/line with A/N keyboard
DISPLAY TERMINALS	
P 2740	A/N Display, 960 char screen (12x80), A/N kybd 1-5 stations
DATA COMMUNICATIONS	
Interface	Single-line, CCITT V.24, 600-9,600 bps, sync

Processor

The P410 processor is microprogrammed; a 6K 40-bit word 700 ns MOS/ROM implements the same 54 instruction set as the larger P450 and P455. This set includes five alphanumeric byte-chain handling, seven decimal arithmetic, 16 fixed point binary arithmetic and logical, nine data conversion, and 17 control instructions. There are 32 special-purpose and 32 general-purpose 8-bit registers which can be chained to hold variable length decimal operands of up to 31 bytes or digits and sign. Fixed-point binary operands are 16 bits long; alphanumeric byte chains may be up to 256 bytes long. Instruction length is also variable from 2 to 11 bytes.

Console

The P410 console keyboard comprises a standard alphanumeric typewriter keyboard, a separate 12-key numeric keypad, and nine control and function keys. A single line 32 position A/N display is integrated above the keyboard; 16 positions are used to display status information, and 16 to display the most recent operator keyboard inputs.

The 100 cps console serial matrix printer has a 312 print position-wide carriage equipped with two variable margin width and independently advanced continuous forms feeds. It can also be equipped optionally with one or two ledger card front feeds, including a 384 or 768 byte magnetic ledger card feed.

SOFTWARE

The P410 runs under the same DOS 400 disc operating system as the larger P450 and P455. This system can multiprogram up to four different user programs initiated either from the console keyboard or from any of the optional local display terminals.

Programming languages are BASIC, COBOL and PHOCAL. PHOCAL (PHilips Office Computer Assembly Language) is used on the smaller P300 and P350 systems and allows former users of these systems to retain their current programs when upgrading to a P410, gradually making the program conversion. New disc processing programs are written in BASIC or ANSI COBOL. The IDEAL disc data management system is a modular system for creating, updating, and querying user files.

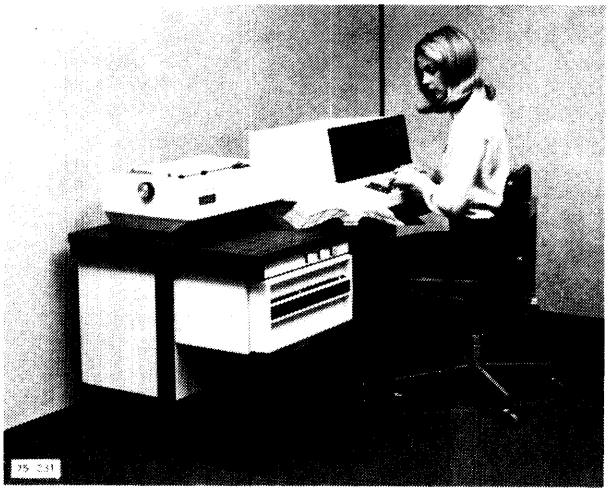
Standard applications packages are also being developed for the P410 by each national sales organization.

PRICE DATA

Model No.	Description	Purchase Price DM ($)
BASIC P410 SYSTEM		
P 410	Mainframe console with processor 16K bytes core memory, kbd, single-line display, 100 cps printer, 1 mag tape cassette drive	97,000
P 3433	One Cartridge Disc Drive, 2.5M fixed + 2.5M byte exchangeable disc	(38,800)

QANTEL

Systems 800, 900, 950 and 1200



OVERVIEW

The Qantel 800, 900, 950 and 1200 systems are a series of disc-based small business systems designed for the first-time user. The systems can be oriented toward interactive or batch processing or a combination of the two. To date, Qantel systems have found particular acceptance in banking and wholesale distribution, as well as in medical and meat packing applications.

Qantel feels that one of their strong competitive advantages, aside from its low price tag, is the wide range in system size, allowing the user to expand from small entry-level systems to larger, more versatile systems for mature applications. Users can move from one model to the next with no extra costs for conversions; the total price of a purchased system can be applied to the next higher model.

The four models share the same essential hardware components. User memory capacity, disc capacity and the number of peripherals supported vary among the models. The smallest System 800 offers 4K bytes of user memory and 6 million bytes of disc storage. It can process two concurrent jobs and host up to eight local and remote terminals. A large System 1200 can have up to 32K bytes of user memory, 120 million bytes of disc storage and a communications subsystem hosting up to 16 local and remote terminals operating as many as four jobs concurrently. Other peripheral subsystems may include magnetic tape drives, card readers and line printers. All systems include 32K bytes of system memory, which is separated and protected from user memory. The 32K system memory includes the initial 4- to 6K bytes of user memory.

Qantel is a small, privately-owned company; these four business systems are their only products. Until recently Qantel has concentrated on developing only systems software in-house, arranging for custom development of applications software through designated software houses. Unlike many minicomputer makers, Qantel sells or rents hardware directly to the user rather than through a software house. The user is steered by Qantel to a software house appropriate for his area and application. The nationwide Computer Usage Corporation has handled most of the banking software and ISC (International Software) has handled medical clinic, wholesale and meat packing software. If the user does not want to deal directly with a software house, Qantel charges a project management fee to oversee the software development and iron out problems.

Qantel-developed system software includes BEST, a disc-based foreground/background operating system; QIC, a user-oriented FORTRAN-like language; an assembler; and emulators for IBM 2701, 2740, 2770, and 2780 terminals, Univac 1004, Burroughs TC500 and Control Data 200 protocol.

In banking, Qantel Systems are used for funds transfer, coupon securities collection, securities custody, broker accounting, and international letter of credit operations.

Nine out of the top 20 banks in the country and three branches of the Federal Reserve System use the Qantel system as an integral component of their data processing installations.

In the medical clinics market, Qantel markets their systems on the basis of fast receivables turnaround, the availability of more detailed reports than those offered by a service bureau, sophisticated appointment scheduling and better overall control of data and medical clinic management information.

Qantel offers several software applications packages for the wholesale distribution industry. The Meat Information Management Systems (MIMS), which is a standard package available from ISC, provides receivables control,

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adjustment to price fluctuations in the commodity market, discounting, portion control and payroll routines. Other types of wholesale distributors can use Qantel's SOLUTION application package. SOLUTION is a comprehensive set of packages for order processing, accounts receivable and invoicing, inventory and sales analysis, accounts payable, purchase order processing, payroll and general ledger accounting. The package is modular, so the user can obtain only the elements he needs. A principal feature of SOLUTION is its ability to interact with a common disc resident information base. Table 1 lists the general specifications of the Qantel Systems.

Table 1. Qantel Systems 800, 900, 950 and 1200: Specifications

Central Processor	
Word Size (bits)	8
Capacity (words)	4K-32K
Cycle Time (μsec)	1.5
Working Storage	MOS
Microprogrammed	Yes
Auxiliary Storage	Disc, mag tape
Data Output	
Line Printer (lpm)	100, 240, 300, 245-1,100, 700-1,800
Serial Printer (cps)	45
Card Punch (cpm)	No
Paper Tape	No
Data Input	
Keyboard	ASCII
Card Reader (cpm)	500
Paper Tape (cps)	No
Software	
Assembler	Yes
Operating System	Yes

PERFORMANCE AND COMPETITIVE POSITION

Qantel, a small, privately-owned company founded in 1969, has shown steady growth in revenues and numbers of systems installed since 1972, when their first system was installed. Their revenues are running in the $6 to $8 million range, with more than 250 systems installed. In addition to their domestic marketing efforts, Qantel also markets their systems in Japan, Canada and the Netherlands through export distributors.

The successful competitive stance of smaller companies like Qantel has been threatened by the introduction of IBM's System/32, a diskette-based interactive system starting in the $30,000 range. In spite of assembly language compatibility problems with System/3 and the high cost of adding reasonably substantial disc storage, System/32 will prove a strong competitor because of the low-cost applications software IBM is offering. System/32 applications software is currently aimed at five market sectors (construction, medical, membership, wholesale paper and food industries). At present Qantel will probably feel the pinch in the medical and some wholesale applications. The low-cost 800 and 900 models, which offer larger disc capacity at lower prices (less than $20,000 for model 800), put the company in a position to continue competing against the industry giant with entry-level systems. This competitiveness will continue even if IBM introduces software in Qantel's traditional markets.

Larger Qantel systems compete with IBM's popular System/3 and (to a lesser extent) with systems made by large and small manufacturers such as NCR, Burroughs, Four Phase, Datapoint, and Basic/Four. The company's chief advantage against all of these is their expandability, the concentration on the market segments mentioned above, and the resultant expertise that new users can rely on. The advantage of lower price, of course, is a lever all smaller manufacturers try to use against the larger ones. In this regard, Qantel notes that systems like theirs have to be priced at about half of IBM's comparable system in order to win a user away from the industry giant.

USER REACTIONS

Users we contacted were unanimous in feeling that the Qantel system offered very good performance for its price. They mentioned that the Qantel is simple to install and operate, it is rugged, communication facilities are good, the system is flexible, and uptime is good. One user quoted an uptime of 93 to 94 percent.

Some did feel that maintenance service could be improved. Two users we contacted said the maintenance was excellent; another rated it fairly good. Two other users felt the service was "improving."

Users were generally expanding their installations by buying more Qantel Systems and expanding existing configurations. For example, a large bank obtained their first Qantel system through C.U.C. because it was the only hardware/software package on the market that would satisfactorily automate their money transfer application. Now the bank has three systems. It found file maintenance much, much easier and accuracy greatly improved over the old paper tape system. Moreover, they had "hung a lot of peripherals" on each system, including disc, magnetic tape, paper tape I/O, four typewriter terminals and two 10-key numeric terminals. They had chosen to go to a third system instead of multiplexing more terminals on the other two systems because they did not want to alter the existing software or slow the terminal response time.

CONFIGURATION GUIDE

Models 800 and 900 are limited expansion models. They are limited to 4- to 6K bytes of user memory, running two jobs concurrently and hosting eight terminals. The variation in the size of user memory is dependent on the operating systems' residency requirements, which is determined by the peripherals chosen. Systems with fewer peripherals can have as much as 6K bytes of user memory available. These two models are limited to a maximum of six peripheral interfaces. This means that the 800 can add four additional peripheral subsystems and the 900 can add three more to its basic configuration. Either system can upgrade to the 12-million-byte disc drive, but the total

disc capacity of the system cannot exceed 24 million bytes. These models are permitted to attach one magnetic tape drive.

The printer can be upgraded to the 60-to 100-lpm, 240-lpm and 300-lpm models. Other possible peripherals include one additional printer, card readers, magnetic tape drives and interfaces for communication terminals. These two models cannot attach the multiplexed terminal subsystems which permit a single peripheral slot to host multiple terminals. The two models are also restricted to variable speed printer models not exceeding 300 lines per minute.

The models 950 and 1200 can start at approximately the same level as models 800 and 900, but are capable of much greater expansion. The 950 and 1200 can handle eight terminals as standard and up to 16 with the multiplexed terminal subsystem. User memory for both models is a minimum of 8K bytes and a maximum of 16K bytes for the 950, and up to 32K bytes for the 1200.

Both models use the same set of peripherals available to the 800 and 900. The model 950 like the 800 and 900 is limited to a maximum of 24 million bytes of disc storage and a 300 lpm printer. The model 1200, however, can host up to four 30 million byte disc drives and line printer rates of 1,800 lpm. The 950 and 1200 models cannot attach more than four magnetic tape drives.

The multiplexed terminal subsystem permits the 950 and 1200 models to host flexible terminal configurations. Various types of communication line arrangements allow local and remote terminals to be mixed in the same subsystem, all under control of a single 6201 communication controller. Local terminals can be situated up to 2,000 feet from the CPU depending on the type of line used. Remote subsystems can include up to four terminals on a single modem. The hardware of the 950 and 1200 models theoretically can support up to 96 terminals through the addition of several multiplexed terminal subsystems; however, to achieve a reasonable terminal response time, Qantel sets the limit at 16 terminals.

Table 2 presents a tabular summary of the model configurations.

MAINFRAME

The Qantel processor is a microprogrammed minicomputer designed and manufactured by Qantel. Program and data storage is provided by separate, protected byte-oriented memories. The standard user memory unit is 4,096 bytes. Field expansion to 8,192, 16,384, 24,576, or 32,768 bytes of user memory is optional. Program memory ranges from 26-32K bytes, depending on the user's needs, in a separate protected partition. Communications options, for example, typically add 4K-6K bytes to the system memory needed by the basic BEST operating system.

Table 2. Qantel Systems 800, 900, 950 and 1200: Configuration Specifications

	Model			
Feature	**800**	**900**	**950**	**1,200**
User Memory (Kbytes)	4-6	4-6	8-16	8-32
No. of I/O Channels	6	6	6	12
No. of Concurrent Jobs	2	2	4	4
Disc Capacity (mb)	6-24	6-24	6-24	6-120
No. of Terminals	8	8	8	8*
Std. CRT (screen size)	960	1,728	1,728	1,728
No. Mag Tape Drives (800/1,600 bpi)	1	1	1	4
Max. Printer Speed (lpm)	300	300	300	1,800

Note: *Multiplexed communication subsystem may be added to host up to 16 terminals.

Internal processor control is a function of microinstructions executed in a read-only memory (ROM). ROM contains fixed nondestructive memory for the execution of user macro instructions. The standard ROM is 1,540 bytes. Access time is 50 nanoseconds. If a different or special micro control program is needed, the user can simulate ROM in main memory by loading additional microprograms with a special instruction.

Models 800 and 900 and 950 each have six I/O channels; the Model 1200 has 12. Up to nine of the 12 standard I/O channels can be used as direct access (to main memory) channels; the maximum direct access data transfer rate is 668K bytes per second. The I/O bus for model 1200 can also be extended on an RPQ basis, but Qantel has had so few requests for this option that it has been withdrawn from the standard price list.

PERIPHERALS

Qantel offers a selection of peripherals found with most of the small business systems. However, it is unusual to find high capacity discs with independent operation and high-speed line printers available at the Qantel price/performance level.

Disc Drives

There are three types of disc drives storing 6M, 12M, and 30M bytes. The 6M byte disc drives, standard on the basic systems are dual drives with one fixed and one removable cartridge. On all systems it can be upgraded within the mainframe to a 12M byte double density system. A standalone version of the 12M byte disc is also available for 1100 and 1200 systems. A total of four disc drives of any type can be attached to these computers. These can be all 12M byte drives, all 30M byte drives, or any combination of 6M, 12M, and 30M byte drives.

The 314-type disc pack drive is available only on the model 1200. It stores 30.7 million bytes. To minimize search time, the 314 type disc drives all contain their own

controllers, which have full-sector buffers. This allows automatic write/read and check/rewrite operations independent of the program. A randomizing routine rather than an index sequential routine is used to address disc sectors directly. Bad spots on the disc are recorded in the file directory by the disc handler.

CRT

The standard CRT for the model 800 has a 12-inch screen, 12 lines of 80 characters each, a storage capacity of 960 characters, a standard typewriter keyboard with the full 64-character ASCII set, plus a 10-key numeric pad. An integral controller in the mainframe allows the attachment of one CRT on models 800 and 900, two CRTs on model 1100 and up to six on the 1200. The display uses two-level video intensity for distinction between background and foreground data. The cursor is programmable. The standard CRT for models 900, 950 and 1200 displays 1,728 characters (24 lines of 72 characters).

Serial Printer

Two serial printers are available. The standard 45-cps serial printing is a terminal quiet character keyboard printer, with standalone models and video-printing models also available. The serial dot matrix printer uses a 5 x 7 dot matrix, prints 132 characters per line (buffered) at a rate of 60 to 100 lines per minute, and makes an original and up to four copies.

Line Printer

Four models — all drum printers — print 245 to 1,800 lines per minute; 240 lines per minute, 300 lines per minute, and 700 to 1,800 lines per minute. All are impact printers and feature 132 print positions per line. All printer controllers have a one-line buffer. All four printers use a 64 or 96 ASCII character set and can produce an original and five copies. The variable speed printers all have alternate models with 96-character sets.

Card Reader

A single card reader is offered. It reads 80-column cards at 500 cards per minute; it translates extended Hollerith (256-character) code to ASCII.

Magnetic Tape Drives

The Qantel system has four tape drives available. All use 9-track, industry-compatible, ½-inch-wide tape and have hardware-buffered controllers. Two models record at 800 bpi and two record at 1,600 bpi. Models are further differentiated by reel sizes (600 feet and 2,400 feet). All models operate at 25 ips. A maximum of four magnetic tape drives can be added to a system under a single controller. A controller cannot mix drives of different densities so, if different densities are to be mixed on a system, more than one controller must be included.

Ten-Key Numeric Input Module

This keyboard uses a standard 10-key adding machine style keyboard, is designed for numeric data entry, has a 31-digit buffer, and has an audible program-controlled signal that warns an operator of an incorrect procedure. This device is not supported by the BEST operating system.

Programmer's Control Console

This console is used to troubleshoot the processor or debug user programs. It allows usual debug functions such as display or modify memory address register, memory locations, and other registers. It is not supported by BEST.

DATA COMMUNICATIONS

The Qantel System can transparently communicate with host computers from many manufacturers, such as IBM, Univac, and Burroughs. It can simulate the IBM 2701, 2740, 2770, and 2780, as well as the Univac 1004, Burroughs TC 500, and Control Data UT200. It provides communication at rates up to 9,600 baud synchronously and 2,400 baud asynchronously for locally-connected terminals (up to 2,000 feet) and a maximum of 1,200 bps for remotely-connected terminals. Remote terminal support is available only for dedicated communication lines; dial up lines are not supported.

Communications controllers use a microprocessor with up to 2K bytes of memory. The microprocessor handles polling and other communications functions, and transfers data with the Qantel System memory via the direct memory access channel on a cycle stealing basis. A Qantel System can support three types of controllers:

- Asynchronous single-line controller, EIA standard interface, to 1,800 baud, half or full duplex.
- Synchronous single-line controller, EIA standard interface, to 9,600 baud, half or full duplex.
- Asynchronous multiline multiplexor for up to 16 local or remote terminals.

Qantel also supplies the equivalent of Bell 202C and 202D modems.

SOFTWARE

Software provided by Qantel includes a disc-based operating system (BEST), the "QIC" interactive, English-like terminal language, an assembler, a number of communications emulators and, for wholesale distributors, the "SOLUTION" software packages. The company supplements these offerings with applications software from software houses such as Computer Usage Corporation and ISC.

BEST is a modular operating system with file-handling capabilities, sorting routines, and a variety of possible environments. It can be geared to the capabilities of individual systems, allowing expansion to a full-blown

foreground/background system. It includes modules for handling all the peripherals devices except the 10-key numeric keyboard and the programmer's console. Software supported includes an assembler compiler as well as the special QIC language. The QIC language is a FORTRAN-like language designed to ease interactive terminal operation.

The assembler is very similar to IBM's 1401 Autocoder. The instruction set contains 51 business-oriented instructions, which include decimal arithmetic, bit/byte manipulation, branching, and I/O. All instructions are of the one- or two-address type.

Qantel terminal emulators do not offer 100 percent plug-compatible replacement operations. Rather, they are about 90 percent functionally identical; the other 10 percent must be custom-written for a particular user. Qantel supplies emulators for the IBM 2701, 270, 2780, the Control Data 200 and the Univac 1004.

SOLUTION is an applications package designed for wholesale distributors. It contains modules for order processing, accounts receivable and invoicing, sales analysis, accounts payable, purchase order processing, payroll, and general ledger. The system updates a variety of files with a single entry, automatically fills out constant information (name, address, account status) from a key entry (account number), and produces printed invoices, purchase orders, summary reports and other printed outputs.

MAINTENANCE

On-site maintenance is available from a field service organization of approximately 75 people located in 16 nationwide service centers. Maintenance contracts are available for leased systems. Purchased systems carry the typical 90-day warranty, with an optional contract available for maintenance. System engineering is available at offices located in or near New York, Chicago and San Francisco.

PRICE DATA

Description	Monthly Rental $(1)	Purchase Price $	Monthly Maint. $
800/System, 4K words User Memory, System Memory 6M disc, printing terminal; 4 slots for peripherals	449	19,500	155
900 System, 4K words user Memory, system memory, 6M disc, CRT, printing terminal; 3 slots for peripherals	573	24,900	190
950 System, 8K words User Memory, System Memory, 6M disc, CRT, Serial Printer, can add another terminal, peripherals, more disc storage	679	29,500	230
1200 System, 8K words user memory, system memory, 6M disc, CRT, serial printer; can add up to 6 terminals, peripherals, more disc storage	817	35,500	250
Processor Options			
2101 4K word Memory Module	68	2,950	16
2102 8K word Memory Module	102	4,450	20
2901 Real Time Clock	22	950	5
2903 Programmer's Console	33	1,440	10
9503 Upgrade 800 to 1200	229	9,950	—
— Upgrade 900 to 950	160	6,950	—
9505 Upgrade 900 to 1200	229	9,950	—
Peripherals			
3102 12M Byte Disc	321	13,950	90
3201 30.7M Byte Disc	454	19,750	120
9101 Substitute 12M Disc for 6M Disc	90	3,900	20
9102 Substitute 30.7M Disc for 6M Disc	270	11,750	50
4001 960-char CRT	102	4,450	30
4011 1728-char CRT	137	5,950	40
4301 Printing Terminal (45 cps)	137	5,950	45
4321 Video Printer (45 cps)	130	5,650	40
4341 Auxiliary Character Printer (45 ips)	130	5,650	40
4321 Auxiliary Controller	35	1,500	10
4801 400/4011 Controller, when terminals are added to 800 or 900	35	1,500	10
9701 Upgrade 4001 to 4011	56	2,450	10
9702 Upgrade 4341 to 4301	35	1,500	5
9202 Substitute 4011 for 4001	35	1,500	10
9203 Substitute 4301 for 4001	56	2,450	15
5001 60-100 lpm Serial Printer	160	6,950	50
5021 245-1,100 lpm Line Printer (64 char)	483	21,000	140
5022 245-1,100 lpm Line Printer (96 char)	529	23,000	140
5031 700-1,800 lpm Line Printer (64 char)	771	33,500	185
5032 700-1,800 lpm Line Printer (96 char)	817	35,500	185
5041 300 lpm Line Printer (64 char)	288	12,500	80
5042 240 lpm Line Printer (96 char)	334	14,500	90
5046 300 lpm Video Printer (64 char)	288	12,500	80
5047 240 lpm Video Printer (96 char)	334	14,500	90
9302 Substitute 5021 for 5001	357	15,500	90
9303 Substitute 5031 for 5001	644	28,000	135
9304 Substitute 5022 for 5001	403	17,500	90
9305 Substitute 5032 for 5001	690	30,000	135
9306 Substitute 5041 for 5001	161	7,000	30
9307 Substitute 5042 for 5001	207	9,000	40
9308 Substitute 5001 for 4341 (on 900)	56	2,450	10
9309 Substitute 5041 for 4341 (on 900)	184	8,000	40
9310 Substitute 5042 for 4341 (on 900)	236	10,000	50
5201 9-track tape drive,800 bpi, 600 ft reel	114	4,950	35
5202 9-track tape drive, 800 bpi, 2,400-ft reel, cabinet	183	9,950	50
5211 9-track tape drive, 1,600 bpi,600-ft reel	132	5,750	40
5212 9-track tape drive, 1,600 bpi, 2,400-ft reel, cabinet	206	10,950	55
5281 800 bpi Controller, 1-4 drives	35	1,500	10
5282 1600 bpi Controller, 1-4 drives	46	2,000	12
5301 Card Reader	95	4,150	35
5701 10-Key Numeric Keyboard	15	615	5
Communications			
6001 Sync Controller	58	2,500	30
6101 Async Controller	58	2,500	30
6201 Multiline Async Controller	114	4,950	50
6202 Lines for 6201	28	1,200	15
6801 202C Compatible Modem	22	950	8
6802 202D Compatible Modem	22	950	8

Note:

(1) For typical 66-month lease; price does not include monthly maintenance charges.

RANDAL DATA SYSTEMS INC.

RDS Systems

76-182

OVERVIEW

The Randal Data Systems (RDS) LINK-100, RDS 300, and RDS 400 are a family of minicomputer-based (Data General Nova) small business systems aimed at the first-time computer user.

Any of the RDS systems can be configured with a maximum of 64KB of memory, a variety of line printers, punch cards, magnetic tape, and synchronous or asynchronous communications options. The LINK-100 supports up to eight CRTs and up to eight floppy discs for a total of 5M characters of floppy disc storage. The RDS 300 and 400 support up to 24 CRTs and up to four cartridge discs for a total of 23.2M or 46.4M characters of storage, respectively. The LINK-100 is upward compatible with the RDS 300 and 400. See Table 1 for complete system specifications.

All RDS systems operate under the control of a multitasking operating system, the Randal Time-sharing Operating System (RTOS). RTOS is a disc-resident system that supports both sequential and indexed files. RTOS's operation is transparent to the user; each terminal can execute its own independent program. RTOS also supports a concurrent background batch program. The Randal systems use Business BASIC.

Randal offers standard application packages for data entry, inventory control, and commercial accounting. In addition it offers special packages such as RANDATA for the on-line creation of data files, and RANTEX, a text processing package. Turnkey application packages are also available through RDS distributors.

An IBM 2780 emulation package and a RANCOM package for asynchronous RDS-to-RDS system communications are also available.

Randal Data Systems is a 5-year-old company that markets a family of disc-based small business computers. Marketing of the RDS systems is done through a network of some 20 independent distributors who perform installation, training, and program customization in addition to the sales function.

First deliveries of these RDS systems were made in June 1974; to date, over 250 systems have been installed.

PERFORMANCE AND COMPETITIVE POSITION

The general market for small business computers is one of the fastest growing areas of data processing, and, as such, is one in which competition is quite heavy. The smaller LINK-100 has relatively few direct competitors, due to its low price. Digital Equipment Corporation with its floppy-disc based Datasystem 300 line, and Wang with its WCS/20 are the major manufacturers producing systems similar to the LINK-100 in a competitive price range. The Wang WCS/20 cannot attach additional operator stations (the WCS/30 can, however), and offers BASIC. The DEC Datasystem 300 Series can attach more than one CRT station to a system, but only offers DIBOL. BASIC is available only on the larger PDP-11-based Datasystem 500 line.

The larger RDS configurations are directly competitive with some of the major entrants in the small business computer marketplace. The closest competitor is BASIC/Four, which offers equipment quite similar in architecture and function to the RDS 300, at approximately the same prices. Digital Equipment's cartridge-based Datasystem 300 and 500 Series also offer equivalent performance, although at considerably higher prices. For users who require only a single operator station, and have cartridge-disc-sized files, the IBM System/32 can be considered a strong but high-priced competitor.

HEADQUARTERS

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Table 1. Randal LINK-100, RDS 300 and 400: Specifications

	LINK-100	SYSTEM 300, 400
CENTRAL PROCESSOR		
Main Memory (bytes)	32-64K	32-64K
Word Size	16 bits	16 bits
Direct Memory Access	Yes	Yes
Real-Time Clock	Yes	Yes
Power failure/Auto restart	Yes	Yes
SOFTWARE		
Operating System	RTOS	RTOS
Language	Business BASIC	Business BASIC
DISC STORAGE		
Type	Floppy discs	Cartridge disc
Maximum/System	1 to 8	1 to 4
Capacity per Drive (bytes)	630K	5.8M (System 300) 11.6M (System 400)
Transfer Rate (bytes/sec)	62,000	300,000
CRT DISPLAY & KEYBOARD		
Maximum/System	1 to 8	1 to 24
Screen Size	12" diagonal	12" diagonal
Char/line	80	80
Lines	12 or 24	12 or 24
Numeric Pad	Yes	Yes
Protected Fields	Yes	Yes
Cursor Positioning	Yes	Yes
PERIPHERALS		
Matrix Char Printer	30 cps, 70 lpm, 300 lpm	70 or 300 lpm
Chain Line Printer	300 or 600 lpm	300 or 600 lpm
Tape drive system, 9-track, 800 or 1,600 bpi	12 to 45 ips	12 to 45 ips
Card Reader	450 cpm	450 cpm
DATA COMMUNICATIONS		
Async Adapter	Single line, multiport	Single line, multiport
Sync Adapter	Single line	Single line, multiport

The systems software of RDS is fairly comprehensive. RTOS is a disc- and file-oriented executive operating system. It includes features such as full file management (with multiple-key index files), foreground/background operation, security protection, and support for up to 24 time-sharing users. Randal's Business BASIC is an extension of the well known BASIC language, and runs as an interpreter for each time-sharing user. Important commercial processing features such as character string manipulation and index file I/O are supported by the interpreter. An unusual feature of the language is the ability of one operating station to send and test semaphores to/of another station.

USER REACTIONS

Due to Randal's method of marketing RDS systems, both system end users and Randal distributors were interviewed. The most frequent comment made by both was that the effectiveness of the RDS systems quite often depended on the quality of the software provided by the distributor.

One representative of a systems software house has found that an increasing portion of his systems work is being done on Randal systems. He believes Randal's equipment usually provides performance equal to that of competitors at a lower price to the end user. Although he makes use of Randal's application and utility software, he finds that his own application packages are more effective for his customers.

A representative RDS end user is the small business with gross sales in the range of $1 to $20 million. Usually a Randal system is employed as a first step up from manual accounting methods. One user of this type stated that his company was performing all bookkeeping functions on a diskette-based RDS system in 4½ hours a day, a job that had formerly involved some 20 man-hours daily. This particular user was very pleased with the direct cost savings, and enthusiastic about the company's ready access to current office information.

Another user of a LINK-100 with three diskettes was employing the equipment for office accounting functions — accounts receivable and payable, payroll, billing, and general ledger. Primary usage for the system was an accounts receivable file of some 500 active accounts. This user was located in southern California and dealt directly with Randal for service, which has been found satisfactory.

Another user purchased a LINK-100 system, but was in the process of having it installed, with acceptance testing in progress at the time of the interview. The system was purchased to maintain a small inventory of perishable goods located at several sites, but the user also expected to perform standard office accounting functions on the equipment. He was attracted to the LINK-100 system by the apparent simplicity of operation, and he had a great deal of confidence in the distributor who was performing system installation.

While the majority of RDS users employ the equipment in a variety of small business accounting applications, an exception is one large, national company that has purchased several of the larger RDS systems as turnkey-distributed data processing stations. The Randal systems are employed as sophisticated data entry stations for the validation of transactions. They also use the communications facilities for transmitting valid batches of data to large host computers.

SYSTEM DESIGN

The minimum Randal system comes with 32K bytes of main memory, a CRT/keyboard operator station, and either floppy- or cartridge-disc storage. The minimum LINK-100 system is provided with one floppy-disc drive capable of holding 630K bytes of data. The minimum System 300 comes with a single cartridge disc consisting of a fixed and a removable platter, each holding 2.9MB of data. System 400 is similar to System 300, but a dual-density cartridge disc, which holds a total of 11.8MB of data, is

used. The LINK-100 does not support cartridge discs and the cartridge-disc systems do not support floppy discs. The operating system and software, however, is the same for the LINK-100 and System 300 and 400.

In maximum configurations the LINK-100 can support up to eight diskette drives, and the System 300 and 400 can support up to 4 cartridge drives. Memory can be added to all models in increments of 16K bytes, up to a total of 64K bytes. A wide variety of printers may be attached to any system, with speed variations from 30 characters per second to 600 lines per minute. All models may have a card reader or magnetic tape drive attached.

Additional CRT/keyboard operator stations may be attached to all systems. A theoretical maximum of 24 CRT units may be attached, although response time suffers on the diskette-based LINK-100 system if more than two or three stations are attached.

PERIPHERALS

The LINK-100 and the RDS 300 and 400 have a variety of peripherals: CRTs, printers, disc storage, magnetic tape storage, and a card reader. All three systems are peripheral compatible.

CRTs. The standard CRT for the LINK-100 and RDS 300 and 400 has a 12-inch screen of 12 or 24 lines by 80 characters per line. The keyboard is standard typewriter with 128 ASCII characters with a separate numeric pad. A maximum of eight CRTs can be attached to the LINK-100.

The RDS 300 and 400 can theoretically attach a maximum of 64 terminals, but Randal Data Systems recommends limiting the number to 24 terminals. Terminals can be local or remote.

Printers. There is a wide variety of printers available for use with the LINK-100, all with a maximum of 132 print positions. The matrix character printer prints up to 70 characters per second or 300 lines per minute; the chain line printer has speeds of 300 or 600 lines per minute.

The RDS 300 and 400 can use either a standard 60-line-per-minute (132-column) printer or a 30-character-per-second matrix printer. Also available for the 300 and 400 are 200, 400, and 600-line-per-minute printers.

A DECprinter I matrix printer can be used with all three systems. The DECprinter has a 132-column maximum format that employs a 128 ASCII alphanumeric character set. A hardcopy teleprinter — the DECwriter — can also be used with these three systems. The DECwriter prints 132 columns, 30 characters per second throughout with a 60-character-per-second catch-up mode. There is a standard typewriter keyboard with a 128 ASCII alphanumeric character set. Optional with the DECwriter is a 97-character set that is compatible with uppercase-only devices.

Disc Storage. The basic LINK-100 uses a 630K-character floppy disc. A maximum of eight drives can be used with the system for a total of 5M characters of floppy disc storage. Transfer rate is 62K bytes per second.

The standard RDS 300 uses a cartridge disc with 5.8M characters, 2.9M fixed and 2.9M removable. A maximum of four cartridge discs can be used with the system for a total of 23.2M characters of storage.

The RDS 400 uses an 11.6M-character cartridge disc. The 400 can support a maximum of four cartridge discs for a total of 46.4M characters, 23.2 fixed and 23.2 removable. Both the RDS 300 and 400 have a transfer rate of 300K bytes per second.

Magnetic Tape Drives. There are four, nine-track drives that can be used with the LINK-100 and RDS 300 and 400:

- 800 bits per inch, 600-foot reel, 25 inches per second.
- 800 bits per inch, 1,200-foot reel, 25 inches per second.
- 800 bits per inch, 2,400-foot reel, 45 inches per second.
- 1,600 bits per inch, 2,400-foot reel, 45 inches per second.

Card Reader. A card reader that reads 450 cards per minute is available for use on the three systems.

DATA COMMUNICATIONS

The RDS systems support single-line synchronous or asynchronous communications adapters. The LINK-100 can use either a four- or eight-port asynchronous adapter or a single-port synchronous or asynchronous adapter. The RDS 300 and 400 can use either an eight-port asynchronous adapter or a single-port synchronous or asynchronous adapter.

Randal offers an IBM 2780 emulator that allows an RDS system to communicate in binary synchronous mode with other computers or terminals. Also offered is RANCOM, an asynchronous communications package designed for RDS-to-RDS system communication.

SOFTWARE

All Randal Data Systems operate under the control of a time-sharing operating system, RTOS (Randal Timesharing Operating System). RTOS is a disc-resident, commercially-oriented operating system that supports multitasking. It includes a comprehensive file management system (both sequential and multiple indexed files), automatic file cataloging and space allocation, and a complement of file handling utilities. Concurrent program operation is the normal operating mode, with each operator station capable of executing its own independent program. An operator station may also initiate concurrent background processing by causing a "phantom terminal" to process a noninteractive background batch program. The system includes a set of security protection features,

including password protection of system facilities and files, at several privilege levels. System use accounting maintains and reports terminal usage time, CPU time, and disc storage statistics.

RTOS uses Business BASIC, which has special facilities for data management. Business BASIC is an interpretive system, with program swapping used to control active program time-sharing. Arithmetic precision can be up to 14 digits in accuracy, and a full set of matrix arithmetic operators are supported. Program segments may be linked together by means of a CHAIN statement, and machine language subroutines may be executed by a BASIC program by use of the CALL verb. An unusual verb of the language is SIGNAL, which allows one terminal to communicate with another by sending and reading semaphore variable values.

All system file formats are supported within the BASIC language, and extensive print line formatting features are available. Program error occurrence can optionally be placed under control of the program through error branching facilities.

Application Programs. Randal also maintains and markets a program library, consisting of a variety of application and utility programs. All programs in the library are unbundled and have been developed by Randal, various distributors, or end users. Included in the library are such systems as RANDATA, a self-contained data entry system allowing the on-line creation and maintenance of data files, and RANTEXT, a comprehensive text processing system. Commercial application packages are also available for payroll, inventory control, accounts payable and receivable, and general ledger.

MAINTENANCE

Maintenance of Randal systems is performed by Randal within the southern California area, and by the service organizations of Sorbus, Raytheon, or Olivetti in other parts of the country. Service representatives usually restore operation in no more than 4 hours after placement of a service call.

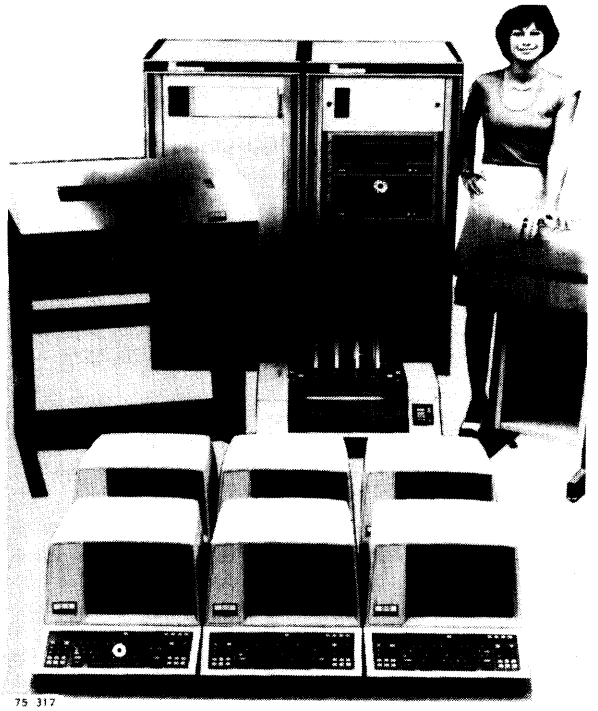
PRICE DATA

Model Number	Description	Purchase Price (Maint. not Included) $	Monthly Maint. $
RDS LINK 100			
100-032	LINK-100 with 32K-byte memory, 960-char CRT console, single diskette drive, RTOS, Business BASIC	12,000	100
	Additional 16K memory	1,900	5
	Second additional 16K memory	1,500	5
2102A	Diskette Drive, 630K bytes	1,500	10
920	Single Line Adapter, async	950	10
923	Single Line Adapter, sync	1,400	10
924	Four-Port Line Adapter, async	1,500	15
925	Eight-Port Line Adapter, sync	2,500	15
RDS 300			
300	System 300 with 32K-byte memory, 960-char CRT console, 5.8MB cartridge disc drive, RTOS, Business BASIC, choice of printer		
310-032	With 70-lpm Matrix Printer	33,500	235
320-032	With 300-lpm Matrix Printer	36,850	260
325-032	With 300-lpm Chain Printer	42,450	265
330-032	With 600-lpm Chain Printer	46,450	330
RDS 400			
400	System 400, like System 300 but with 11.6MB cartridge disc: add to System 300 prices	2,000	40
2301A	Cartridge Disc Drive, 5.8MB (System 300)	8,750	75
2401A	Cartridge Disc Drive, 11.6MB (System 400)	10,750	115
926	Eight-Port Line Adapter, async (System 300 or 400)	3,900	20
913	Single Line Adapter, sync (System 300 or 400)	1,950	13
914	Single Line Adapter, async (System 300 or 400)	1,000	10
1104	CRT Terminal, 960 chars & keyboard	2,950	25
1105	CRT Terminal, 1,920 chars & keyboard	3,450	30
1202	Printing Terminal, 30 cps, 132 cols, matrix char, keyboard	3,450	30
1203	Printing Terminal, 30 cps, 132 cols, letter quality, keyboard	6,500	45
1204	Remote Printer, 180 cps, 132 cols	7,400	55
3101	Printer, 30 cps, 132 cols	4,200	40
3102	Printer, 70 lpm, 132 cols	7,450	55
3201	Printer, 300 lpm, chain, 132 cols	16,950	85
3202	Printer, 600 lpm, chain, 132 cols	21,500	150
4101	Tape Drive, 9-track, 800 bpi, 12.5 ips	8,900	75
4103	Tape Drive, 9-track, 800 bpi, 45 ips	10,950	100
4104	Tape Drive, 9-track, 1,600 bpi, 45 ips	13,950	120
1501	Card Reader, 450 cpm	5,100	53

Software	Purchase Price $
Program System	
Text Editor	100
RANDATA	500
RANTEXT	1,000
2780 Emulation (point-to-point)	500
2780 Emulation (multipoint)	700
RANCOM, async point-to-point communication	500
RANCOM, multipoint	700
Accounts Receivable	2,000
Accounts Payable	1,000
General Ledger	2,000
Payroll	2,000 + 200/state
Entry Processing & Inventory Control	3,500
FACTS	5,000 + 200/state
RANMIS	8,000 + 200/state

RAYTHEON DATA SYSTEMS CO.

PTS/1200 System



OVERVIEW

Raytheon, in September 1975, introduced the PTS/1200, a system that it believes to be one of the first computers specifically designed for the distributed processing market. The system combines the conventional minicomputer, operator's terminal, peripheral hardware, and specially designed software; it allows remote field locations of large corporations to perform what Raytheon judges to be functions common to offices that are part of a distributed processing network. Raytheon has defined these functions as:

- Source data entry.
- File maintenance.
- Remote batch functions.
- Stand-alone processing.
- Local report printing.
- Terminal emulation.

The support provided by the preceding six functional areas ripples out and becomes the basis for a great number of business applications. While an individual installation's stand-alone programs must be written by the user, Raytheon feels that its MACROL compiler language and AUTOQUERY software package provide the basic tools for carrying out individual application needs. MACROL has been developed specifically for a display-oriented system; it is accompanied by disc-resident utilities and debugging aids. AUTOQUERY is a preprogrammed package that is ready to use the moment the system is installed; it provides standard routines for basic data entry, file generation, and format creation. Keyboard commands implement AUTOQUERY and permit the user to begin building data files while application programs are being written.

In effect Raytheon is providing the user with local data entry and local processing capabilities (including local file management), along with communications capabilities. The result is a hybrid small business computer with key-to-disc, remote batch, and intelligent terminal capabilities.

The PTS/1200 can be configured with 48 to 128K bytes of semiconductor memory, up to 24 locally connected operator's displays, and up to eight input/output channels. The processor has a 1.0-microsecond cycle time. See Table 1 for systems specifications.

Peripherals for the PTS/1200 include a 2.5MB removable disc (up to eight drives per system), Philips-compatible removable cassette, three models of printers (100 cps, 165 cps, 300 lpm), and a card reader (300 cpm).

The operator's display and keyboard consists of a 15-inch diagonal video screen that has a display capacity of 480, 960, or 1,920 characters, and a standard typewriter keyboard with numeric pad.

Binary synchronous communications up to 9,600 bps are supported by the PTS/1200. Emulation for IBM's 3270 interactive display terminal or 2780 remote batch terminal is also part of the PTS/1200's communication package.

Raytheon describes itself as "a quiet presence" in the intelligent terminal market. It views the introduction of the PTS/1200 as the third stage in a marketing plan that will "make Raytheon Data Systems one of the nation's largest suppliers of intelligent processing systems."

So far, all seems to be going according to plan. To date, the company has more than 15,000 products installed. Its current product line consists of the PTS-100 programmable terminal system, the RDS-500 minicomputer system (both the PTS-100 and RDS-500 hardware and software experience has been incorporated into the PTS/1200), and a line

HEADQUARTERS

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Table 1. Raytheon Data Systems PTS/1200: Specifications

Processor	
Main Memory	48-128K bytes
Increment Size	16K bytes
Cycle Time	1 μsec
Languages	MACROL (compiler)
No. of Instructions	110
Operator's Console	
Keyboard	69 or 81 keys
Display	15" diagonal
Display Capacity	480, 960 or 1920 char.
No. of Displays/System	Up to 24
Peripherals	
Disc	2.5MB/disc
Max. No. of Disc Drives	8
Tape Cassette	Up to 2 Philips cassettes
Serial Printers	100, 165 cps
Line Printer	300 lpm
Card Reader	300 cpm
Communications	
Line Discipline	Bi-sync (BSC 1, 2, or 3)
Transmission Rate	Up to 9600 bps
Transmission Code	EBCDIC
Emulation Mode	IBM 2780 or 3270

of microwave transmission systems. Roughly 1,000 PTS-100 units are shipped per month.

Rental prices for a basic PTS/1200 system begin at approximately $1200/month and purchase at $28,500. Initial deliveries began in September of 1975.

PERFORMANCE AND COMPETITIVE POSITION

If past performance of Raytheon's products is indicative of future success, the PTS/1200 will be the feather in Raytheon's cap. Behind it stands the proven hardware capabilities of the PTS/100 (the PTS-100 processor is being used for the PTS/1200) and the software experience gained from both the PTS-100 and the RDS-500 (Raytheon's minicomputer). What Raytheon can offer interested PTS/1200 customers is a reliability gained from experience.

The key word in Raytheon's marketing efforts has been and remains "selected." They sell selected and well-defined products to selected markets. The PTS/1200 continues this Raytheon tradition; it is meant as a distributed information system for distributed processing networks. Raytheon appears confident that distributed processing is more than a buzz word and that there is a viable market for genuine distributed processing systems. However, distributed processing, at the moment, is a concept defined by the user to meet individual and specific processing requirements. If the capabilities of a given system are broad enough, it can be said that the system is readily adaptable for most distributed processing requirements. Thus, the burden lies on the user to discover which system and which company will provide the capabilities and the support needed for his particular applications.

Distributed Processing

Raytheon's concept of distributed processing is as follows:

- Distributed processing is meant for decentralized, large companies.
- Distributed processing allows jobs to be split between the local terminals at local sites and the central processor at a central site. In this way, the central processor can do what it is designed to do best — repetitive jobs that require fast, efficient processing — and the local site terminals can do what they are designed to do best — enter clean data at the source site and handle interactive jobs and local files.

Raytheon traces the migration toward distributed information networks to several factors: the desire to move the preparation of information closer to the source; the need to relieve mainframes of the burden of extraneous work; the desire to improve the responsiveness of the local system to local needs; and the wish for distributed data bases.

Instead of designing a system that can be *used* in a distributed processing network, Raytheon has designed a system *specifically for* the distributed processing market.

While competitive systems from all segments of the marketplace (this would include minicomputers, intelligent terminals, key-to-storage systems, small business computers, A/N displays, and teleprinters) claim to have some distributed processing features and capabilities, in reality the PTS/1200's only direct competitors are the IBM 3790 Communication System and the Four-Phase Systems IV/40 and IV/70. The IBM 3790 was an important development; it marked a shift from IBM's tendency toward heavily centralized systems and a recognition of the distributed processing concept. However, IBM's success thus far with the 3790 has not been great. By forcing users to operate the 3790 in an SNA (Systems Network Architecture) environment only, IBM has limited the range of customers who are willing or ready to entrust their networks to IBM's new communications "game plan." But IBM still believes in the distributed processing market and the 3790, and has recently enhanced its capabilities to include a key-to-disc option — the 3760 Data Entry Configuration.

Four-Phase Systems was one of the pioneers in what is now called distributed processing. Its System IV/40 and IV/70 offer the user a wide variety of intelligent terminal systems to choose from. Network Transaction Processing (NTP) and Data IV/70 Version 3 software packages enhance the capabilities of Four-Phase's local site terminals. Large capacity discs, 2.5 and 66MB, are also available for use with the System IV/70. The recent announcement of Four-Phase's NP/80 Network Processor, which works in conjunction with System IV/40 and IV/70, adds a further distributed processing dimension to its product offerings. The NP/80 can support up to 270 MBs of disc and a large number of terminals. The NP/80 is the middleman between remote Four-Phase IV/40 and IV/70 systems and a host mainframe. Thus processing and data files can be arranged

in a hierarchy of responsibility, such as a district, regional, and headquarters scheme of organizational divisions.

Four-Phase Systems uses a subset of COBOL for programming; however, Raytheon finds COBOL a rather cumbersome language to work with when a large number of terminals are being used. In response to this discovery, Raytheon has designed the MACROL language, which is specifically oriented toward handling the needs of distributed information networks.

Additional competition comes from products which, because of their emulation capabilities, will fit into just about any kind of information network. Thus, they also become prime contenders in the distributed processing marketplace. So, like the major intelligent terminal manufacturers and some small business computer manufacturers, Raytheon uses its terminals' capability to emulate the major IBM products (particularly the ever-popular IBM 3270 display terminal) to expand its user base. The emulation capabilities create a transparency between the original products and the PTS product line. Banking, travel, insurance, and credit authorization organizations are typical of firms that already operate with some kind of computer network; Raytheon hopes to convince these users that the PTS/1200 will solve their networking needs.

A Functional Approach

Raytheon has taken the multitude of applications that are performed by any of the following companies — airlines, banks, communications firms, distributors, financial institutions, government agencies, insurance companies, leisure and travel firms, manufacturers, retailers, and utilities — and condensed them into the six basic functions that the PTS/1200 system is designed to perform. These are:

- Source data entry — The PTS/1200 can perform the following: checking, editing, batch balancing, and table validation tasks.
- File maintenance — The PTS/1200 maintains indexed, sequential, and random files. It provides the following file maintenance functions: automatic format creation, file creation, record or file retrieval, and updating of files. The PTS/1200 uses an inverted file structure, not an indexed sequential file structure.
- Remote batch terminal — The PTS/1200 operates in a bi-synchronous mode at speeds up to 9,600 bps in an unattended mode. IBM 2780 emulation is provided.
- Stand-alone processing — While no standard application programs are provided for the PTS/1200, Raytheon believes that all the necessary tools for user programming are provided. MACROL, Raytheon's own assembler language, and AUTOQUERY, the software package for format and file generation, are the tools that Raytheon offers.
- Local report printing — Raytheon offers three models of printers for local report printing. Up to eight printers can be used with a PTS/1200 system.
- Terminal emulation — Besides the IBM 2780, the PTS/1200 can emulate the IBM 3270 Display Terminal. At the present time, the PTS/1200 cannot emulate the IBM 3790 Communication System; however, Raytheon plans to add this emulation capability to its list. Raytheon is probably waiting to see how popular the enhanced 3790 system proves to be (as are most other independent manufacturers) before committing itself to a 3790 plug-compatible product.

CONFIGURATION GUIDE

A typical PTS/1200 configuration includes a 16-bit processor with a 48K-byte MOS memory (expandable to 128K bytes in 16K-byte increments); one tape cassette drive for system generation and diagnostics; up to 24 CRT displays in any mix of 480-, 960-, or 1,920-characters, with either data entry or alphanumeric typewriter keyboards; up to eight local or remote serial printers or local line printers; up to eight 2.6MB fixed or removable disc drives; and a 300-cpm card reader.

Binary synchronous communications up to 9,600 bits per second is supported by the PTS/1200. IBM's 2780 protocol is the PTS/1200's standard communications mode. IBM 3270 on-line terminal emulation is also offered — when this is the case, the IBM 3270 software program replaces the PTS/1200 software system. BSC1, BSC2, or BSC3 line disciplines can be used.

MAINFRAME

The mainframe cabinet of the PTS/1200 houses 48K to 128K of semiconductor main memory and a Philips-compatible, removable cassette for program and diagnostic loading. Separate units house up to four disc drives. A maximum of 24 operator's consoles can be used with each system. Each console comes equipped with a video display screen and typewriter keyboard. Any combination of serial and line printers up to a maximum of eight can be used with the system. They are connected locally up to 4,000 feet away or at remote locations using a 1,200-bps modem (line printers cannot be used at remote locations). Bi-sync communications and IBM 3270 emulation are supported. Peripherals other than disc drives and display terminals are interfaced via a multiplexor channel with eight positions. See Table 1 for system specifications.

Processor

The processor used for the PTS/1200 is the same processor used for the PTS/1200 intelligent terminal. It is a 16-bit general-purpose minicomputer with semiconductor MOS technology and a 1-microsecond cycle time.

I/O CONTROL

An I/O bus with one multiplexor channel is standard on every PTS/1200 system. In addition to the multiplexor channel, up to eight high-speed devices can directly interface the I/O bus. The multiplexor channel has eight subchannels; however, one subchannel is dedicated to

keyboard input from the CRT displays. Up to two more multiplexor channels can be added to a system.

Display adapters connect directly to memory via the memory bus for display and screen refresh. The display adapter connects to the CRT display via a monitor controller. A maximum system can host four display adapters, each controlling either one 1,920-character display, two 960-character displays, or four 480-character displays. The terminals must be located at a maximum of 200 feet from the monitor controller. Using a remote concentrator, up to 16 display terminals can be located at 4,000 feet from the processor.

PERIPHERALS

The Raytheon PTS/1200 can use any of the following peripheral devices:

Display Screen and Keyboard. The display unit is 15-inch diagonal video screen that has a display capacity of 480, 960, or 1,920 characters (upper and lowercase). Full cursor control and insert/delete capability are standard on each screen. Characters are generated in a seven-by-nine dot matrix.

The keyboard is composed of the standard typewriter keyboard with numeric pad and 10 separate function keys. An optional data keyboard is available. The total number of keys on any one keyboard is 69 or 81.

Printers. There are three models of Centronics printers available with the PTS/1200:

- 100-cps, 80-column serial printer. For both local and remote use.
- 165-cps, 132-column serial printer. For both local and remote use.
- 300-lpm, 132-column line printer. For local use only.

An adjustable tractor feed is standard on each printer.

Disc Storage Unit. Each PTS/1200 system has a capacity of eight 2.6MB fixed or removable discs. Maximum disc capacity on any PTS/1200 system is 20.8MBs. Average seek time is 70 milliseconds. Discs are packed to maximize record capacity.

Card Reader. A 300-cpm card reader is available for the loading of application programs or card files.

DATA COMMUNICATIONS

The standard communications mode for the PTS/1200 is the IBM 2780 protocol. When operating in this mode, the PTS/1200 functions as a BSC1, BSC2, or BSC3 class of device. PTS/1200 to PTS/1200 communication can be accomplished with BSC1 or BSC2 communication. Batch transmission may be attended or unattended (under control of the host). As an alternate method of communication, IBM 3270 on-line terminal emulation is supported. When operating in the 3270 mode, the 3270 emulator software program replaces the PTS/1200 software, and the system acts strictly as an IBM 3270 Information Display System. Presently, Raytheon is working on an IBM 3270 enhancement package. Interactive batch transmission takes place in an attended mode.

Transmission rates for the PTS/1200 are 2,000 to 9,600 bits per second; code is EBCDIC. The PTS/1200 works in point-to-point, multipoint, or polled data networks.

Emulation for IBM's 2780 remote batch system or IBM's 3270 display terminal for interactive transmission is offered. While emulation capabilities have always been the *raison d'être* for so-called distributed processing systems, with the advent of such protocols as IBM's SDLC and Burroughs' BDLC (Burroughs Data Link Control) the real power of any distributed processing network will be proven only if it has the ability to emulate these (and other) new protocols.

SOFTWARE

The PTS/1200 functions under a disc operating system that handles multi-tasking and multiprogramming automatically. Memory resources are handled virtually; lower priority programs (usually batch) are rolled out if core is full when higher priority programs (keyboard-initiated) are called up. Up to 20 tasks running simultaneously have been field proven on the PTS/1200. Tasks are defined by Raytheon as any activity related to a system device; for example, if four displays and four printers are used with the PTS/1200, eight tasks can be performed simultaneously. These tasks can be running under the same program or a mix of programs.

AUTOQUERY is the software package designed by Raytheon to work along with the PTS/1200 keyboard. The 10 function keys on the operator's keyboard are used for screen format generation, querying the data base, data base sort/merge routines, report format generation, and listing the data base.

With AUTOQUERY, the user can establish his own primary and secondary key functions. Also, AUTOQUERY'S preprogrammed functions permit the user to build and work with files even before application programs have been written.

Utilities, programming, and debugging aids are all disc resident. There are 25 PTS/1200 utilities covering program support, disc management routines, date and time setting, and error logging.

Languages

Raytheon has also developed its own language for the PTS/1200. MACROL, a high-level language, is written in 110 macro statements and has been developed specifically for display-oriented systems. Raytheon believes that COBOL, the business language employed by many of the

terminal manufacturers, is not well suited for use with a large number of terminals.

MAINTENANCE AND SUPPORT

Raytheon services the PTS/1200 from 73 service centers located in major U.S. cities. Maintenance costs include preventive maintenance and standard 5-day-a-week prime time service. Extended maintenance service contracts can be negotiated on an individual basis with Raytheon.

A unique service that Raytheon offers is a customer monitoring service center located at the company's headquarters in Norwood, Massachusetts. Using its own equipment, Raytheon monitors all installed, domestic equipment. Any system that is down for more than 2 hours is brought to the attention of a Raytheon service center. Also, the center maintains files on each system for preventive maintenance purposes.

PRICE DATA

Typical Configurations Description	Monthly Rental (1 yr lease inc. maint) $	Purchase (maint. price not incl $	Maint $
2 displays (1,920 char), 48K byte processor, 2.5MB disc, 100-cps printer, cassette, and communications	1,278	36,060	222
4 displays (1,920 char), 48K-byte processor, 2.5MB disc, cassette, and communications	1,271	28,500	165
6 displays (1,920 char), 64K-byte processor, 5MB disc, 100-cps printer, cassette, and communications	1,636	47,280	315
8 displays, (1,920 char), 64K-byte processor, 5.0MB disc, 100-cps printer, cassette, and communications	2,039	57,840	340
8 displays, (1,920 char), 64K-byte processor, 5.0MB disc, 300-lpm printer, cassette, and communications	2,384	66,840	383

OVERVIEW

Singer's System Ten is a well established small business computer system aimed at novice small-business computer users and at large organizations with scattered work locations needing a network of input terminals. System Ten is sold both as a turnkey system and as a user-programmable system with an RPG compiler. It has a series of models based on application type: the 110 models for various types of business accounting and data entry, the 210 models for general-purpose processing, the 310 models for communications applications and the 410 models for various types of data collection.

The system is characterized by its comparatively modest cost, its flexibility and its ease of operation. System Ten is unique — it does not have an operating system. Instead it employs up to 20 hardware partitions plus a common memory area to control multiple jobs operating concurrently. Memory size ranges from 10K to 110K words. The multiprogramming is provided by a round-robin, time slicing priority system that is monitored by hardware without the use of an operating system or an operator.

Although System Ten does away with traditional operating systems and operators, it does offer a wide variety of applications packages including: System Program Applications providing a wide variety of general accounting capabilities, the Singer On-Line Interactive Driver (SOLID), the Client Accounting System (CAS) for certified public accountants, the Factory Information and Control System (FICS) and the Medical Management Information System. In addition, economical turnkey systems can be developed by Singer by customizing the packaged systems. For users who want to do their own programming, an RPG compiler and an assembler language are available.

System Ten requires little user training to operate its standard and special-purpose I/O terminals. The terminals are designed for use by clerical personnel, sales personnel, factory workers, hospital orderlies, and others. Users report as little as 2 hours instruction are needed before an untrained person can comfortably use the system.

System Ten's field expandability permits operator stations or more storage modules to be added at the installation site without interrupting the operation. As a result, users can start out with small systems and expand to larger configurations as needed.

The System Ten is flexible. It provides on-line information storage and retrieval with up to 20 simultaneous users and 200 I/O devices on a single system. It can serve as a remote processor and I/O terminal for a larger central computer such as an IBM System/360 or 370. The System Ten can combine batch processing with interactive operations.

Most System Tens are disc-based. Peripheral devices include printers, card and paper tape I/O, magnetic tape drives, CRT and other terminals, and communications. Special-purpose peripherals include employee badge readers and cash-register-type terminals with merchandise tag readers.

Singer has grown to be an important supplier at the lower end of the computer market. It sells remote batch

terminals (Singer M & M division), calculators and accounting machines (Singer-Friden) and various other computer-related and computer based systems. Probably its most famous product in the computer market is the MDTS intelligent point-of-sale terminal, which was the first really successful POS system.

System Ten was first delivered in 1970. General product specifications are presented in Table 1.

Table 1. Singer System Ten: Specifications

PROCESSOR	
Main Memory (kc)	10-110
Char Size (bits)	6
Addressable Registers	3/partition, except common
Cycle Time (μsec)	3.3
No. Of I/O Channels	1 slow-speed/user partition; 1 high-speed (FAC)
Max Devices/Channel	10
AUXILIARY STORAGE	
Storage Medium	Disc
Capacity (mc)	4; 160
Transfer Rate (kc/sec)	229
DATA ENTRY	
Keyboard	Workstation; includes serial printer (15-25 cps)
Card Reader (cpm)	300
Paper Tape Reader (cps)	275
DATA OUTPUT	
Card Punch (cpm)	100
Paper Tape (cps)	150
Line Printer	132 col; 110-450 lpm
CRT Display	80 col x 20 lines
SOFTWARE	
Operating System	Multipartitioning via hardware
Assembler	Yes
Compiler	RPG

COMPATIBILITY

All System Ten configurations are upward compatible with each other. Additionally, the System Ten is compatible with the various Singer special-purpose peripherals such as the MDTS point-of-sale system and the job information system (JIS). The languages supported by System Ten are not compatible with those of any other computer; however, data format is compatible with IBM System/360 and 370 equipment in all categories except disc files.

Internal data format in System Ten uses a 6-bit subset of ASCII. For 9-track magnetic tape output, data is converted to ASCII and written on the tape in a format compatible with that used by most other manufacturers' tape drives.

PERFORMANCE AND COMPETITIVE POSITION

System 10's wide range of configurations and well-developed application packages permits the system to compete with a wide variety of systems. A competitive list would include a sampling of systems from both intelligent terminals and small business computers.

At the smallest system sizes, System Ten competes with smaller interactive systems. Competition, however, does not extend downward to the office computer market, which is addressed by systems like NCR's 299 and the smaller members of Burroughs L Series (which resemble accounting machines) and the Wang 2200 and Hewlett Packard 9830 (which resemble calculators).

Competitive market identification depends on the specific series and model of the System Ten line. The 110 series of models compete in the interactive accounting market with systems such as the Burroughs 700 Series and Basic Four models. The lone 210 model is a small general-purpose communications system offering competition to systems such as the Burroughs B 1712 and L 8000. The 310 series offers models that compete as intelligent remote batch terminals or large versions of general-purpose communications systems. Intelligent terminal competition would include Four-Phase IV/70 systems; the general-purpose competition would come from Burroughs B 1726 and 1728 models. The 410 series is aimed at the specialized application market offering large and small versions of data collection, factory information and job accounting systems. In all these markets, it is the larger time-sharing type applications that show System Ten's unique capabilities to the best advantage.

USER REACTIONS

Comments from users indicate that System Ten was selected after comparisons with all other makes on the market led them to believe that, for the price, no other system offered the same advantages of on-line interactive processing combined with the modularity that permits easy growth. Users feel that System Ten requires little training, because any clerk typist can operate a terminal after a few hours of instruction.

In addition, users of larger computers are finding System Ten a useful supplement to or substitute for the larger computer. They are installing System Ten because of the advantages of having one or more small flexible computers in-house and dedicated to a specific project, rather than having to share a larger computer located elsewhere.

Some applications using System Ten include the following.

Hospital

A large general hospital developed manual procedures over a period of 5 years to identify where drugs, supplies, and services such as surgical, nursing, and laboratory were used; to control inventory of drugs and supplies; and to bill patients for these items.

This hospital eventually needed a system that could be on-line 24 hours per day, could be run by hospital orderlies or unskilled personnel, and would cost less than time on a large computer. The hospital investigated the

capabilities of IBM System/360 Model 40 and DEC's PDP-15 Series before looking at Singer System Ten. Features of the System Ten that held appeal and led the system's installation in the hospital were the combination of lower-cost, hardware-controlled multiprogramming; on-line conversational terminals; simultaneous operation of programs; ease of expanding the system for future growth; and the convenience of having small functional units that are job-oriented. This hospital has installed System Ten, using two computers with eight CRT terminals and two typewriter-type workstation terminals, for inventory control and billing of customers. Supplies used, and doctor's and nurse's services, can be billed to each patient. A simple system in which information is typed by hospital orderlies at a terminal, for use in billing as well as automatic inventory control and reordering of supplies, has enabled the hospital to perform more accurate inventory control 24 hours per day; the system has also reduced inventory from a 150-day stock level to a 30-day level, as well as decrease losses on inventory items by more than $500,000 a year.

Aircraft

A large aircraft manufacturer with eight scattered facilities used to depend on manual clerical procedures to obtain information on the status of all manufacturing operations. Major considerations in the selection of a new system were flexibility to support a number of systems, capacity to handle more information, operating simplicity, and ability to handle transactions quickly with an audit of data entered. Singer System Ten met these requirements, and within an economical price range.

Eleven System Tens are installed as remote processors and input terminals for large IBM System/360s. Input to the System Ten computers is from 492 job information stations and 140 attendance terminals (badge readers). Job information stations are programmed to display information pictorially. Data from 16,000 hourly workers forms a massive data base that supports 18 major information systems. The terminals are used to record time, attendance, and work in progress. At 7:00 a.m. each day, action reports are available for shop foremen to use in scheduling, determining priorities, and planning manpower and equipment requirements.

Sales

A company with many sales representatives, selling cosmetics directly to about 50,000 customers, has installed three System Tens with seven on-line CRT terminals and an array of data terminals for a point-of-sale data collection that is being enlarged from about 20 terminals to about 70. One System Ten is used for inventory control, another for general ledger and accounts payable; the third System Ten is used for data on sales to the 50,000 customers. This system polls the remote locations. As the company opens more outlying locations, it plans to install more data terminals.

Retail/Mail Order

A very large chain of retail stores and mail order catalog facilities, with 836 stores and more than 1,200 catalog sales offices, as well as warehouses and business offices, has installed a large network of System Ten computers with Singer Data Terminals for point-of-sale data collection; the systems serve as remote data collectors and processors for 33 IBM System/370s. There are 200 System Tens connected to up to 18,000 Data Terminals.

In addition, the chain of stores is experimenting with reading wands attached to the data terminals for reading credit cards and sales tags. This technique not only speeds up checkout lines and cuts credit losses, but also it controls inventory, assists in ordering, provides sales data, handles numerous accounting and personnel records, and ties in about 1,000 of the company's largest suppliers to the purchasing offices.

University

A large state university has installed a System Ten with 30K core for scheduling bookings of rental films that are distributed to schools across the state. The film library has more than 9,000 film titles, with one to 35 prints of each film. Schools order a film for as many days as needed. Scheduling must be done as much as 16 months in advance; there are as many as 120,000 bookings per year.

One requirement that the library expected the computer to meet was the on-line retrieval of information. Singer System Ten was the only computer that met the requirements of low cost, on-line processing, and flexibility to perform various functions. IBM System/3 was not on-line, but merely card based.

Now, with a System Ten and an on-line interactive terminal, the personnel can determine immediately if a request can be honored on the date requested, or if alternate dates are available. The computer prints shipping documents for confirmed bookings and can report on failures to book as requested, thus pinpointing the need for additional prints of some films. Use of its System Ten has enabled this film library to handle requests more efficiently and to reduce the costs of manpower and film rental.

Life Insurance

A large life insurance company uses a large computer, and has more than 65,000 computer reels that it needs in processing insurance transactions that used to be manually card indexed. The facility needed to improve turnaround time on jobs and decrease the number of lost-reel searches. At the same time, the tape library was growing fast; there was an additional need for features that would enable keeping track of maintenance information.

Before deciding on the Singer System Ten, management compared prices of alternatives. The manual system was costing $98,000 a year; to use an in-house telecommunications system (IBM) would cost $250,000 a year, while a modified version of this would cost $134,000 a year.

The cost of the Singer System Ten was estimated at $61,000 a year. It is used with on-line terminals to index tape reels, provide on-line reel status information, supply information needed to bill charges to user departments, and furnish maintenance reports needed for cleaning and recycling tapes. System Ten is online 24 hours per day, has saved up to $20,000 a year in employee time over the manual system, and has allowed the company to provide better service.

Auto Parts

An auto parts dealer with remote branches has installed a System Ten with online terminals for inventory control and shipping of more than 45,000 auto parts.

CONFIGURATION

System Ten is built around three basic processor models which differ mainly in memory and I/O capacity: Model 24-1 can include 10K-20K bytes of memory and a single I/O channel, Model 24-2 can include 10K-40K bytes of memory and up to four I/O channels and Model 21 can include 10K-110K bytes of memory and up to 20 I/O channels. The number of I/O channels reflects the number of user partitions. Each I/O channel (partition) can attach up to 10 devices, but they all must be the same device or in the same "family" of devices; certain readers and punches can share partitions. The high-speed FAC channel is used to attach the disc — maximum disc capacity is now 160M bytes; each system can have 1 FAC.

Singer has reorganized the models of the System Ten line and expanded the applications software, so delineation of various types of turnkey systems are easier. Current models consist of the following:

- 110-1 and 110-3: small interactive accounting systems with one terminal, either a keyboard-printer (110-1) or a keyboard-CRT (110-3); 110-3 has an additional serial printer.
- 110-4 and 110-5: interactive accounting systems capable of processing up to three tasks simultaneously, with keyboard/CRT input.
- 210-7: a basic general-purpose system capable of attaching all peripherals, except data communications, POS, or data collection; expandable up to a system maximum of 110K memory and 20 partitions.
- 310-4 RJ: RJE terminal with no disc, limited expansion.
- 310-5 TP: RJE terminal with disc for some local processing; limited expansion.
- 310-7: a complete communications-oriented system capable of expansion up to 20 partitions and 110K bytes of memory.
- 410-4: either a time and attendance or a job information system with limited expansion.
- 410-5: the FICS Factory Information System with limited expansion.
- 410-7: data collection system combining time and attendance, job information system, and expansion capabilities up to system limits.
- 410-8: FICS system capable of expanding up to system limits.

The minimum configurations for these systems is presented in Table 2. Those models designated as limited in expansion usually can only substitute a higher speed device (such as substituting model 54 line printer for the model 52 serial printer on 410-5) or can add more of the same type of device (such as adding up to nine more time and attendance terminals on Model 410-4). The capabilities of the different peripheral devices are discussed later in the PERIPHERALS section.

MAINFRAME

Mainframe specifications for the System Ten appear in Table 1.

Central Processor

Data Structure. System Ten uses 6-bit characters. Data fields are variable in length and can contain up to 10,000 characters, depending on the instruction being executed.

Instruction Set. System Ten uses 13 machine instructions. Each machine instruction word is 10 characters long. Most instructions specify two operand addresses; each operand address is four characters long.

The operand fields have an alternate usage in I/O instructions. One operand field becomes the address of the I/O area, and the other the data count. If the addressed device is a disc, the second operand field is treated as an indirect address. All disc transfer must be 100 characters, so it is unnecessary to specify the count for disc operations.

Addressing Facilities. Every location in core can be addressed directly. A program instruction can directly address any location in its partition (10K maximum) and any location in Common (which is expandable to 65K in the Model 21 processor). Indirect addressing is available on the Model 21 processor. When an address in an instruction is indexed, the contents of the selected index register are added to the address. Indexing of one operand address requires 31.1 microseconds, and indexing of both operand addresses requires 58.9 microseconds. There is no double indexing in System Ten.

Interrupt Control

Interrupts occur as a result of program checks and imitiation of I/O instructions. When a single character is

Table 2. Singer System Ten Models

MODEL	110-1	110-3	110-4	110-5	210-7	310-4
PROCESSOR	24-1	24-1	24-2	24-2	21	24-2
MEMORY, char						
Min	20K	20K	30K	30K	20K	10K
Max	20K	20K	40K	40K	40K	30K
I/O CHANNELS						
Min	1	1	2	2	2	2
Max	1	1	4	4	20	3
MINIMUM CONFIGURATION						
Disc, bytes	8M	8M	8M	40M	40M	–
Mag Tape	–	–	–	–	–	
Printers, lpm	–	165 cps	200	200	165 cps	125
Communications	–	–	–	–	–	Yes
CRT	–	1	1	2	1	1{Opt(4)
Workstation	1	–	–	–	–	1{Opt(4)
TAT Term(1)	–	–	–	–	–	–
TIS Term(2)	–	–	–	–	–	–
EXPANSION						
Limited	X	X	X	X	–	XX
Nearly All(3)	–	–	–	–	X	–
ORIENTATION	Data Entry and Accounting				General Purpose	Data Communications

MODEL	310-5	310-7	410-4	410-5	410-7	410-8
PROCESSOR	24-2	21	24-2	24-2	21	21
MEMORY, char						
Min	10K	20K	30K	40K	40K	40K
Max	30K	110K	40K	40K	110K	110K
I/O CHANNELS						
Min	2	2	2	2	2	2
Max	3	20	4	4	20	20
MINIMUM CONFIGURATION						
Disc, bytes	10M	20M	10M	20M	10M	40M
Mag Tape	Yes	Yes	No	No	Yes	Yes
Printers, lpm	125	125	100	100	100	125
Communications	Yes	Yes	Yes	Yes	Yes	Yes
CRT	2	1	1{Opt(4)	2	–	1{Opt(4)
Workstation	–	–	1{Opt(4)	–	1	1{Opt(4)
TAT Term(1)	–	–	1{Opt(4)	–	–	–
TIS Term(2)	–	–	1{Opt(4)	–	1	–
EXPANSION						
Limited	X	–	X	X	–	–
Nearly All(3)	–	X	–	–	X	XX
ORIENTATION			Data Collection			

Notes
(1) Time and Attendance Terminal.
(2) Job Information Station.
(3) Model 210-7 Cannot attach Communications, P.O.S. Terminals or Data Collection Terminals; Model 410-7 and 410-8 cannot attach to Model 42 split disc.
(4) The minimum system contains one or the other but not both.

ready for I/O transmission, an interrupt is signalled by the IOC. The processor temporarily stops processing in whatever partition it is currently working, transfers the character, then resumes processing where it left off. If the processor should switch to a partition in which an I/O operation is in progress, it immediately switches to the next partition.

There are six causes of a program check: an out-of-limit address, a privileged area violation attempt, an attempt to store the protected area of common, an invalid op code, bit 5 in any character of an instruction not being a 1 (Model 20 processor only), and a binary-coded-decimal value in excess of 9 in the numeric portion of a character fetched by the ACU.

Main Memory

Hardware partitioning divides main memory into partitions, with the size of each partition ranging from a minimum of 1,000 locations to a maximum of 10,000, in multiples of 1,000. In every System Ten computer, there must be one section of memory, called common, of at least 1,000 locations, and from one to 20 user partitions. Thus, a minimum configuration of 10K might contain one core module divided into a 1,000-location common area and a 9,000-location user partition. (Memory allocation is done by the Singer customer service representative at the time of installation, and can be changed easily by him when the need arises.)

Storage allocated to a partition is accessible in one of two ways: to a program resident in that partition and to a program in common that has been activated by the same partition. In either case, the storage is accessible only during the time slice alloted to that partition. Common does not have its own time slice; instead, programs in that area are activated by branching from a partition's program, and remain active only for the duration of the calling partition's time segment.

Reserved Storage. The first 300 character locations of Common are protected from program alteration although they can be examined by any program. In this protected area, each partition has three fields used for storage and maintenance of program status and I/O control information. In the remaining common area, 1,000-character segments, which are contiguous, can be designated as privileged area of common (Model 20 only).

Input/Output Control

I/O control is established via the IOC for slow-speed devices (card readers and punches, paper tape readers and punches, line printers, and terminals) and the FAC for high-speed devices (magnetic disc and tape). The channel concepts are second generation in origin and result from the lack of an operating system in the System Ten.

IOC. A dedicated IOC is associated with each user partition and can control up to 10 devices. Data transfer via IOC is overlapped with processing on a cycle-stealing basis. Each IOC can support a data transfer rate up to 1.5K characters per second.

FAC. Each user partition shares the single FAC to access the magnetic disc and tape files. This architecture is necessary in order not to duplicate files used simultaneously by several partitions. FAC supports data transfer rates up to 330K characters per second. FAC can handle one tape controller with up to four tape drives, as well as one disc controller with up to 10 disc drives (an additional controller is needed for more than four discs). Devices on the FAC are available to all partitions although, through programming, it is possible to allocate these resources selectively by partition. Operations on the FAC must proceed sequentially; they will halt all processing activities but not operations currently proceeding on the IOCs.

Special-Purpose Channels. System Ten supports optional synchronous (SCA) and asynchronous (ACA) communications adapters and an asynchronous terminal adapter (ATA). SCA and ACA each replace two regular I/O channels and each attach to one user partition. ATA replaces one I/O channel and is attached to one user partition. Other partitions communicate with the SCA, ACA, and ATA partitions via the common partition or disc or magnetic tape.

SCA allows programs to be transmitted between System Ten and remote computers via voicegrade communications lines. Over SCA, transmission can be 2,400 bits per second when over a dedicated line using a Bell Series 201 data set, up to 9,600 bits per second over a dedicated line using non-Bell data set, or 2,000 bits per second over the switched (DDD) telephone network, respectively.

ACA allows data to be transmitted over voicegrade lines between System Ten and asynchronous ASCII terminals, and to receive from Model 800 individual store-and-forward modules. Over ACA, transmission rates up to 1,800 bits per second are selectable under program control.

ATA allows data transmission between System Ten and low-speed operator-oriented terminals over voicegrade lines. Nominal transmission rate is established by hardwired connection and is from 110 to 300 bits per second.

PERIPHERALS

System Ten has a complement of slow-speed, high-speed, and special peripheral devices.

Slow-Speed Devices

Models 50 and 52 Line Printers — 132-columns; Model 50 prints up to 450 lines per minute; Model 52

prints up to 110 lines per minute; buffer store for two lines of print; attaches to CPU through the I/O channels.

Model 53, 54, 55, 56 Line Printers — all four use standard 64-character print set; six lines per inch; 120 print positions; respective speeds are 125 lines per minute, 200 lines per minute; 300 lines per minute; and 400 lines per minute; options include 132 print positions; eight lines per inch, OCR A and B print drums, and 12-channel VFU tape for vertical tabbing.

Model 30 Card Reader and Model 35 Punch — 80-column, 300 card-per-minute reader attaches via an I/O channel; 100 card-per-minute, punch connects to the CPU through a multiterminal I/O channel; up to 10 readers or nine punches can be serviced by a single partition.

Model 31 Card Reader — reads 20, 51, 80, or 96-column cards at 300, 600, or 1,000 cards per minute (selectable at time of purchase.)

Model 60 Paper Tape Reader and Model 65 Punch — reads continuous reels or strips of punched tape at 275 characters per second; Model 65 can punch 150 characters per second; up to 10 readers and punches can be serviced by a single main memory partition.

High-Speed Devices

Model 40 Disc Drive — 10 million characters; average access time 73 milliseconds; data transfer rate 229,000 characters per second. Up to 10 drives on-line to the central processor, providing up to 100 million characters of storage. The disc drives are linked to the CPU through the disc controller on the FAC. When more than four drives are used, the fifth and successive disc drives require an auxiliary disc controller rather than regular controller. Each disc read or write involves a 100-character transfer.

Model 42 Disc Drive — split-disc drive, features two separate and removable disc packs — one mounted on top of the other in a single unit; resident pack (Model 41A) used for active manipulation and filing of data, which then can be duplicated onto the other pack (Model 41B), called the "removable pack," and stored for file backup; both the resident and the removable packs provide 4 million characters of storage capability; access rate and data transfer rate are the same as for Model 40 disc drive; up to 10 disc drives can be connected to a central processor.

Model 44 Disc Drive — uses removable and interchangeable disc packs with a total capacity of 40 million bytes; four of these disc drives can be attached to the central processor through the disc controller and the FAC; each Model 44 looks like four Model 40 drives (that is, has four logical subdivisions) to the central processor; the Model 44 also can be intermixed with Model 40 or 42 Disc Drives as long as the total number of logical devices does not exceed 10.

Model 45 Magnetic Tape Drive — 9-track or 7-track industry-compatible tape; 556 or 800 bits per inch; 9-track tapes always 800 bits per inch; both 7- and 9-track tape drives have maximum transfer rates of 20,000 characters per second; 7-track drive normally reads and writes the System Ten 6-bit ASCII subset; 9-track drive reads and writes in ASCII; it reads or writes unsigned numeric data in packed format or 8-bit codes, such as EBCDIC, by using a double-frame mode.

Magnetic tape, used as auxiliary storage or as back up for disc, is connected to the CPU via a tape controller.

Special-Purpose Devices

Model 70 Workstation — desk-type data entry keyboard and serial printer output device prints at 15 to 25 characters per second; standard alphanumeric keyboard; prints a 170-character line; pressure-platen forms handler; optional pin-feed forms handler. Operator panel with indicator lights displaying system status can serve as a load device when given device address zero.

Model 80 CRT Display — generates 1,600-character display in 80-column by 20-line format; display is fully buffered; can be programmed to resemble a blank form onto which the operator "types" entries before feeding the entered data to the CPU (shortens the question and response time between the computer and operator); can be located up to 2,000 feet from the CPU; 10 can be serviced by a single I/O channel.

MDTS Data Terminals — have the capabilities of a freestanding calculator, receipt printer, and totalizer; compact units; particularly useful in a retail environment; can be used with automatic tag readers for both detachable and nondetachable merchandise tags, as well as with credit card readers; transaction is recorded on an internally stored audit tape that can hold the details of approximately 400 transactions; CPU can poll each freestanding terminal by telephone line for its magnetic tape contents, and use the data to update the files; tapes from every terminal can be processed at the end of each day or sent out; directly linked terminals can be on-line to magnetic disc and/or magnetic tape files to ascertain customer credit limits, special customer discounts, and so on; up to 180 such terminals can be connected by a simple 2-wire line to a single System Ten CPU up to 8 miles distant; when the MDTS with data terminal is employed with System Ten, other equipment provided by Singer for use with MDTS includes the following: Line Switching Unit (LSU), Model 191; Individual Store and Forward (ISF) Module, Model 800; Asynchronous to Synchronous Transmission Adapter (ASTA), Model 850, Asynchronous Communications Adapter (ACA); and Modular Data System (MDS) I/O Channel.

Model 100 Job Information Station — the JIS is an intelligent terminal; it guides the operator with a series of preprogrammed indicator lights on a display panel. It is used primarily for numeric data entry from a job station to

a remote CPU; it can read punch-coded employee badges and punched cards; it features a numeric keyboard for nonstandard data entry and a set of function keys. JIS applications include monitoring work in progress, with regular reports directly from the manufacturing floor; other manufacturing applications are stockroom, toolroom, and instrument-room inventory control. The JIS can also be used for check-in/check-out stations in libraries and warehouses, and as a nurses' reporting and communications station in hospitals. The badge reader with the JIS can be used separately as an on-line time and attendance recorder.

Model 105 Attendance Station — records employee in-and-out attendance; it is computer monitored and holds information on up to 13 badges while establishing contact with the computer. Each station clock is synchronized with the processor system clock every 10 minutes.

SOFTWARE

The System Ten has no operating system in the conventional sense. It relies on its hardware interrupt schemes; buffered devices; hardware partitioning; and a round-robin, time slicing priority scheme to achieve its multiprogramming environment.

Even so, the environment achieved actually has no priority setup other than I/O interrupts and the 37.5 millisecond time slice (which in an I/O-bound program, or with an unbuffered device, can never be experienced).

Under normal circumstances, each partition must have dedicated to it whatever devices (except discs) that it will use. However, a multipartition loader is available that allows a "blind" partition (core allocated, but no devices) to be used to absorb data from devices otherwise dedicated to another partition.

System Ten supports two levels of assemblers and of RPG compilers, as well as software for communications, business data processing, and disc file management. Since the system is available turnkey, a user doesn't have to worry about being able to find (or having to write) his own application.

The Disc Management Facility (DMF) software utilizes a file organization and access method that enables the user to perform a wide variety of disc operations by entering logical commands through an on-line work station or other input device rather than by executing assembler language instructions. A DMF system can use one to 10 disc packs and is divided into segments called pools. Each pool is given a 1- to 6-character alphanumeric name. The user accesses pools and files by using pool and file names with the control statements.

Communications software is designed solely for data communications processing, in which a Singer System Ten is linked to a remote larger computer, and serves as a remote processor or remote job entry input device for the larger computer. A System Ten also can communicate with another System Ten.

Assembler

The System Ten supports two levels, Assembler I and II. Assembler I is the less-sophisticated card version, while Assembler II is the disc version run under control of DMF. Source input can be a DMF file (accessed randomly by pool name and file name), or it can be input from any input device. Object code and listings can be output in DMF files or routed through any output device. Both assemblers require 9,000 locations in a partition; although Assembler I can use common, Assembler II never does.

Both assemblers allow the user to process data; control the assembly process; format the assembly listing; and to define I/O areas, work areas, and constants. They also allow the insertion of debug instructions and provide an optional cross-reference listing. In addition, Assembler II provides for macro definition and expansion; conditional assembly; assembly-time variables, statements, and functions; extended mnemonics; literals; relocatable object code; a cross-reference listing that shows "where set" and "where used;" assemble-and-execute capability; additional assembler-control statements; indirect addressing; and disc storage of assembler work files, including a symbol table that allows the assembly of a larger program than can be handled by Assembler I.

Report Generator

RPG accepts input specifications from the user, specifying I/O devices, the format of the data file, and the calculations to be performed. Output of the report can be punched on cards, printed by a line printer, routed to a disc file or to a buffer area in common. RPG requires 10,000 locations in a partition and can place the object program generated from the specifications either in a disc file or in a punched object deck.

Communications Software

Remote Job Entry Facility (RJF) comes in a basic version and a disc version. It is a set of programs used by System Ten for communicating over voicegrade lines while appearing as an IBM 2780 Remote Job Entry Terminal.

Thus, with RJF, a System Ten computer can serve as a remote I/O satellite for an IBM System/360 OS HASP system. In this manner, the 360 executes batch programs entered at the remote locations and transmits the output via communications lines to the original terminal, where the output can be printed or punched. One System Ten computer can accomplish up to six HASP-type remote operations. The disc version allows input to the data transmission system from DMF files resident on disc, without preparation of intermediate card decks or paper tape.

Likewise, output received from the HASP system can be spooled to the disc.

Additional communications software includes the synchronous communications access method (SCAM), which is a set of 16 programs that control the synchronous communications adapter (SCA) I/O channel.

Applications Software

Systems Programmed Applications (SPA). SPA is a general accounting package with a great deal of processing flexibility. The SPA package marketed internationally with national versions under the name of STELLA (Latin for "star") — Systems Programmed Applications Reporting. SPA includes the following modules.

- Order entry/invoicing.
- Finished forms invoicing.
- Accounts receivable.
- Accounts payable.
- General ledger accounting.
- Payroll.
- Inventory control.
- Sales analysis.

Singer On-Line Interactive Driver (SOLID). SOLID is an interactive, table-based accounting system. It is a set of programs that provides business processing capabilities, including sales order entry, invoicing, accounts receivable processing, accounts payable processing, inventory control, sales analyses reporting, general ledger processing, and payroll processing. These parts are modular so that the user can purchase or lease only those modules that he needs. Each module can be individually adapted at modest cost. Minimum hardware configuration includes one workstation (used for messages from the system and responses with requested data from the operator), one disc drive, and a 10,000-location common partition with one 10,000-location user partition.

Factory Information and Control System (FICS). This software Package provides extensive capabilities to factory management. It can run on the smaller 410-5 or on a more expanded 410-8 configuration modules include:

- Bill and Materials.
- Inventory Control.
- Engineering Documentation Control.
- Operating Routing.
- Purchase Order Statistics.
- Shop Floor Control.
- Pyramid Cost Building.

Medical Management System. The Medical Management System is a hospital information and accounting system with the following modules.

- Patient Information.
- Clinical Laboratory and Pharmacy.
- Patient Accounting.
- Payroll and Personnel.
- General Ledger.
- Accounts Payable.
- Inventory Control.

Client Accounting. The Client Accounting package for certified public accounts, is available for Models 110-4 and 5.

Utility Software

System Ten's complement of utilities includes routines for text editing, code translation, conversational testing, loading object cards, tracing, disc sorts, file copying, providing dumps, retrieving and modifying individual records from a disc file, and editing.

MAINTENANCE

The first customer delivery of System Ten was made in 1970. The capabilities of the central processor, and the variety and nature of peripherals, have been expanded and refined as experience dictated. Singer offers maintenance for System Ten through its worldwide network of over 400 sales and service offices. Users interviewed commented that maintenance is dependable and available on short notice, often within an hour.

PRICE DATA

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
	SINGER SYSTEM TEN CENTRAL PROCESSOR & WORKING STORAGE			
20-101RJ	Card-Oriented Remote Job Entry System Terminal (including processor, 10K core, 2 multiterminal I/O channels, communication adapter, and SCA)	205	10,660	NA
20-101TP	Disc-Oriented Remote Terminal Processor (including processor, 20K core, FAC, disc controller, 2 multiterminal I/O channels, communications adapter, and SCA; max increase 10K core)	495	22,335	NA
20-104	Processing Unit (20K (including file access channel (FAC), disc controller, 2 multiterminal I/O channels)	720	24,075	NA
20-106	Processing Unit (20K) (including file access channel (FAC), disc controller, 3 multiterminal I/O channels)	765	25,380	NA

Model Number	Description	Monthly Rental $	Purchase Price $	Monthly Maint. $
21	Processor (expanded version of 20-104 and 20-106; includes additional 10K core; price shown to be added to 20-104 or 20-106)	190	7,500	NA
	10K Core Memory Unit	155	6,175	NA
	MASS STORAGE			
	Disc Controller	95	3,000	NA
	Auxiliary Disc Controller	28	715	NA
40	Disc Drive	415	14,500	NA
	Disc Pack	–	400	NA
42	Split Disc Drive	440	15,500	NA
	Disc Pack			NA
44	Disc Drive	1,000	35,000	NA
	Disc Pack			NA
	INPUT/OUTPUT			
	Magnetic Tapes			
50	Mag Tape Controller	95	2,970	NA
45	Mag Tape Drive	390	12,000	NA
	Punched Cards			
30	Card Reader	220	6,000	NA
31	Card Reader			
	300 cpm	200	6,250	NA
	600 cpm	290	9,750	NA
	1,000 cpm	315	10,750	NA
35	Card Punch	320	9,000	NA
	Paper Tape			
60	Paper Tape Reader	140	4,000	NA
65	Paper Tape Punch	180	5,000	NA
	Printers			
50	Line Printer (450 lpm)	585	18,000	NA
52	Line Printer (100 lpm)	315	12,600	NA
53	Line Printer (125 lpm)	410	17,500	NA
54	Line Printer (200 lpm)	470	19,000	NA
55	Line Printer (300 lpm)	550	22,000	NA
56	Line Printer (400 lpm)	635	25,000	NA
	DATA COMMUNICATIONS			
–	File Access Channel (FAC)	40	2,500	NA
–	Multiterminal I/O Channel	48	1,305	NA
70	Workstation	165	5,345	NA
80	CRT Display	160	5,950	NA
7102	Communications Terminal	140	4,750	NA
100	Job Information Station	145	5,616	NA
105	Attendance Terminal	70	2,592	NA
–	Sync Communications Adapter (SCA) (for 20-106 only)	180	6,520	NA
–	With Automatic Dialing Option	205	7,187	NA
–	With Local Communications Option	260	9,435	
	Async Terminal Adapter (ATA)			
–	Direct Connect	60	1,700	NA
–	Communicator	100	2,835	NA
–	With Automatic Dialing Option	113	3,402	NA
–	Digital Clock	38	1,134	NA
2024	Modem (selectable rates of 1,000/1,200/2,000/ or 2,400 bps)	60	1,600	NA

Notes:

– *Not applicable.*

NA *Not available.*

**Rental prices quoted are based upon a 1-year lease.*

For nondisc communications systems, delete price of FAC and disc controller. Lease rates include maintenance; Singer does not publish separate maintenance prices.

HEADQUARTERS

Singer Business Machines
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San Leandro CA 94577

SINGER

System Ten Report Update

ICL TAKES OVER SINGER BUSINESS MACHINES' INTERNATIONAL DIVISION

On March 22, 1976 the British mainframe manufacturer, International Computers Ltd., (ICL) announced that it was buying the International Division of Singer Business Machines (SBM) for an undisclosed sum. It will be responsible for marketing all Singer DP products throughout the world, except in the United States and Canada.

The agreement provides for a phased implementation of the takeover. On April 1, 1976 ICL began managing the SBM International Division on Singer's behalf, but the division will continue trading for 6 months under the Singer label; during that time Singer will be responsible for both losses and profits. Also during this 6-month management period, ICL management will assess the Singer product line and decide which products it wishes to incorporate into the ICL product line. At the same time it will decide which products will be discontinued.

On October 1, 1976 Singer Business Machines' International Division will be absorbed into the ICL marketing network and begin trading as ICL. ICL will announce which Singer products will be marketed under ICL's label. Manufacturing will continue at the Singer factory at Albuquerque, New Mexico until June 1977. ICL also acquires manufacturing rights for any Singer products that it wishes to incorporate into its own product line.

SINGER SYSTEM TEN IN THE UNITED STATES

Although Singer Business Machines is still for sale in the United States, TRW Inc. has signed a definitive agreement under which it will assume responsibility for Singer's maintenance and customer support functions. Singer claims it will continue selling the System Tens that it has in inventory, and that it is fully committed to servicing (along with TRW) its business machines for a minimum of 5 years.

TEKTRONIX INC.

4051 Graphic Computing System

OVERVIEW

Tektronix has for a number of years been marketing a series of storage tube graphic terminals. By combining the inherent advantages of its storage tube technology with the latest in microprocessors, it has now produced the 4051 BASIC Graphic Computing System. The 4051 can be described as a number of products for a number of markets. It is aimed at the time-sharing market, the desk-top or personal computing market (also known as the super-calculator market), and the minicomputer direct instrument control market.

In all of these markets Tektronix will emphasize the 4051's stand-alone graphics capabilities, its intelligence, and its BASIC language capabilities.

The announcement of the Tektronix 4051 on the heels of IBM's announcement of its 5100 Portable Computer has tended to swamp this product in the bow wave of the larger company. This is unfortunate for, while the 4051 resembles the 5100 in a number of ways, it is in no sense a me-too product.

For a number of years now, Tektronix has been building and marketing its storage tube graphic terminals as the 4000 Graphic Terminal Series. Due to the inherent economy of storage tube technology, these devices were capable of displaying high-quality graphics at reasonable costs. Over the years, Tektronix has been one of the leading advocates of the many advantages of the graphic representation of data. But its elegant hardware suffered from the disadvantage of requiring host-machine software to create the graphic output. On-line graphic software is still found only on a relatively small proportion of today's computers. The Tektronix 4051 solves this problem by putting the graphic software at the graphic display itself.

The Tektronix 4051 consists of an 11-inch storage tube, a microprocessor with firmware BASIC, a 3M-type tape drive, and a minimum of 8K bytes of workspace. The BASIC language contains a number of special extensions for production of graphs, in addition to the more common set of BASIC extensions implemented by other BASIC language processors. A number of peripherals are offered with the 4051: a screen hardcopy duplication unit, additional tape drives, a joystick, a plotter, and a printer interface. A data communications interface option allows the 4051 to communicate with host computers, emulating the Tektronix 4012 graphic display terminal or a Teletype.

The basic price of the Tektronix 4051 is $6,995. First shipments were in the first quarter of 1976. System specifications are listed in Table 1.

PERFORMANCE AND COMPETITIVE POSITION

The Tektronix 4051 is targeted at three separate markets:

- Time-sharing.
- Desk-top computing (also known as super-calculator market).
- Minicomputer systems.

Because the most unique aspect of the 4051 is its inherent graphic capability, this feature will be stressed in all of these markets.

As the 4051 will be marketed by the Information Display Group, which has sold the successful 4012 Graphic Terminal, time sharing will probably be the area of initial emphasis. In this area, there is no direct competitor to the 4051, at least not in its price range. To a certain extent, other

HEADQUARTERS

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graphic terminals (such as the recently announced DEC GT62, based on a PDP-11) may be considered competitive, but usually at considerably higher prices. The cost effectiveness of the 4051 will benefit two types of time-sharing users: the user who spends what he considers too much with his time-sharing supplier, and the user who would like to employ graphic facilities but does not have access to a time-sharing processor that supports them. The 4051 provides a real answer to both these problems.

Without question, a large portion of time-sharing costs are associated with either long data- or program-entry sessions, or relatively simple program executions. With dumb terminals, the user has no alternative but to pay for these facilities at the time-sharing computer rates. With a device such as the 4051, the user may enter his data or program files locally (off-line from the central computer), edit them, and then transmit the entire file for execution at the central site, without paying on-line charges for his keying time. Similarly, the user will be able to execute programs locally, using the hardwired BASIC language. In this market, Tektronix finds itself in direct competition with the IBM 5100. IBM offers either BASIC or APL, or both, but does not have a graphic capability similar to that of the 4051. And the 5100 is somewhat more expensive.

Most commercial time-sharing services support Tektronix graphic software. Tektronix will also make available software for such time-sharing systems as IBM's TSO. But not all interactive systems support graphics, and here the 4051 can prove effective. The data to be graphed can be transmitted as a sequence of numbers, and the local processing power of the 4051 can convert the data to graphic form.

The 4051 is also a member of the desk-top computer (also known as super-calculator) class of device. As such it is in competition with systems such as the Hewlett-Packard 9800 series, the Wang 2200, and the IBM 5100. Of machines in this class, only the 4051 offers display graphics, although both Wang and HP do offer optional hardcopy graphic peripherals. In terms of functional capabilities — (i.e., processing verbs and file handling) — the 4051 appears to be on a par with these competitors. Tektronix claims that the 4051 is significantly faster than the IBM 5100 and on the same order of internal speed as the HP equipment. Both HP and Wang currently offer a large variety of peripheral devices for their equipment, although it appears that Tektronix will be offering additional peripherals in the near future.

Tektronix feels that the 4051 will be a cost-effective competitor against mini-computer systems, primarily in the area of direct instrument control. The General-Purpose Bus Interface (GPIB), which adheres to the new IEEE 488-1975 interface standard, will allow connection of up to 15 devices, in a daisy-chain fashion, to the processor. Included in the devices that may be attached are the 4662 digital plotter and the 4924 magnetic (3M) tape unit peripherals. In addition, Tektronix plans to allow attachment of a floppy disc drive, similar to that presently offered on its display terminal line, on this bus. When, as expected, new instruments reach the market using the new standard interface, the 4051 can be expected to be configured as the central processor of such instrument control systems, at attractive prices.

Mention should be made of the technology of the 4051 display, which is somewhat unique. As opposed to the more common types of graphic displays, the 4051 storage tube does not require conventional storage memory to be used to refresh the screen image. Rather, lines characters, and points are painted directly onto the screen, and are maintained there by means of a residual electrostatic charge. This has the advantage of a substantial saving in electronic hardware, which is reflected in the cost of the storage tube displays. However, once an element has been painted on the screen, it cannot be erased without first blanking the entire screen and then reconstituting the screen image, less the element to be erased. The time to blank the screen is only momentary, but the time to generate a new full screen is dependent on the complexity of the display. To what extent this may be a problem to the user (if at all) must be evaluated individually.

SYSTEM DESIGN

Minimum user memory (workspace) for the 4051 is 8K and may be expanded in units of 8K up to a total of 32K. Each 4051 is equipped with three I/O ports: two RS-232-C interfaces and the General-Purpose Bus Interface (GPIB), adhering to the IEEE 488-1975 standard. The user has the option of attaching either a telecommunications option (with a ROM backpack) or a local printer connection (also with a backpack), or both. One magnetic tape cartridge is housed in the processor chassis and additional magnetic tape drives, the digital plotter (which itself contains a microprocessor), and/or instruments may be attached via the GPIB. In addition, both a joystick cursor control and a hardcopy screen display copier, using a dry process technique, may be directly attached to the processor display.

Firmware

An interesting optional peripheral of the 4051 is what are termed "ROM backpacks." These are optional plug-in units of ROM firmware, with each backpack containing 8K firmware bytes. At present, up to two such backpacks may be attached to a processor. They are used to support either the local printer or the telecommunications interface. The telecommunications backpack allows for specification of half or full duplex, a line speed up to 2,400 baud, and parity type, all under program control.

Tektronix also plans to provide an extension of the present backpack facilities by means of a ROM selection device. This device will be capable of holding up to 16 ROM backpacks, with backpack selection being performed under program control. In addition to the presently offered ROM functions, Tektronix expects to produce backpacks to handle extended matrix operations, instrument control packages, and syntax editors (including "foreign" languages such as FORTRAN).

Table 1. Tektronix 4051: Specifications

CENTRAL PROCESSOR	
Type	LSI microprocessing unit (Motorola 6800)
Main memory (workspace)	8K to 32K bytes
Character size	8 bits
Cycle time	1.0 microsecond
No. of I/O channels	1 (daisy chain)
Interrupt levels	1
ROM memory	32K bytes
AUXILIARY STORAGE	
Type	3M magnetic tape cartridge
Capacity	300K bytes
Transfer rate	6,000 bytes/sec
Read/write speed	30 in/sec
Search speed	90 in/sec
Attachment limits	1 std, several opt
KEYBOARD ENTRY	
Keyboard type	alphanumeric
Numeric cluster	yes
No. of keys	96
DISPLAY OUTPUT	
Type	storage tube
Viewing area	11" diagonal (8" x 6")
Screen capacity	2,520 characters, 1,024 x 780 addressable graphic pts
Characters per line	72
Lines	35
Character set	U.S., general European, Spanish, special symbols
INTERFACE BUS	
Type	conforms to IEEE standard 488-1975
Transfer mode	byte serial or bit parallel
Device attachment limits	0 to 15
PRINTER INTERFACE	
Type	RS-232-C
Operating mode	bit serial at 110 to 2,400 baud.
COMMUNICATIONS	
Type	RS-232-C interface
Line facility	switched
Line configuration	point-to-point
Line speed	110 to 2,400 baud
Transmission mode	async
Emulation	Teletype, Tektronix 4012 display terminal
Attachment limits	0 or 1
ROM BACKPACK	
Capacity	8K bytes
Attachment limits	0 to 2
HARDCOPY UNIT	
Type	dry copy reproduction of display screen
Attachment limits	0 or 1
DIGITAL PLOTTER	
Plot size	10" x 15"
Plotting speed	16 in/sec, 10 pts/sec
Resolution	.005 in
Digitizing capability	yes
Attachment limits	0 or 1
SOFTWARE	
Operating system	firmware extended BASIC with plotting verbs
Firmware options	printer controller backpack, telecommunications controller backpack
Utilities	statistics, engineering, and mathematics packages

Display Terminal

The display terminal for the 4051 system is an 8-inch by 6-inch CRT screen. It can display a total of 2,520 alphanumeric characters in 35 lines of 72 characters each. Graphic resolution is 1,024 by 780 points. No memory is used to refresh the screen of the 4051 display; a residual electrostatic charge maintains the alpha and numeric characters that are painted onto the screen. The 4051 provides a full ASCII character set (upper- and lowercase), which includes Scandinavian, German, general European, and Spanish fonts.

Keyboard

The alphanumeric keyboard offers 128 characters, a 10-key numeric pad, 10 function keys (for up to 20 functions), and five editing keys (for 10 editing functions that can be used to modify BASIC source programs).

PERIPHERALS

A full listing of the 4051 peripherals can be found in the PRICE DATA section of this report.

DATA COMMUNICATIONS

In the emulation mode, the 4051 can emulate the Tektronix 4012 computer display terminal, with keystrokes sent directly to the remote computer and data and graphics

Table 2. 4051 Graphic Verbs

VIEWPORT:	Controls how much of the output surface is used for a graph and where the boundaries will be.
WINDOW:	Controls what portion of the available X-Y coordinate data will be placed in the viewport.
SCALE:	Divides the X-Y coordinates of the viewport into segments corresponding to the proper numeric values for the graph.
POINTER:	Causes the machine to display an arrow positionable with the optional joystick.
DRAW:	Draws a straight line between the present position of the cursor and a specified point in the WINDOW.
RDRAW:	Relative draw. Draws a straight line between the present position of the cursor and a point in the WINDOW specified relative to the position of the cursor.
MOVE:	Like DRAW except no line is produced.
RMOVE:	Relative move. Like RDRAW except no line is produced.
AXIS:	X and Y axis lines are drawn and scale tic marks located.
GIN:	Graphic Input. Records the location of the graphic point; either the point of the arrow or the lower left corner of the normal 5 x 8 dot matrix rectangular cursor.
ROTATE:	Causes relative draw or relative move to follow a path that departs from the normal by a specified number of radians or degrees.

from the remote computer displayed as received on the 4051 screen. Teletype emulation is also supported.

In communications mode, the 4051 emulates a paper tape reader/punch, with characters being read/written from the magnetic cartridge. In this mode asynchronous communication rates up to 2,400 baud are supported.

SOFTWARE

The BASIC language of the 4051 is an extended version of the Dartmouth BASIC language. In addition to the common extensions of character string and logical manipulation, there is a special set of graphic keywords, used in the construction of screen displays. Line and point drawing, cursor movement, scaling, rotation, and windowing are all supported as single BASIC statements. Table 2 gives a synopsis of these commands. A set of file manipulation commands are also supported, including file searching, listing, and concatenation.

Tektronix is initially offering a variety of BASIC programs with the 4051, including a system tutorial program (with emphasis on graph creation), special graphics software on the system tape, and several volumes of routines in the areas of statistics (linear regression, analysis of variance, etc.), mathematics (matrix manipulations, special functions, metric and base conversion, etc.), and electrical engineering (circuit analysis and construction, etc.).

MAINTENANCE

Tektronix has over 50 service centers in the U.S. and Canada. Service representatives usually restore system operation in no more than 24 hours after placement of a service call.

PRICE DATA

Model No.	Description	Rental/Month (Maint Included) 1-yr lease $	Rental/Month (Maint Included) 2-yr lease $	Purchase Price $	Monthly Maint $
4051	Graphic System 8K-byte 4051 with 11" Direct View Storage Tube, 3M tape drive with 300K bytes of storage, 30 ips read, 90 ips search. General-Purpose Interface Bus (GPIB), ASCII keyboard, numeric keyboard, general-purpose and special-purpose function keys, audio bell, upper- and lowercase characters, expanded BASIC language with strings and graphics	420	350	6,995	60
Options	(Options must be ordered with the original order.)				
Option 1	Data Communications Interface Allows the 4051 to emulate a 4012 terminal or communicate to a host via an RS-232-C interface at 110, 150, 300, 600, 1,200, or 2,400 baud, half or full duplex; even, odd, or no parity, all under program control.	90	75	1,500	8
Option 10	RS-232 Printer Interface Output-only channel for line printers with RS232 interface. One control and 1 sense line, 5 switch-selectable output rates (110, 150, 300, 1,200, and 2,400 baud), captive 10' cable with 25-pin female connector	33	28	550	5
Option 20	16K bytes total memory An additional 8,192 bytes of random access memory for a system total of 16,384 bytes	129	108	2,150	4
Option 21	24K bytes total memory An additional 16,384 bytes of random access memory for a system total of 24,576 bytes	201	168	3,350	8
Option 22	32K bytes total memory An additional 24,576 bytes of random access memory for a system total of 32,768 bytes	273	228	4,550	12
Accessories					
021-0188-00	Data Communications Interface Allows the 4051 to emulate a 4012 terminal or communicate to host via an RS-232-C interface at 110, 150, 300, 600, 1,200 or 2,400 baud; half or full duplex; even, odd, or no parity, all under program control. Requires backpack substitution.	90	75	1,500	8
021-0189-00	RS-232-C Printer Interface Output-only channel for line printers with RS232 interface. One control and 1 sense line, 5 switch-selectable output rates (110, 150, 300, 1,200, and 2,400 baud), captive 10' cable with 25-pin female connector	33	28	550	5
040-0776-00	8K to 16K Memory Expansion Board Field-installed board and electronics to expand the standard 4051 from 8K to 16K bytes. Order through Field Service.	143	120	2,390	4
040-0777-00	8K Memory Expansion Kit Field-installed 8K bytes to expand the 4051 memory from 16K to 24K bytes or expand from 24K to 32K bytes Note: 2 kits required to expand from 16K to 32K bytes. Prerequisite: at least 16K bytes of memory. Order through Field Service.	120	100	1,995	8
016-0376-00	Dust Cover	N/A	N/A	25	N/A
119-0680-01	Blank Tape Cartridges (5/box)	N/A	N/A	130	N/A

PRICE DATA (Contd.)

Model No.	Description	Rental/Month (Maint Included) 1-yr lease $	Rental/Month (Maint Included) 2-yr lease $	Purchase Price $	Monthly Maint $
334-2630-00	Overlays (10/box)	N/A	N/A	15	N/A
006-1603-00	1 Roll 3M Type 777 paper for Hard Copy Unit	N/A	N/A	50	N/A
006-1603-01	4 Rolls 3M Type 777 paper for Hard Copy Unit	N/A	N/A	180	N/A
070-2058-00	Manual, PLOT 50: Introduction to Programming in BASIC	N/A	N/A	25	N/A
070-2059-00	Manual, PLOT 50: Introduction of Graphics Programming in BASIC	N/A	N/A	25	N/A
070-1940-00	4051 Graphic System Operators Manual	N/A	N/A	50	N/A
070-2056-00	4051 Graphic System Reference Manual	N/A	N/A	50	N/A
020-0160-00	System Software Tape	N/A	N/A	125	N/A
020-0161-00	System Software Backup Tape	N/A	N/A	125	N/A
012-0630-01	2-Meter GPIB Cable	N/A	N/A	75	N/A
016-0346-00	Viewing Hood	N/A	N/A	15	N/A
016-0364-00	Pedestal	6	6	125	N/A
Peripherals					
4631	Hard Copy Unit	240	200	3,995	50
	Produces hard copy of all characters and graphic information displayed on storage tube display. Includes 10' cable with mating connector.				
	Option 1 Copy Counter	3	3	55	N/A
	Option 2 4-Channel Multiplexor	30	25	535	5
012-0547-00	10' Hard Copy Unit cable			60	
012-0548-00	20' Hard Copy Unit cable			80	
012-0549-00	50' Hard Copy Unit cable			135	
	1 Roll 3M Type 777 paper			50	
	4 Rolls 3M Type 777 paper			180	
4952	Joystick	30	25	495	4
4952	Option 2 Joystick	4	3	65	1
	Allows operator to enter Graphic Input (GIN). Includes 11-1/2' cable with mating connector to 4051.				
4662	Interactive Digital Plotter	240	200	3,995	40
4662	Option 1 Interactive Digital Plotter	0	0	0	0
	GPIB-compatible interface (IEEE 488-1975) connects the 4051 to this Digitally Stepped X-Y Plotter/Digitizer with a 10" x 15" work area. Resolution is ± .005 in. Plotting rate is 16 in/sec after approximately 100 ms. Pen rate is 10 pts/sec. Includes Alpha Numeric Character Generator, Auto Scaling and One Degree Character Rotation, Absolute Addressing, and joystick for digitizing. Includes 2-meter GPIB cable, pens, digitizing cursor, paper, and manuals.				
016-0345-00	Dust Cover	N/A	N/A	10	N/A
	Pens	N/A	N/A		N/A
016-0589-00	Replacement Pen Package, Red (3 each)	N/A	N/A	6	N/A
016-0589-01	Replacement Pen Package, Green (3 each)	N/A	N/A	6	N/A
016-0589-02	Replacement Pen Package, Black (3 each)	N/A	N/A	6	N/A
016-0589-03	Replacement Pen Package, Blue (3 each)	N/A	N/A	6	N/A
	Paper (11" x 16-1/2" by 100 sheets)	N/A	N/A		N/A
006-1698-00	Linear Square (in)	N/A	N/A	7	N/A
006-1699-00	Linear Square (cm)	N/A	N/A	7	N/A
006-1700-00	Semi-Logarithmic, 10" x 3 cycles	N/A	N/A	7	N/A
006-1701-00	Semi-Logarithmic, 15" x 2 cycles	N/A	N/A	7	N/A
006-1702-00	Full-Logarithmic, 2 cycles x 3 cycles	N/A	N/A	7	N/A
4641	Printer	292	247	4,495	52
	132-column, multi-form character printer. Includes interface and 10' cable.				

NA — Not applicable

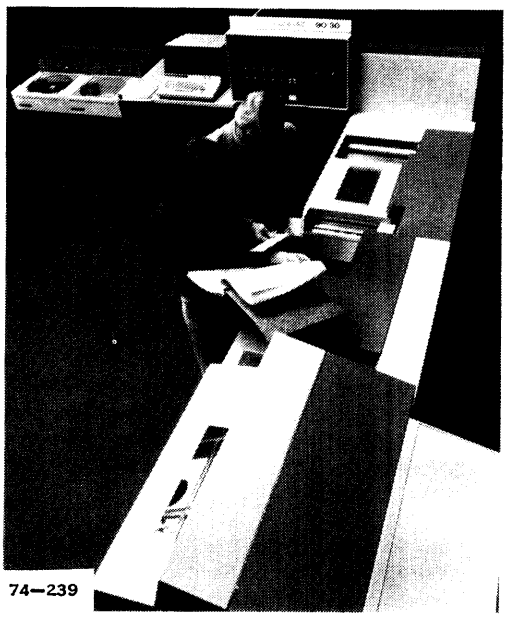
Software Programs

The software products are the sole property of Tektronix, Inc., and may not be reproduced or used outside the customer's organization without the express written consent of Tektronix, Inc., The products are supplied to the customer for use with associated Tektronix products upon payment of a singe-use fee.

PLOT 50, Software Products		
4050A01	PLOT 50: Statistics, Volume 1	175
	This volume of 24 programs permits evaluation and generation of tabled values of many of the common distributions. It also allows testing of various kinds of hypotheses and plotting of data with several regression techniques. Includes binder, manual, overlays, and 1 tape cartridge.	
	Prerequisite: 8K bytes of memory.	
	Option 48 Tape Cartridge only	—50
	062-1854-00 Manual only	50
4050A02	PLOT 50: Statistics, Volume 2	175
	Six large sophisticated programs for 1-, 2-, and 3-way analysis of variance and commonly used techniques for experimental design. Includes binder,	

PRICE DATA (Contd.)

Description	Purchase Price $
manual, overlays, and 1 tape cartridge.	
Prerequisite: 16K bytes of memory.	
Option 48 Tape Cartridge only	—50
062-1855-00 Manual only	50
4050A03 PLOT 50: Statistics, Volume 3	400
Performs multiple linear regressions, data plots, and polynomial regression curves for input data. Extremely valuable in analysing experimental data. Includes binder, manual, overlays, and 1 tape cartridge.	
Prerequisite: 16K bytes of memory.	
Option 48 Tape Cartridge only	—50
062-1856-00 Manual only	50
4050A04 PLOT 50: Mathematics, Volume 1	175
Twenty-two programs of commonly used numerical analysis techniques such as conversions, function analysis and plots, integration, differential equations, and systems of linear equations. Includes binder, manual, overlays, and 1 tape cartridge.	
Prerequisite: 8K bytes of memory.	
Option 48 Tape Cartridge only	—50
062-1857-00 Manual only	50
4050A05 PLOT 50: Mathematics, Volume 2	225
Sixteen programs that provide sophisticated techniques for solving differential equations, systems of equations, Eigen analysis, fast Fourier transform, and linear programming. Graphics are extensively used in equations, regression, and curve fits. Includes binder, manual, overlays, and 2 tape cartridges.	
Prerequisite: 16K bytes of memory.	
Option 48 Tape Cartridges only	—50
062-1858-00 Manual only	50
4050A06 PLOT 50: Electrical Engineering, Volume 1	400
A single large program that performs microwave and general active and passive circuit analysis with Smith chart, rectangular or polar plotting. Includes binder, manual, overlays, and 1 tape cartridge.	
Prerequisite: 24K bytes of memory.	
Option 48 Tape Cartridge only	—50
062-2280-00 Manual only	50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OVERVIEW

Sperry Univac announced the Model 90/30 on June 20, 1974. The first 90/30 is scheduled for delivery with all system software in January 1975. The Model 90/30 is the lowest entry level system into the Series 90. It operates at about one-half the speed of the 90/60 and less than half that of the 90/70, see Table 1. The 90/30 is modular and has a broad range of configurations. Univac claims it competes favorably in price/performance with the Burroughs B 1700 line (1712, 1714, 1726, and 1728); IBM System/3 Models 10 and 15; and IBM System/370 Models 115, 125, and 135. Further, the 90/30's processing power, measured in terms of KOPS (thousands of operations per second), is over twice that of the IBM System/3/15 and System/370 Models 115 and 125 and is comparable to that of the IBM System/370 Model 135.

The smallest 90/30 system consists of a microprogrammed CPU with a basic instruction set of 84 instructions, emulation for the Univac 9200/9300 and IBM System 360/20, integrated peripheral channel with attached CRT console, card reader, card punch, and printer, and an integrated disc adapter with two disc drives, 28.9M bytes each. Optional features include memory to 262K bytes, data communications for up to 24 half-duplex or 12 full-duplex lines, disc drives with capacity up to 1,600 million bytes, and additional peripherals.

The 90/30 runs under a new operating system called OS/3, which features multiprogramming, multitasking, automatic job scheduling, remote job entry, and integrated communications. Up to seven jobs can run concurrently.

Univac has partially departed from its previously bundled pricing. The cost of three applications packages available for the 90/30 will be added to the contracted system price. These proprietary programs are PROFITS, UNIS Industrial System, and NEWSCOMP. Other applications packages will not be separately priced.

The 90/30 uses all MOS semiconductor memory composed of 1K chips. Circuitry consists primarily of T^2L logic. Systems will be manufactured in Japan, Germany, and the United States. Benchmarks will be available by November 1974. First deliveries will be during the first quarter of 1975. The first two system demonstrations were in Germany and at the DPMA conference.

Univac's recent past FY73 shows the company in a favorable financial position: shipments up 30 percent, orders up 18 percent, installed base up 12 percent to $5.5 billion, gross income up to $1.1 billion, fifth consecutive year of 15 percent growth.

COMPETITIVE POSITION

The 90/30 is an attractive addition to the Series 90 line and in the right direction, downward. No serious contender in the general-purpose computer market can let the thousands of small computer users get hooked on another system and expect very many of them to migrate to another system when their computer needs increase. These users want an easy, relatively painless upgrade path, as IBM System/3 customers have shown by using another System/3 rather than upgrade to the System/370.

Univac has chosen a sitting duck to go after, the IBM System 360/20, which is not really compatible with the 360 line and not readily upgradable by downgrading to the System/3. The path is relatively rocky for the System 360/20 user no matter what route he takes. So, why not go the 90/30 route which offers 360/20 emulation for an orderly upgrade?

The 90/30 is also an easy upgrade for the Univac 9200/9300, which it also emulates. The 90/30 is a much more powerful system with larger memory, powerful operating system, more disc storage, and more programming languages (RPG II, COBOL, FORTRAN, and ASSEMBLER).

In head-to-head competition with the Burroughs B 1700, IBM System/3 Models 10 and 15, and IBM System/370 Models 115, 125, and 135, the Univac 90/30 has considerably tougher competition. KOPS (thousands of operations per second) are only KOPS, not throughput. Univac's chances of liberating very many of these systems are relatively slim except for some System 3/15 upgrades. A Univac spokesman characterized the market as consisting of "those considering but not committed to the 370." When competing for new accounts, however, the 90/30 offers enough of a price/performance edge to get a hefty share of that business.

Honeywell will not be strong competition for the 90/30 in the United States until the company announces Series 60 Levels to replace the 2020 and 2030. In the important

Table 1. Comparison of the Univac 90/30 with the 90/60 and 90/70

Characteristic	90/30	90/60	90/70
Orientation	Disc	Disc	Disc
Memory			
Size (bytes)			
Minimum	32K	131K	131K
Maximum	262K	524K	1M
Bytes/Access	2	4	4
Cycle Time (nsec)	600/2 bytes	600/4 bytes	600/4 bytes
Operating System	OS/3	OS/7	OS/7
Disc Capacity	5.7M-1,600M	7.25-1,600M	7.25-1,600M
Data Comm Line			
Full-Duplex	12	15	64
Half-Duplex	24	30	128
Peripheral Subsystems	27	32	40
First Delivery	Jan 1975	Jan 1974	4th qtr 1973

European market, however, the Honeywell 60 Levels 58, 62, and 64 are quite competitive. Univac expects 35 to 40 percent of the 90/30 sales to be outside the United States.

As the trend toward smaller computer systems continues, it is good that the company whose name has become synonymous with computer has a price/performance leader in the field, for the moment at least. With LSI technology moving so rapidly these days, the newest system tends to be the leader for only a brief moment.

CONFIGURATION GUIDE

The basic 90/30 system includes a processor with 32K bytes of memory, 84 basic instructions, and 32 registers, an integrated peripheral channel (IPC), and an integrated disc adapter. Minimum systems also include a CRT console printer attached to the IPC.

The first main memory expansion within the CPU cabinet adds 16K bytes to make 64K; freestanding units of 32K-byte increments can be added thereafter until the maximum of 256K bytes is reached (K = 1,024). Processor capabilities can also be expanded through the addition of storage protect modules and various types of expansion to the system micrologic. Storage protection is added in increments of 512 bytes. Micrologic expansion capabilities include a floating-point processor with 44 more instructions and four more registers, IBM 360/20 compatibility with two more instructions, and a privileged/nonprivileged instruction set of 16 instructions. A special set of instructions designed for malfunction analysis and maintenance can replace a portion of the instructions.

Two types of peripheral expansion are available to the basic system without attachment of additional I/O channels. Up to eight 8416 disc drives can be supported by integrated disc adapter attached directly to the CPU. Four more peripheral devices can be supported by the IPC: the 0717 card reader, 0773 printer, 0605 card punch, and a communications adapter for up to 24 lines. Only one peripheral of each type can be added to the IPC.

To add more peripherals to the system or to increase I/O rates, one multiplexor channel and one or two selector channels can be added to the system. The multiplexor channel handles up to eight subsystems, including 0716 card reader, 0604 card punch, 2703 optical document reader, 0920 paper tape subsystem, 0770, 0768 printers, UNISERVO VIC subsystem (subject to availability), and 9000 series channel adapter. The channel adapter can be used to interface to a 9200 or 9300 computer. Selector channels handle up to eight control units each, such as those for 8430, 8414, and 8411 disc subsystems and UNISERVO 12, UNISERVO 16, and UNISERVO 20 tape subsystems. The 8430 and all three UNISERVO subsystem controllers can handle 16 drives each; thus the on-line mass storage capability of the system is considerable.

Although the subsystems that can be attached to the IPC are restricted to one of each type, the selector and multiplexor channels can attach any combination of the subsystem controllers. Older subsystems which are no longer in production are subject to availability, however. These include the 8414, 8411, and UNISERVO VIC subsystems.

COMPATIBILITY

The 90/30 emulates the IBM 360/20 and the Univac 9200/9300. At the higher-level language level, RPG II, COBOL, and FORTRAN compilers are implemented.

COBOL is based on the National Standard COBOL and is a Level 4 DoD (Department of Defense) compiler. It includes Level 2 features for the nucleus, sequential access, random access, sort, segmentation, and library. The table handling module for Level 3 is included. A smaller version runs on 32K-byte systems. The 90/30 FORTRAN language conforms to National Standard FORTRAN.

The 90/30 operating system OS/3 is not a subset of OS/7 used on the 90/60 and 90/70; the job control languages are not compatible. The instruction set of the 90/30 is a subset of that for the 90/60 and 90/70. The 90/30 ASSEMBLER is also a subset of the 90/60 and 90/70 ASSEMBLER. The higher-level languages are compatible but programs should be recompiled.

Any 9200 or 9300 Series system can attach to the 90/30 via a 9000 Series channel adapter.

MAINFRAME

The 90/30 mainframe characteristics are summarized in Table 2.

Table 2. Univac 90/30: Mainframe Characteristics

Characteristic	90/30 Implementation
System Orientation	Disc
Central Processor	
Type	Microprogrammed
Instruction	84 basic, 64 opt (including floating-point arithmetic)
Registers	16 for user program; 16 for operating system; 4 for floating-point arithmetic
Word Length	32 bits
Integrated Emulators	9200/9300, IBM System 360/20
Memory	
Type	MOS
Addressable Unit	Byte
Units/Access	2 bytes (halfword)
Cycle Time	600 nsec/halfword
Storage Protection	Opt
Page Size	512 or 1,024 bytes
INPUT/OUTPUT	
Integrated Peripheral Channel	Up to 5 subsystems: integrated CRT console/printer, card reader, card punch, and printer; optional comm adapter; 50K bytes/sec
Integrated Disc Adapter	Up to 8 disc drives: 2 integrated, 6 opt
Multiplexor Channel	Opt for up to 8 subsystems, 83K bytes/sec
Selector Channels	2 opt for up to 8 subsystems each, 825K bytes/sec each

Central Processor

The 90/30 CPU operates under microprogram control. The basic chassis includes an interval timer, register stack, integrated peripheral channel, and integrated disc adapter. Optional features are an integrated communications adapter, storage protection, multiplexer channel, one or two selector channels, and floating-point arithmetic.

The register stack includes 16 full-word registers for user programs, 16 for the supervisor program and four doubleword floating-point registers. Separate registers contain the program relocation bases for active programs.

The standard instruction set includes instructions that operate on 64-bit double words, 32-bit words, and 16-bit halfwords. Packed and unpacked decimal arithmetic and binary arithmetic are standard features. Instruction formats include halfwords, fullwords, and doubleword instructions, with the op code as the first byte, regardless of instruction length.

The microinstructions that implement the instruction set reside in a high-speed control memory that is partly read/write and partly read-only.

MAIN MEMORY

Main memory consists of high-speed, semiconductor memory modules. Up to 65K bytes can reside in the mainframe. Memory beyond 65K bytes is contained in freestanding units. Memory cycle time is 600 nanoseconds for a 2-byte access. Word length is 32 bits or four bytes.

Memory is available in capacities of 49K, 65K, 98K, 131K, 163K, 196K, 229K, and 262K bytes. Memory protect divides memory into pages of 512 bytes for systems with no more than 131,072 bytes of memory. Larger memories are divided into 1,024-byte pages.

INPUT/OUTPUT

After appropriate instruction parameters have been transferred to the I/O channel, data transfers occur concurrently with other processing. The standard Integrated Peripheral Channel (IPC) is the slowest I/O channel at 50,000 bytes per second; it handles only slow-speed and communications devices. The integrated disc adapter allows an 8416 to transfer data at up to 625,000 bytes per second. The multiplexor channel is somewhat faster than the IPC, with a maximum combined transfer rate of 83,000 bytes per second; subsystems connected to the channel operate concurrently; the channel transfers one byte from each operating subsystem at a time in a round-robin fashion. The selector channels, on the other hand, operate only in burst mode with each subsystem retaining control of the channel until the block transfer is complete.

PERIPHERALS

The 90/30 system peripherals include card, paper tape, printers, OCR subsystem, magnetic tape, and magnetic disc units.

Slow-Speed Peripherals

0717 Card Reader. Uses 80-column cards; 500 cards per minute; 2,400-card hopper, 2,000-card stacker; short-card feed optional; attaches to IPC.

0605 Card Punch. Uses 80-column cards; 75 to 160 cards per minute (28-80 columns); 700-card hopper; two 600-card stackers; optional card read at 160 cards per minute; attaches to IPC.

0773 Printer. Band printer, 500 lines per minute for 48-character set, 120 columns; format buffer, six or eight line-per-inch spacing, 22 inch-per-second skip speed; options include 132- or 144-column line, and 63-, 85-, 96-, 128-, or 256-character sets (speed is 400 lines per minute for 63-character set and 114 lines per minute for 256-character set); attaches to IPC.

0716 Card Reader. Uses 80-column cards; 1,000 cards per minute; image or translate mode; ASCII, EBCDIC, or compressed code standard to either mode, 2,400-column hopper, two 2,000-column stackers; attaches to MUX channel.

0604 Card Punch. Uses 80-column cards; 250 cards per minute; two output stackers; attaches to MUX channel.

0770 Printer. Band printer; maximum speed 2,000 lines per minute; 132 columns for 48-character set; vertical format buffer; power stacker; options include 800 line-per-minute and 1,400 line-per-minute submodels for 48-character set, and 64-, 96-, 128-, and 256-character set options; attaches to MUX channel.

0768 Printer. Drum printer series; three drums with 63-, 94-, and 132-character set; printing speed depends on number of contiguous characters used: 63-character drum prints 1,100 lines per minute for 49 characters; 94-character drum prints 840 lines per minute for 94 characters and 2,000 lines per minute for 14 characters; 132-character drum prints 1,200 lines per minute for 63 characters and 1,600 lines per minute for 43 characters; attaches to MUX channel.

0920 Paper Tape Reader/Punch. Uses 5- to 8-channel tape; reads 300 characters per second, punches 110 characters per second; optional spoolers; attaches to MUX channel.

High-Speed Peripherals

The new 8416 disc subsystem has been specially designed for the 90/30; it attaches directly to the system via an integrated adapter. The 8430 disc subsystem and the 8411 and 8414 subsystems as available can also be attached to a 90/30 via selector channels. Similarly UNISERVO 12, 16, and 20 magnetic tape subsystems can be attached to a 90/30 via a selector channel, but UNISERVO VIC, when available, must be attached to a slower-speed multiplexor (MUX) channel. Tables 3 and 4 list disc and magnetic tape specifications, respectively.

Table 3. Univac 90/30: Disc Subsystem Characteristics

Characteristic	8411*	8416*	8416[1]	8430[2]
Channel	Selector	Selector	IPS	Selector
Drives/Control	2-8	2-8	2-8	2-16
Heads/Drive	10	20	7	19
Usable Surfaces/Drive	70	20	7	19
Tracks/Surface	200	200	404	404
Bytes/Track	3,625	7,294	10,240	13,030
Capacity (bytes)	7.25M	29.2M	28.9M	100K
Access Time				
Head Positioning (msec)	25-135	25-130		7-50
Avg Access Time (msec)	75	60	33	27
Latency (msec)	12.5	12.5	10.8	8.33
Rotational Speed (rpm)	2,400	2,400	2,800	3,600
Transfer Rate (bytes/sec)	156K	312K	625K	806K

Notes:
(1) Designed specifically for 90/30 by new ISS division.
(2) Adapted Itel disc.
* As available.

Table 4. Univac 90/30: Tape Subsystem Characteristics

Characteristic	Uniservo VIC	Uniservo 12	Uniservo 16	Uniservo 20
Channel	MUX	Selector	Selector	Selector
Units/Control	2-8	1-16	1-16	1-16
Number of Tracks	7/9	7/9	7/9	7/9
Tape Speed (ips)	42.7	42.7	120	200
Transfer Rate	34K	68K	192K	320K
Recording Mode	NRZI	PE; NRZI	PE; NRZI	PE

As available.

Special Peripherals

2703 Document Reader. Reads 300 6-inch documents per minute; document size 3.0 to 8.75 by 2.75 to 4.25 inches; OCR-A and Univac H14 fonts; 2,000-document hopper, three 1,000-document stackers; options include mark read, punch card feed, validity check, Mod 10 check digit verification, speed upgrade to 600 documents per minute; attaches to MUX channel.

Channel Adapter. Connects 90/30 with 9200, 9200II, 9300, or 9300II; attaches to MUX channel of both computers; housed in 9200A300 processor cabinet.

Console

The system console includes a keyboard and CRT display, which monitors all communication between the operator and the system. The console provides an alphanumeric keyboard, cursor control keys, editing keys, data control keys, and indicators. A printer for hard copy is optional.

DATA COMMUNICATIONS

Data communications is supported by the optional integrated communications adapter (ICA), which includes the communications adapter interface, communications multiplexor module and line adapters, mounted in the console. The standard ICA supports six full-duplex lines; an option expands the system up to 12 full-duplex or 24 half-duplex lines. The ICA module performs the proper sequencing when the IPC issues a connect signal or a device requests service, and it also performs functions relating the message discipline.

The ICA can recognize special characters or sequences of characters; it checks character parity; and it coordinates data transfers in and out of main memory. It supports auto dial/answer, private leased lines, public telephone networks, TWX networks, telegraph loops, Telex both United States and International, wideband and military communication networks, and new digital data networks.

Software to control communication is via ICAM (Integrated Communications Access Method), a modular

component of OS/3. System generation allows three language interfaces to ICAM: BAL (Basic Assembly Language), RPG II, and IMS (Information Management System). ICAM software includes channel control routines, physical I/O control system, remote device handlers, network definition and control, message sequencing, journal control, IMS/90 software interface, and options for auditing, recovery, and restart.

Terminals

ICAM supports the IBM 2780 Data Transmission Terminal; Teletype Models 28, 32, 33, 35, 37, and 38; the Sperry Univac 9200/9300 computers; and the following Univac terminals.

Uniscope 100. Keyboard/CRT with 480, 512, 960, or 1,024 characters; hardcopy option; can be used for data entry or system display.

DCT 500. Keyboard/printer; RO, KSR, or ASR modes; field expandable; paper tape for ASR; 132 columns; ASCII code.

DCT 1000. Terminal printer (30 characters per second) can expand to include keyboard, card reader, card punch, paper tape reader/punch, and auxiliary printer; batch or conversational modes; two 160-character buffers; polling and address recognition allows up to 31 DCT 1000s per line.

DCT 2000. Batch terminal printer with optional card reader/punch; private line to 2,400 baud or dialup to 2,000 baud; EIA RS232C interface.

1004/1005 Card Processor. Processor, card reader/punch, and printer. Model 1005 has core storage and more local processing; several submodels per model with different I/O speeds, and magnetic tape option.

SOFTWARE

The 90/30 operating system, OS/3, is a modular batch-processing system that supports COBOL, FORTRAN, RPG II, and Basic Assembly Languages; Data Base Management System called IMS/90; ICAM communications package; IBM 360/20 and Univac 9200/9300 emulators; job control language; and a variety of utilities, diagnostic and application programs. Table 5 summarizes system software.

OS/3

The OS/3 Executive includes the supervisor and job control language. Important segments of the executive include:

- Generalized physical I/O control system handles queues, initiates I/O commands, and completes interrupt routines.
- Resource allocation controls main storage, processor time, and I/O channels with associated devices.

Table 5. Univac 90/30: Software Packages

Package	Description
OS/3	Specifically designed for 90/30
Compilers	
RPG II	Implementation of IBM RPG II
COBOL	Based on ASA COBOL
FORTRAN	Based on ASA FORTRAN
Assembler	Macro facility
SORT/MERGE	Subroutine and stand-alone package
Data Utilities	File to file routine, special-purpose routines and macroinstructions
Linkage Editor	
IBM 360/20 Emulation	Used in conjunction with the 360/20 emulator microcode
9200/9300 Emulation	Used in conjunction with the 9200/9300 emulator microcode
Application Programs	
UNIS Industrial System	Modular system for solution of management problems in manufacturing
NEWSCOMP	Newspaper production system
IMS/90	Information Management System
MCS	Management Control System – advanced PERT
LP/90	Linear Programming
UPACS	Hospital Accounting Package
MINIAPT	Automatically Programmed Tools
WIMS	Wholesale Inventory Management System
PROFITS	On-line package for financial institutions
LINCO III	Line-justification program

- Task control provides for up to seven jobs for concurrent execution.
- Timer and day clock services include time of day, elapsed time, and timer interrupts at various intervals.
- Program management helps the program use allocated memory space by loading programs, managing overlays, linking subroutines, terminating job/task, and checkpointing/restarting.
- Record and file protection prevents accessing a shared file while it is being updated.
- Console management provides for input and output via console.
- Spooling includes input readers, output writers, spool-in, and spool-out.
- Diagnostic and debugging aids include trace and monitor mode, snapshot display of memory, error messages, and uniform error response.

OS/3 Data Management software support provides four access methods for storage and retrieval of data: sequential access method (SAM), direct-access method (DAM), indexed-sequential access method (ISAM), and system access technique (SAT). System Service Programs include data utilities, linkage editor, librarian, tape/disc initialize display program, testing aids, sort/merge, and COBOL/FORTRAN libraries.

Language Processors

The FORTRAN, COBOL, and RPG II processors adhere to national standards. 90/30 COBOL is consistent

with the American National Standard COBOL X3.23: 1968. Two FORTRAN compilers are available: a proper FORTRAN IV subset of American National Standard FORTRAN (ANSI-X3.9-1966) which is a compatible superset of IBM/DOS 360 FORTRAN IV and FORTRAN IV subset more compatible with IBM 1130 and System/3 FORTRAN.

Although the RPG II compiler includes a large number of enhancements, RPG II source code compatibility extends to programs written for IBM 360/20 and Univac 9200/9300 systems; features provide compatibility between OS/3 RPG II and compilers offered with IBM System/3 and 360/DOS.

The 90/30 assembler is a 2-pass macroassembler that produces either relocatable or absolute object code.

HEADQUARTERS

Sperry Univac
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Blue Bell PA 19422
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PRICE DATA

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	CENTRAL PROCESSOR AND WORKING STORAGE			
3029-00	CPU (includes 32K bytes storage, expandable to 256K, 600-nsec cycle time/4 bytes, 32 general registers, 2 timers, integrated peripheral channel, relocation registers, CRT/keyboard operator station, 9200/9300 compatibility mode, 360/20 compatibility mode)	1,635	78,480	320
-99	90/30 Processor (same as 3029-00 except has 48K bytes)	1,775	85,200	340
-98	90/30 Processor (same as 3029-00 except has 64K bytes)	1,915	91,920	360
-97	90/30 Processor (same as 3029-00 except has 96K bytes)	2,195	105,360	400
-96	90/30 Processor (same as 3029-00 except has 128K bytes)	2,475	118,800	440
-95	90/30 Processor (same as 3029-00 except has 160K bytes)	2,755	132,240	480
-94	90/30 Processor (same as 3029-00 except has 192K bytes)	3,035	145,680	520
-93	90/30 Processor (same as 3029-00 except has 224K bytes)	3,315	159,120	560
-92	90/30 Processor (same as 3029-00 except has 256K bytes)	3,595	172,560	600
	Processor Options			
8541-84	Console Printer (30 cps)	72	2,856	22
F1622-00	Storage Protect (provides read/write protection and accesses to main storage and 2 additional processor instructions; protection in 512-byte blocks for processors with up to 128K bytes of main storage, and 1K-byte blocks for processors with more than 128K bytes of main storage)	15	720	–
F1623-00	Micrologic Expansion (adds 64 instructions: 44 floating-point and 20 nonprivileged)	95	4,560	15
1921-00	Channel Cabinet (provides housing for multiplexor and up to 2 selector channels)	195	9,360	30
F1618-00	Selector Channel (8 subsystem max, 825-KB transfer rate, 2 max, cabinet reqrd)	170 each	8,160 each	30 each
F1620-00	Multiplexor Channel (8 subsystem max, 83-KB transfer rate, 1/system, cabinet reqrd)	125	6,000	30
	Memory			
	Expansion Storage			
F1775-00	16K Bytes	140	6,720	20
F1907-01	32K Bytes	280	13,440	40
	MASS STORAGE			
	Discs (can also use 8414/8411 disc subsystem, subject to availability)			
	Integrated Disc Storage			
F1621-00	Disc Adapter (provides interface and control for up to 4 8416-type disc drives; expandable to 8 drives with addition of IDA expansion; min of 2 drives reqrd)	200	9,600	50
	Features			
-99	IDA Expansion (expands disc adapter control to up to 8 8416 drives)	170	8,160	30
8416-02	Disc Storage (provides direct access of up to 28.9M bytes of data using removable disc packs; avg access is 33 ms; transfer rate is 625 KB/sec)	240	11,520	75
F1216-01	Disc Pack	20	450	–
	8430 Disc Subsystem			
5039-00	Control Unit (selector channel reqrd; controls up to 8 8430-type disc drives with access to 800M 8-bit bytes; min of 2 disc units/subsystem)	1,200	57,600	300

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	8430 Disc Subsystem (Contd.)			
8430-00	Disc Storage (provides single disc drive using removable disc pack; 1M byte/drive capacity; avg access time is 27 ms; transfer rate 806 KB)	520	24,960	130
	Features			
F1230-00	Disc Pack (provides up to 100M bytes of removable storage for 8430-type drive; maintenance NA)	40	750	–
	16-drive expansion (provides the capability to attach up to 16 8430 disc drives)	160	7,680	40
	INPUT/OUTPUT			
	Punched Card			
0605-00	Integral Card Punch (75-160 cpm serial punch; includes validity checking, 700-card input hopper, 600-card output stacker, eject stacker)	205	9,840	75
F1617-00	Punch Read Station (permits reading of 80-col cards)	15	720	5
0604-99	Row Punch Subsystem (250 cpm, 80-col multiplexor I/O channel reqrd; includes program control of stacker selection; input hopper 1,000 cards; 2 output stackers, 1,000 cards each)	386	16,443	101
F0875-00	Read/Punch	124	5,219	53
0717-00	Integral Card Reader (500-cpm, 80-col card; validity checking with a read check station; 2,400-card input hopper and 2,000-card output stacker)	190	9,120	60
	Features			
F1627-00	Short Card (permits read of 51-col card)	35	1,680	10
-01	Short Card (permits read of 66-col card)	35	1,680	10
	Card Reader Subsystem			
0716-99	Card Reader and Control (1,000 cpm, 80-col card; multiread checking, input hopper 2,400 cards, 2 output hoppers, 2,000 cards each)	305	14,364	95
	Features			
F1487-00, 01	51- or 66-col read	39	1,497	10
F1488-00	Validity Check	16	756	–
F1498-00	Alternate Stacker Fill	10	504	–
F1530-99	Dual Translate (adds ASCII translator; under program control)	22	1,008	5
	Paper Tape			
	Paper Tape Subsystem (requires multiplexor I/O channel feature; subsystem requires controller and reader and/or punch, reader spooler, and punch take-up spooler)			
0920-02	Controller	185	7,917	29
F1033-02	Reader (300 cps; 5, 6, 7, or 8 channels)	39	1,680	17
F1032-02	Punch (110 cps; 5, 6, 7, or 8 channels)	135	5,754	24
F1034-00	Reader Spooler (5" diameter spools)	39	1,680	5
F1035-00	Punch Take-Up Spooler (5" or 8" diameter spools)	16	688	5
	Printers			
0773-99	Integral Printer (prints 48 char at 500 lpm, 120 print positions expandable to 144; requires print cartridge)	460	22,080	175
	Features			
F1648-00	132 Print Positions (expands print positions from 120 to 132)	40	1,920	10
-01	144 Print Positions (expands print positions from 132 to 144)	40	1,920	5
-02	144 Print Positions (expands print positions from 120 to 144)	80	3,840	15
F1649-00	Extend Character Set (provides for use of print cartridges with more than a 64-char array)	45	2,160	8
F1647-xx	Print Cartridges (many available)	30 each	1,440 each	–
0768-00	Drum Printer and Control (multiplexor I/O channel required; 132 print positions; 63 char at 900 lpm, 49 char at 1,100 lpm; 6 or 8-lpi spacing)	1,001	42,709	354
-99	Drum Printer and Control (multiplexor I/O channel reqrd; prints 63 char at 1,200 lpm, 43 char at 1,600 lpm; 132 print positions; 6 or 8-lpi spacing)	1,242	52,989	438
F1071-00	Converts 0768-00 to 0768-99	241	10,280	84
F1820-00	Stacking/Acoustical Aid (provides additional sound suppression to 0768 printers; also provides power driven assistance to form stacking)	10	436	–
0770-00	Band Printer and Control (prints 48 char at 800 lpm, 132 print positions/line; vertical spacing 6 or 8 lpi; max forms advance rate 50 ips; print cartridge not included)	1,066	45,539	221

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Features (Contd.)			
-02	Band Printer and Control (same as 0770-00 except prints 1,400 lpm and max forms advance is 75 ips)	1,275	54,469	289
-04	Band Printer and Control (same as 0770-00 except prints 2,000 lpm and 100 ips)	1,806	77,128	368
	Features			
F1533-00	160 Print Positions (expands from 132 positions to 160 positions; factory installed only)	87	3,707	16
F1534-00	Expanded Character Set Control (provides control reqrd for print cartridges containing char sets other than 48-char)	57	2,400	5
F1536-xx	Print Cartridges (a variety of char sets and fonts available)	21	420	–
2703-00	Optical Document Reader (reads printed numeric data of a specific font style from various size documents; feeds documents of a 6" length at rates of up to 300/min)	937	44,100	197
F1108-00	600-dpm Speed Upgrade (permits speed to be increased to 600 documents per minute for 6" documents)	236	11,088	34
F1163-00	Modulus 10 Check Digit (computes by modulus 10 formula a check digit based upon numeric data printed on the document and compares the result with a check digit printed on the document)	22	1,008	5
F1106-00, 01	Mark Read – EBCDIC, ASCII (permits reading of vertical pencil marks located in columns on the document; marks can be read in image mode or translated into EBCDIC or ASCII)	177	8,316	39
F1149-00	Punch Card Read (permits reading of 80-col cards; F1106-00, 01 is reqrd)	59	2,772	10
F1154-00	Validity Check (F1106-00, 01 reqrd)	10	504	–
F1155-00	Univac H-14 Conversion	–	762	–
F1156-00	USASCSOR Conversion	–	762	–
F1557-00	OCR "B"	–	762	–
F1239-00, 01	EBCDIC, ASCII Conversion	–	–	–
F1249-00	EBCDIC Mark Read Convert (permits field conversion from ASCII mark read feature to EBCDIC mark read feature)	–	63	–
F1249-01	ASCII Mark Read Convert (permits field conversion from EBCDIC mark read feature to ASCII mark read feature)	–	300	–
0768-02	ASCII Printer and Control (multiplexor I/O channel reqrd; 132 print positions; 6 or 8-lpi spacing; 2,000 lpm-numeric, 1,000 lpm, 87-char set, 840-lpm, 94-char set)	1,146	48,873	398
F1522-00	Print Code Expansion (provides for expansion to 108-char set; special print drum reqrd)	5	252	–
	Magnetic Tape			
	Uniservo 12/16 subsystem involves either (a) Uniservo control plus (max of 4) masters and slave (max of 3/master), or (b) Uniservo 12/16 control and max of 16 tapes; selector channel reqrd.			
5017-99	Uniservo 12 Control (controls up to 16 9-track phase-encoded, 1,600-bpi Uniservo 12 tape units)	520	22,224	95
	Features			
F0825-00	Dual Channel (permits nonsimultaneous operation on selector channel from 2 CPUs) Simultaneous Operation (provides R/R, R/W, W/R, and W/W capability on 2 selector channels)	87	3,885	16
F1029-99	For Uniservo 12 Control	332	14,162	63
-00	For Uniservo 12/16 Control		15,905	
F0823-99	7-Track NRZI (provides capability of adding 7-track tape units to control)	113	5,025	16
F0826-00	9-Track NRZI (enables read or write in NRZI mode at 800 bpi)	113	5,028	16
F1028-95	7-Track Addition (adds 7-track NRZI to 9-track NRZI)	82	3,654	10
-96	9-Track Addition (adds 9-track NRZI to 7-track NRZI)	82	3,654	10
F1131-99	Uniservo 16 Capability (permits use of Uniservo 16 tape units with Uniservo 12 control)	41	1,743	10
0861-00	Uniservo 12 Master (9-track phase-encoded; handles up to 3 slaves; 1,600 bpi, 68-KB transfer rate)	360	15,383	113
-01	Uniservo 12 Slave (9-track phase encoded)	289	12,333	78
-04	Uniservo 12 Master (7-track NRZI handles up to 3 slaves; 200/556/800-bpi density; transfer rate 8,540/ 23,741/34,160 cps)	313	13,334	113
-05	Uniservo 12 Slave (7-track NRZI)		10,963	

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Features (Contd.)			
F0934-99	7- or 9-Track Simultaneity Phase-Encoded (1 reqrd for each master; control must have simultaneous feature)	80	3,429	17
-01	7- or 9-Track Simultaneity NRZI (1 reqrd for each master; control must have simultaneous and 7- or 9-track NRZI capability features)	91	3,885	17
F0935-00	Dual Density (reqrd in each master to read both NRZI and phase-encoded tapes)	53	2,284	10
F1041-00	7- to 9-Track Conversion (converts 7-track NRZI non-simultaneous master to phase-encoded master)	48	2,049	–
-01	7- to 9-Track Conversion (converts 7-track NRZI simultaneous Uniservo 12 master [0861-04] with F0934-98 to 9-track 1,600-bpi phase-encoded simultaneous master [equivalent to 0861-00 with F0934-99])	48	2,049	–
F034-98	Simultaneous Operation (reqrd in each master [0861-04] to achieve 7-track NRZI simultaneous operation; each control unit must contain F0823-99)	80	3,429	17
F1042-00	7- to 9-Track Conversion (converts 7-track NRZI slave to phase-encoded slave)	32	1,371	–
5017-00	Uniservo 12/16 Control (controls up to 16 9-track phase-encoded Uniservo 12 and/or 16 tape units); same options as Uniservo 12 control)	561	23,967	105
0862-00	Uniservo 16 Tape Unit (9-track phase-encoded; 1,600 bpi, 192-KB transfer rate)	459	19,609	116
-02	Uniservo 16 Tape Unit (7-track NRZI; 200/556/800-bpi, 24/66/96-KB transfer rate)	459	19,609	116
	Features			
F0936-99	Simultaneous Feature (reqrd for each unit for simultaneous operation)	21	914	–
F0937-00	Dual Density (reqrd in each unit to read or write both phase-encoded and NRZI)	51	2,284	–
	Uniservo 20 Tape Subsystem			
5034-00	Uniservo 20 Control (selector channel reqrd; controls up to 16 9-track phase-encoded Uniservo 12s, 16s, 20s, or a mixture of each; 1,600 bpi, 2 control units reqrd for dual-access operation)	765	32,681	95
	Features			
F0823-98	7-Track Capability (provides capability of adding 7-track NRZI Uniservo 12/16 tape units to control)	113	5,544	16
F1028-98	9-Track Addition (adds 9-track NRZI capability to 7-track capability feature)	113	5,544	16
F0826-99	9-Track NRZI (enables R/W operations in 9-track NRZI at 800 bpi and 9-track phase encoded 1,600 bpi on Uniservo 12 and 16 tape units; Uniservo 12/16 tape units must have appropriate features)	133	6,552	21
F1028-97	7-Track Addition (adds 7-track NRZI capability to 9-track NRZI option)	92	4,536	10
0864-00	Uniservo 20 (9-track phase-encoded tape unit; transfer rate 320,000 bytes/sec; 1,600 bpi; reads forward and backward; writes forward)	577	24,620	132
	Features			
F1510-00	Dual Access (provides for dual access and simultaneous R/R, R/W, W/R, and W/W operations when added to 2 or more Uniservo 20s; requires 2 control units)	51	2,284	10
	DATA COMMUNICATIONS			
	90/30 Communications Subsystem			
F1625-99	Communications Adapter (controls and coordinates transfer of data from up to 6 full-duplex or 12 half-duplex lines; each line requires adapter)	195	9,360	35
	Features			
F1625-98	Communications Adapter Expansion (expands the capability of the communications adapter to 12 full-duplex or 24 half-duplex lines; each line requires a line adapter)	195	9,360	35
	Line Adapters			
F1826-00	Synchronous Line Adapter (interface for data sets conforming to RS232 and CCITT)	18	864	7
-01	Synchronous Line Adapter (same as F1826-00 plus provides reverse channel of up to 150 baud async; requires 2 ports)	27	1,296	8

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Line Adapters (Contd.)			
F1828-00	Asynchronous Line Adapter (provides interface to async data sets conforming to RS232 and CCITT)	14	672	6
-01	Asynchronous Line Adapter (same as F1828-00 plus provides reverse channel of up to 5 baud)	18	864	7
-02	Asynchronous Line Adapter (same as F1828-00 except provides reverse channel of up to 150 baud; requires 2 ports)	22	1,056	8
F1830-00	Wideband Line Adapter (provides a sync full-duplex interface to an AT&T 300 series data set operating at 40.8K bps with 56K-bps max speed)	22	1,056	8
-01	Wideband Line Adapter (provides a sync full-duplex interface with an AT&T 300 series data set at 50K bps; includes auto-answering capability)	22	1,056	8
F1831-00	Dial Adapter (provides the interface to both rotary or touch-tone auto dialing units; requires a line adapter location for each dialing unit)	14	672	6
F1832-00	Asynchronous Relay Line Adapter (provides async full-duplex interface optionally compatible with either 20-75 ma neutral or 10-40 ma polar telegraph lines)	14	672	6
F1835-00	TWX Line Adapter (provides interface to the USA TWX network)	14	672	6
F1836-00	Telex Line Adapter (provides interface to USA WU Telex network)	14	672	6
F1870-00	Active Line Indicator (provides display panel to display line activity on up to 12 communication lines; 2 permitted if F1625-98 is present)	7	336	2
F1001-01	Channel Adapter 9200/9300 (provides communication via respective multiplexor channels)	88	3,885	16

Model Number	Description	Monthly Rental $
	SOFTWARE	
	90/30 Newscomp	
	Basic 90/30 Newscomp	
6500-00	(Provides typesetting composition control routines instructed by commands for the automatic typesetting of textual material. Commands are provided for delimiters, space control, face selection, format control, language control, character string manipulation, justification modifiers, and auxiliary control)	100
	Editing Control	
F5000-00	(Adds the capability to edit information, via Uniscope 100 terminals, to Basic 90/30 Newscomp. Editing capabilities include: open text, compress text, scroll forward, scroll backwards, save text, insert text, duplicate text, restart, and terminate edit. Four levels of control commands include: log, route, release, delete, monitor, merge, copy, rename, unload, load, close system, and abort system.)	100
	Classified Ads	
F5001-00	(Adds classified ad processing capabilities to Basic 90/30 Newscomp. These capabilities include: sort by classification, content or optional key; ad extension; ship dates, and automatic ad deletion. The ability to output by classification or groups of classification is also provided. Editing/Control [F5000-00] is prerequisite)	100
	90/30 UNIS	
6501-00	Basic 90/30 UNIS (includes a Master Data Processor which provides for maintenance of the standard manufacturing data files, and for processing capabilities in the areas of bill materials retrievals and standard routings)	75
F5002-00	Production Planning and Scheduling to Infinite (This subsystem of 90/30 UNIS provides for backward scheduling, forward scheduling, splitting, overlapping, and reduction of wait times in scheduling to infinite capacity Excludes Finite [F5002-01])	75

Model Number	Description	Monthly Rental $
	90/30 UNIS (Contd.)	
-01	Production Planning and Scheduling to Finite. (This subsystem of 90/30 UNIS employs priority calculations, calculation of realistic start, and calculation of realistic end dates in scheduling to finite capacity. Excludes Infinite [F5002-00])	100
F5003-00	The Inventory Management Subsystem of 90/30 UNIS (adds capabilities in the areas of inventory control, statistical forecasting, requirements planning, order recommendation, order allocation, ABC analysis, and statistics)	75
F5004-00	The Work Order Management Subsystem of 90/30 UNIS (adds capabilities to Inventory Management [F5003-00] for order release and order control. Order release functions include on-hand availability control, creation of on-hand reservations, and shortage reporting. Order control includes work order status update, work in progress quantity, and reservation control. Inventory Management [F5003-00] is prerequisite)	25
	90/30 Profits	
6502-00	Profits/Time Deposits (provides overall communications and control and on-line time deposits transactions including: passbook update, cash, mail, check deposits [with/without holds]; interest calculations, cash, check, mail withdrawals, return check, rebate interest. Off-line support program for maintenance and reloading of data files are also provided)	420
-01	Profits/Loans (provides for on-line commitment record generation, on-line processing of transactions for mortgage, [capitalized and non-capitalized] commercial, and construction and discount loans. Off-line support programs are also provided for maintenance and file reload and generate the necessary information for off-line reports)	165

— Not Applicable

WANG LABORATORIES INC.

WCS/10, 20, and 30

OVERVIEW

The WCS systems represent Wang's offerings for the first-time computer user. Introduced in April 1975, the WCS/10, 20, and 30 marked Wang's entrance into the highly competitive business of marketing a computer system that will replace any of a variety of methods (manual operations, tab equipment, accounting machines, service bureaus) used by small businesses to process their daily operations.

The WCS systems have been designed to fit comfortably into the office environment. Each system is housed in an office-furniture-type cabinet that contains the CPU with eight to 32K bytes of user memory, operator's keyboard, and CRT display screen.The WCS/10 uses a single magnetic tape cassette for storage, and the WCS/20 and 30 have a disc storage system. The WCS/20 uses a flexible disc, and the WCS/30 uses a flexible disc and a fixed/removable disc.

To the basic WCS systems can be added a variety of peripherals including line printers, plotters, a punched tape reader, a mark sense card reader, and additional auxiliary storage. The newest addition to the WCS systems is a workstation (up to three) that can be multiplexed to a WCS/30 configured with a fixed/removable disc. The Model 2200WS workstations allow the WCS user to configure a system that will allow up to four operators to work simultaneously.

The WCS systems use the Wang hardwired BASIC interpreter which provides 42.5K bytes of read-only memory (ROM). This allows some of the most commonly used BASIC instructions and statements to be entered into the WCS via single function keys on the operator's keyboard.

Wang realizes that customized applications software is critical to the success of entry-level systems. Therefore, in addition to user-created programs, Wang has established agreements with over 200 software houses. Wang will sell the systems; the software houses will sell the software — both, it is stated, will share the responsibility for any problems. Wang itself offers national packages for engineering, scientific, technical, general business, educational, and medical applications. Notable additions to these groups of applications packages is the Wang/CASH turnkey system for public accounting and the Wang Management Planning System (MPS) for financial forecasting.

In addition, Wang offers over 50 applications packages on the regional basis. Wang also has a users group called SWAP (Society for Wang Applications Programs) which is still another source of applications software.

The WCS models are packaged versions of the popular Wang System 2200 Computer. The 2200 has found wide acceptance in the scientific, engineering, and business communities as a dedicated, stand-alone system. Its modular components and wide variety of peripheral offerings has made it a front-running system in the supercalculator or desk-top computing marketplace. As a low end for the System 2200 line, Wang introduced (March 1976) the Wang 2200 Portable Computing System (PCS). The PCS, like the WCS systems, is based on the Series 2200 central processor.

The WCS models were first shipped in June 1975. See Table 1 for system specifications.

Compatibility

The Wang System 2200 Computer, the 2200 Portable Computer (PCS), and the Wang WCS/10, 20, and 30 are all based on either the 2200S or 2200T processor and share some of the same peripherals. All use the Wang BASIC interpreter language, either in the standard or extended versions.

Program compatibility differences between the systems reside in the type of auxiliary storage they support.

HEADQUARTERS

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Table 1. Wang WCS/10, 20, and 30: Specifications

	WCS/10	WCS/20	WCS/30
CONSOLE			
Cabinet (in.)	30 x 30	30 x 46	30 x 72
CRT	9 in., 1,024 char	12 in., 1,024 char	12 in., 1,024 char
Keyboard	52-key typewriter, 10-key numeric, 5 special function keys	52-key typewriter, 10-key numeric, 5 special function keys	52-key typewriter, 10-key numeric, 5 special function keys
PROCESSOR			
Main Memory (bytes)	8-32K	8-32K	16-32K
Word Length (bytes)	8	8	8
Cycle Time (μsec)	1.6	1.6	1.6
Program Languages	BASIC	BASIC	BASIC
Max No. of Devices	11	11	11
AUXILIARY STORAGE			
Tape Cassette	78K bytes/cassette	Opt	Opt
Diskette	No	262,144 bytes	262,144 bytes
Fixed/Removable Disc	No	Opt	5,013,504 bytes
PERIPHERALS			
Printer	Opt	Opt	9 x 9 dot matrix (200 cps)
Workstations	No	No	8-32K bytes memory
Punched Tape	Opt (300 cps)	Opt (300 cps)	Opt (300 cps)
Output Writer	Opt (13 cps)	Opt (13 cps)	Opt (13 cps)
Plotting Writer	Opt	Opt	Opt
Hopper Feed	Opt	Opt	Opt
Card Reader	Opt (285 cards/min)	Opt (285 cards/min)	Opt (285 cards/min)
Digitizer	Opt	Opt	Opt
9-track 1/2-in. Tape Drive	No	Opt	Opt
Punched/Mark Sense Cards	Opt	Opt	Opt
COMMUNICATIONS			
Async (bps)	To 9,600	To 9,600	To 9,600
Binary Sync (bps)	No	To 4,800	To 4,800
COMPATIBILITY			
Emulation	TTY	TTY, IBM 2780, 3780, 3741	TTY, IBM 2780, 3780, 3741

- The 2200 PCS (based on the 2200S processor) uses tape cassette.
- The System 2200 Computer (either the 2200S or 2200T processor) can use tape cassette, floppy and/or hard discs.
- The WCS/10 (based on the 2200S processor) uses tape cassette storage; the WCS/20 (based on the 2200T processor) uses floppy disc storage; the WCS/30 (based on the 2200T processor) uses floppy and fixed/removable disc storage.

PERFORMANCE AND COMPETITIVE POSITION

Small business computers designed for the first-time computer user are appearing from every segment of the marketplace. Major mainframers, independent manufacturers, systems houses, and people working out of their garages are trying to tap the reservoir of first-time computer users.

Certainly, it will be several years before the market fully matures and before the winners are separated from the losers.

The Wang WCS systems have the makings of a winner — a year after their introduction, about 1,700 systems had been shipped. The reasons for their success? Most prominent on the list would be the well-proven capabilities of the Wang 2200 processor; the BASIC language capabilities of the system; and the wide range of available peripherals for the WCS. Added to that are the numerous application packages supplied by Wang and the network of vendors (responsible to Wang) that can turnkey customize a WCS system.

However, the WCS faces some stiff competition. Until Wang added workstation capabilities (up to three), the WCS competed primarily at the low end of the small business market with systems like the NCR 399, the Burroughs L Series with flexible disc storage, and low-priced systems like Digital's Datasystem 310. With the workstation capabilities the WCS systems compete directly with a whole new can of worms. Its primary competition would include IBM System/32 with 3740 data stations, the Burroughs B730 with B9347-2 Direct Data Entry Stations, the IBM System/3 Model 4, and Basic/Four. The workstation capabilities of each of these systems differ. The Wang workstations may be running four different jobs, for example, but all stations must be accessing the same program on the disc.

USER REACTIONS

Not too surprisingly, several of the Wang users interviewed were not using their WCS systems for business applications. Wang's traditional strength, gained from the reputation of the System 2200, has been in the scientific, engineering, and educational markets. The packaged WCS systems represent Wang's successful attempt to attract the small business market; however, they still draw a large group of users from the nonbusiness market. Consequently, users are putting the WCS hardware to some very sophisticated tests and finding that it is passing with

flying colors. At the same time, business users are finding that their WCS systems fit their general accounting and record-keeping needs and are easily accessed and operated by their existing office staffs.

Retail Fuel Oil Company. A fuel oil company is using a WCS/30 for accounts receivable, accounts payable, and product and service dispatching. The firm has never had an in-house system, and a spokesman for the firm reported that the WCS is being operated by the existing office staff. The CRT/keyboard input method has helped to acclimate the staff to the system. Although Wang has done all programming for this installation, one of the members of the staff has taken a 2-day course given by Wang and foresees doing some of his own programming in the future.

The firm was one of Wang's first WCS customers. Accordingly, Wang has worked closely with the firm in developing specialized fuel-oil applications modules. There were some initial hardware and software bugs during the first 90 days after the installation of the equipment, but they have since been worked out.

Medical Diagnostic Center. Two WCS/30s are installed at this user site. The first system is configured with 24K bytes of main memory, a floppy disc, a 5M-byte fixed/removable disc, a 200 character-per-second printer, and a 9-track tape drive. The second system is configured with 16K bytes of main memory, a 200 character-per-second printer, and a teletypewriter. The center uses its Wang systems for medical reporting, medical diagnostics, billing, and test data. The programming has all been done by an in-house staff with prior experience using Wang hardware.

This installation uses the WCS/30 as a personal computing tool — it is accessed by only a few people who use it to perform specific decision-making tasks. Essentially, the WCS/30 is being used in the same way as the Wang System 2200, which is generally considered as one of the supercalculator devices.

The medical center experienced good response time from its local service center but noted that equipment requests sent to the Wang headquarters took an exceptionally long time to be filled.

Petroleum Exploration. This company has a Wang WCS/30 and two Wang System 2200 configurations. All of the systems are used for esoteric, specialized applications in the geophysical engineering market.

The spokesman for the firm was adamantly in favor of the Wang equipment's special qualities for his particular applications. Again, this company is not using the Wang for business applications, but rather as a supercalculator. Competing systems, including the Hewlett-Packard 9830, the IBM 5100, and the Tektronix 4051 Graphic Computing System, were all considered and rejected in favor of Wang. The flexibility and strength of Wang's BASIC language and the wide range of peripheral offerings were cited as the strongest capabilities of the Wang system. Also noted were the user-oriented qualities of the Wang system, particularly the CRTs for easy data handling.

CONFIGURATION GUIDE

WCS/10, 20, and 30 are each capable of operating as stand-alone processing units. The three basic configurations for WCS systems are broken down into submodels, which are differentiated by the amount of main memory they support. See the PRICE DATA section of this report for a listing of the WCS/10, 20, and 30 submodels.

WCS/10

The basic WCS/10 configuration includes a single tape cassette for storage; an operator's console Model 2220 with 9-inch CRT screen; and standard typewriter keyboard with 52 keys, 16 special function keys, 10 numeric keys, and five system keys. The WCS/10 has an eight to 32K user memory and a 24K fixed system program and control memory (ROM). The WCS/10 supports asynchronous communications and performs local teletype communications with other WCS systems. Three I/O slots are standard on the WCS/10, and three more may be added as an option. All peripherals are field installable.

WCS/20

The basic WCS/20 configuration includes flexible disc storage, an operator's console with 12-inch CRT screen (removal of the tape cassette left room for expansion), and a keyboard identical to the one on the WCS/10. User memory on the WCS/20 is eight to 32K and fixed system and control memory (ROM) is 42.5K. The WCS/20 is file oriented; the sort and file manipulation routines are hardwired. Asynchronous and IBM 2780 binary synchronous communications are supported. Six I/O slots are standard on the WCS/20, and three more may be added as an option. All peripherals are field installable.

WCS/30

The basic WCS/30 configuration includes a flexible and a fixed/removable disc, an operator's console with 12-inch CRT screen, and the same keyboard as the WCS/10 and 20. User memory on the WCS/20 is 16 to 32K, and fixed system and control memory (ROM) is 42.5K. The model 2221W serial printer (9 x 9 dot matrix; 200 characters per second) is standard on the WCS/30. As on the WCS/20, asynchronous and IBM 2780 binary synchronous communications are supported. Six I/O slots are standard on the WCS/30 and three more may be added as an option. All peripherals are field installable.

Workstations. The Wang 2200WS workstation is a single desk-top unit consisting of eight to 32K bytes of random access memory (RAM), a 42.5 bytes of BASIC interpreter on read-only memory (ROM), a 12-inch CRT display and keyboard, and a 2230MXA disc multiplexor connector.

Up to three 2200WS workstations can be multiplexed to any Wang 2200 or WCS/30 configured with a fixed/removable disc (5MB). Stations are sequentially polled by the multiplexor controller on an "equal priority" basis every four microseconds. When a station requests the disc, all other stations are locked out and the station is permitted to execute a single disc statement or command. When the station is finished with the disc, the multiplexor resumes its polling of all the stations.

A programmable lock-on-mode permits one station to access the disc without being interrupted.

In a four station configuration (one WCS/30 and three 2200WS workstations), the maximum distance between the WCS/30 and the third workstation is 536 feet. The maximum distance between the WCS/30 and the workstation containing the 2230MXA board is 12 feet.

SYSTEM DESIGN

All three models have the same basic architectural features. Each system is housed in an office-furniture-type cabinet. Each unit contains the CPU, which handles logic, arithmetic, and I/O functions; operator's keyboard and display screen; storage devices; and read-only memory (ROM), which executes language and I/O directives. A freestanding line printer is standard equipment on the WCS/30 and optional on the other two systems.

Memory speed, 1.6-microsecond cycle time, is the same for all three systems. Word length is an 8-bit byte. Maximum memory on the WCS/10, 20, and 30 is 32K and is expandable in 8K- or 16K-byte increments. Minimum configurations of the WCS/10, 20, and 30 support 8,192-byte or 16,384-byte memories. Read-only memory capacity is 24K on the WCS/10 and 42.5K on the WCS/20 and 30.

Console

Each WCS has an operator's console that is equipped with an alphanumeric typewriter keyboard and operator's visual display screen.

Keyboard. The basic keyboard for all three systems includes 52 standard typewriter keys. There are also 16 keys, uppercase alpha characters, for BASIC commands and calculations; 32 special functions can be performed with these keys. Each system includes a separate 10-key numeric pad, as well as five separate system keys (Clear, Run, Execute, etc.).

CRT. The CRT screen displays 1,024 characters in 16 lines, with 64 characters in each line. The screen is a 9-inch diagonal on the WCS/10 and a 12-inch diagonal on the WCS/20 and 30. Uppercase characters are standard.

PERIPHERALS

Peripheral devices — high-speed, slow-speed, and special-purpose — are available for all WCSs. Up to 11 peripherals can be attached to a single processor. Currently available peripherals from the Wang 2200 system can also be used.

Tape Cassette. Only the WCS/10 uses a tape cassette for storage. The tape stores 522 bytes per inch and 78,000 bytes on the entire cassette. It operates at a transfer rate of 326 bytes per second.

Flexible Diskette. The flexible diskette (Model 2270-1) is standard equipment on the WCS/20 and 30. Each diskette has 1,024 sectors with 256 8-bit bytes in each sector, for a total of 262,144 bytes per disc. The disc has an average time of 401 milliseconds; average latency time is 80 milliseconds.

Fixed/Removable Disc. Only the WCS/30 uses the fixed/removable disc. Each disc (Model 2230-3) has 9,792 sectors per platter for a total of 19,584 sectors. Total bytes on the disc is 5,013,504. The disc has an average access time of 41 milliseconds; average latency time is 20 milliseconds. A 10M-byte disc (Model 2260) is also available.

Serial Matrix Printer. WCS offers a newly announced serial matrix impact printer. The Model 2221W printer can be used only with the WCS/30 at the present time. The printer has a speed of 200 characters per second or 65 to 300 lines per minute, depending on the length of the line. Model 2221W uses a 9 x 9 dot matrix and has a 96-character upper- and lowercase character set. The printer handles 5-part forms (original plus four carbon copies).

Optional Peripherals. Other peripherals that can be attached to all the WCS models include: 9-track 800 bit-per-inch tape (not available on the WCS/10), punched tape reader/punch (300 characters per second), plotter, mark sense card reader, digitizer (analog-to-digital converter), and 285 card-per-minute card reader.

DATA COMMUNICATIONS

The Model 2227B Buffered Asynchronous Communication Controller provides any WCS model with asynchronous communications capability from 110 to 9,600 bits per second. Model 2227B features Teletype compatibility and allows a WCS to communicate with another similarly equipped WCS or 2200 system.

The Model 2228 Communications Controller permits the WCS/20 and 30 to emulate IBM 2780, 3780, and 3741 binary synchronous communications (BSC) up to 4,800 bits per second. Via the Model 2228, a WCS system can serve as a remote batch terminal to an IBM System/360 or 370.

SOFTWARE

The WCS has no identifiable operating system, assembler, or compiler. It does, however, have over 35 hardwired BASIC commands on the function keys of the operator's console. Also, the WCS user can select customized software packages from 200 software firms. In

addition to this vendor network, Wang is producing its own packaged systems and programs, which will add to the already existing Wang BASIC software with which the WCS is fully compatible.

Specialized WCS capabilities include a data management system, Keyed File Access Method (KFAM), and a file sorting and manipulation system. More than 100 specialized programming systems are available for use on the WCS/10, 20, and 30. The applications they cover include:

Accounting	Leisure	Education
Automotive	Manufacturing	Medical
Agricultural	Marketing	Scientific
Insurance	Real Estate	Engineering
Construction	Transportation	Statistical

MAINTENANCE

Wang provides maintenance for its systems under a monthly or yearly service contract. Service is available during regular business hours from Wang service centers in major U.S. cities.

PRICE DATA

Model	Description	Purchase Price (not incl. maint.) $	Monthly Maint. $	Monthly Rental 1-yr (not incl. maint.) $	Lease $ 2-yr	3-yr	4-yr	5-yr
	Basic Systems							
WCS10-2	2200S CPU with 8K, 3 I/O slots, console-CRT, keyboard, tape cassette	6,100	42.50	207.40	305	219.60	178.73	149.45
WCS10-4	2200S CPU with 16K, 3 I/O slots, console-CRT, keyboard, tape cassette	7,700	58.50	261.80	385	277.20	225.61	188.65
WCS10-6	2200 CPU with 24K, 3 I/O slots, console-CRT, keyboard, tape cassette	9,100	74.50	309.40	455	327.60	266.63	222.95
WCS10-8	2200 CPU with 32K, 3 I/O slots, console-CRT, keyboard, tape cassette	10,500	90.50	357	525	378	307.65	257.25
WCS20-2	2200T CPU with 8K, 6 I/O slots, 12-in. CRT and keyboard, diskette	11,200	73	380.80	560	403.20	328.16	274.40
WCS20-4	2200T CPU with 16K, 6 I/O slots, 12-in. CRT and keyboard, diskette	12,800	89	435.20	640	460.80	375.04	313.60
WCS20-6	2200T CPU with 24K, 6 I/O slots, 12-in. CRT and keyboard, diskette	14,200	105	482.80	710	511.20	416.06	347.90
WCS20-8	2200T CPU with 32K, 6 I/O slots, 12-in. CRT and keyboard, diskette	15,600	121	530.40	780	561.60	457.08	382.20
WCS30-4	2200T CPU with 16K, 6 I/O slots, 12-in. CRT and keyboard, diskette, 5MB fixed/removable disc 2221W printer stand and desk	30,400	245	1,033.60	1,520	1,094.40	890.72	744.80
WCS30-6	2200T CPU with 24K, 6 I/O slots, 12-in. CRT and keyboard, diskette, 5MB fixed/removable disc 2221W printer stand and desk	31,800	261	1,081.20	1,590	1,144.80	931.74	779.10
WCS30-8	2200T CPU with 32K, 6 I/O slots, 12-in. CRT and keyboard, diskette, 5MB fixed/removable disc 2221W printer stand and desk	33,200	277	1,128.80	1,660	1,195.20	972.76	813.40
	Memory							
–	Upgrade of 8K bytes of memory	2,000	16	68	100	72	58.60	49
–	Upgrade of 16K bytes of memory	3,200	32	108.80	160	115.20	93.76	78.40
	System Options							
2200WS	Workstation, with 8K	4,900	–	–	–	–	–	–
–	Second Diskette Disc Drive for WCS-20/30	1,500	15	51	75	54	43.95	36.75
–	Third Diskette Disc Drive for WCS-20/30	1,500	15	51	75	54	43.95	36.75
–	10-Megabyte Disc Drive in lieu of 5-Megabyte Disc for WCS-30	2,000	23.50	68	100	72	58.60	49
2294	WCS Equipment Stand	250	N/A	8.50	12.50	7	7.33	6.13
	Output Peripherals							
2201	Output Writer	2,400	24	120	120	86.40	70.32	58.80
2202	Plotting Output Writer	4,000	40	200	200	144	117.20	98
2212	Analog Flatbed Plotter (10 in. x 15 in.)	3,600	36	180	180	129.60	105.48	88.20
2221W	Wang Line Printer (132 column)	5,000	56	250	250	180	146.50	122.50
2231	Line Printer (80 column)	3,300	33	165	165	118.80	96.69	80.85
2232A	Digital Flatbed Plotter (31 in. x 48 in.)	8,000	80	400	400	288	234.40	196

PRICE DATA (Contd.)

Model	Description	Purchase Price (not incl.) maint.) $	Monthly Maint. $	Monthly Rental 1-yr (not incl. maint.) $	Lease $ 2-yr	3-yr	4-yr	5-yr
2261	High-Speed Printer (132 column)	7,300	73	365	365	262.80	213.89	178.85
2291	Digital Flatbed Plotter Stand	350	N/A	17.50	17.50	12.60	10.26	8.58
	Interface Controllers							
2207A	I/O Interface Controller (RS-232-C) Selectable BPS	600	3	30	30	21.60	17.58	14.70
2227	Asynchronous Telecommunications Controller	900	4.50	45	45	32.40	26.37	22.05
2228	Communications Controller	2,500	15	125	125	90	73.25	61.25
2227N	Null Modem for 2227	50	N/A	2.50	2.50	1.80	1.47	1.23
2250	I/O Interface Controller (8-bit parallel)	400	2	20	20	14.40	11.72	9.80
2252A	Scanning Input Interface Controller (BCD 1-10 digit parallel)	600	3	30	30	21.60	17.58	14.70
	Input Peripherals							
2203	Punched Tape Reader	1,800	18	90	90	64.80	52.74	14.70
2214	Mark Sense Card Reader	1,000	10	50	50	36	29.30	24.50
2234A	Hopper-Feed Punch Card Reader	4,000	40	200	200	144	117.20	98
2244A	Hopper-Feed Mark Sense Punch Card Reader	4,800	48	240	240	172.80	140.64	117.60
2262-1	Digitizer 20 in. x 20 in. Tablet	5,000	25	250	250	180	146.50	122.50
2262-2	Digitizer 30 in. x 40 in. Tablet (special order)	7,000	25	350	350	252	205.10	171.50
2262-3	Digitizer 36 in. x 48 in. Tablet (special order)	8,000	25	400	400	288	234.40	196
	Annunciator option for Digitizer	25	N/A					
	Mass Storage Peripherals							
2209	9-Track Tape Drive	2,000	90	600	600	432	351.60	294
2217	Single Tape Cassette Drive	1,200	13.50	60	60	43.20	35.16	29.40
2218	Dual Tape Cassette Drive	2,300	26	115	115	82.80	67.39	56.35
2230-1	Fixed/Removable Disc Drive 1,228,800 bytes	11,500	100	575	575	414	336.95	281.75
2230-2	Fixed/Removable Disc Drive 2,457,600 bytes	12,000	100	600	600	432	351.60	294.00
2230-3	Fixed/Removable Disc Drive 5,013,504 bytes	12,500	100	625	625	450	366.25	306.25
2230MXA	Daisy-Chain-type Disc Multiplexor (1st CPU)	800	4	40	40	28.80	23.44	19.60
2230MXB	Daisy-Chain-type Disc Multiplexor (2nd, 3rd, or 4th CPU)	500	2.50	25	25	18	14.65	12.25
2270-1	Single Removable Diskette Disc Drive 262,144 bytes	3,200	30	160	160	115.20	93.76	78.40
2270-2	Dual Removable Diskette Disc Drive 524,288 bytes	4,700	45	235	235	169.20	137.71	115.15
2270-3	Triple Removable Diskette Disc Drive 786,432 bytes	6,200	60	310	310	223.20	181.66	151.90
2260	Fixed/Removable Disc Drive 10,027,008 bytes	14,500	123.75	725	725	522	424.85	355.25
	CPU/Keyboard/Display Options							
OP-4	Audio Signal for 2216 & 2216A CRT	200	1	10	10	7.20	5.86	4.90
OP-20	Up to 6 I/O slots for 2200S&T CPUs	600	N/A	30	30	21.60	17.58	14.70
OP-20A	Up to 9 I/O slots for 2200S&T CPUs	1,200	N/A	60	60	43.20	35.16	29.40
OP-21	Matrix ROM	300	1.50	15	15	10.80	8.79	7.35
OP-22	Advanced Programming & Matrix ROM	800	4	40	40	28.80	23.44	19.60
OP-23	General I/O, Adv Prog & Matrix ROM	1,100	5.50	55	55	39.60	32.23	26.95
OP-24	Disc General I/O, Adv Prog Sort & Matrix ROM	2,000	5.50	100	100	72	58.60	49
OP-30	Upper/Lowercase for 2220 & 2226 CRT	200	1	10	10	7.20	5.86	4.90
OP-31	Audio Signal for 2220 & 2226 CRT	200	1	10	10	7.20	5.86	4.90
OP-32	Keyboard Clicker	80	N/A	4	4	2.88	2.34	1.96
2290	CPU/Peripheral Stand	250	N/A	12.50	12.50	9	7.33	6.13
	Keyboard/Display Peripherals							
2215	BASIC Keyword Keyboard	500	3.50	25	25	18	14.65	12.25
2216	CRT Executive Display	1,800	9	90	90	64.80	52.74	44.10
2216A	Upper/Lower Case CRT Display	2,000	10	100	100	72	58.60	49

PRICE DATA (Contd.)

Model	Description	Purchase Price (not incl. maint.) $	Monthly Maint. $	Monthly Rental 1-yr (not incl. maint.) $	Lease $ 2-yr	3-yr	4-yr	5-yr
2216/2217	Combined CRT Executive Display/ Single Tape Cassette Drive	2,800	22.50	140	140	100.80	82.04	68.60
2216A/ 2217	Combined Upper/Lower Case CRT Display/Single Tape Cassette Drive	3,000	23.50	150	150	108	87.90	73.50
2220	Console-CRT/Keyboard/Single Tape Cassette	3,000	15	150	150	108	87.90	73.50
2222	Alpha-Numeric Typewriter Keyboard	500	4	25	25	18	14.65	12.25
2223	Alpha-Numeric/BASIC Keyword Keyboard	800	4	40	40	28.80	23.44	19.60
2226	Console – 12 in. CRT and Keyboard	2,200	10	110	110	79.20	64.46	53.90
2292	Auxiliary Display w/25 ft. cable	600	2.50	30	30	21.60	17.58	14.70

WANG LABORATORIES INC.

2200 Portable Computer System

In an effort to establish itself as a major force in the small business computer market, Wang, in a series of announcements on March 24, 1976, introduced the Wang 2200 Portable Computer System (PCS), a new entry into the desktop computing market.

As part of what Wang has designated its "frontal attack on products currently offered in the small computer market," the Wang PCS has been priced and configured to create a low end for the long-popular Wang System 2200 Computer, and compete directly against the new desktop computers that have recently entered the small systems marketplace.

Aggressive Moves from Tewksbury

When IBM announced the 5100 Portable Computer, Wang quickly retaliated with a press statement charging IBM with a "me-too" approach. Wang claimed that it had been in the desktop computing (or the so-called portable computing) market long before IBM, and that its product, the System 2200, was superior to the 5100.

The System 2200 was introduced in 1972 as an outgrowth product of the Wang programmable calculator models. While the System 2200's initial marketing emphasis was on its capabilities as a sophisticated calculator, its growing peripheral and processing capabilities has led many users to employ the system in "computer-like" applications. Enter the 2200 PCS, which enjoys many of the features of the mature System 2200, while having the advantages of being a fresh face in the desktop market, and an aggressive pricing structure.

The 2200 PCS's Slot in the Marketplace

The 2200 PCS is a 57-pound, self-contained desktop computer. It consists of the 2200 central processor, with eight to 32K bytes of Random Access Memory (RAM) and 42.5K bytes of Read-Only Memory (ROM), that contains the hard-wired BASIC interpreter. Included in the unit is a 9-inch CRT screen and a single tape cassette. Optional peripherals for the system include the Wang 120-character-per-second and 200-character-per-second printers, the Wang drum plotters (single and triple pen), and an auxiliary display connector and display. To date, the PCS does not have communications capabilities, but they are hinted at for the near future. See Table 1 for system specifications.

Wang is targeting the PCS at several markets — all of which have been receiving a large share of attention from the major mainframe and independent manufacturers. These include first-time users, users interested in implementing a distributed processing network, time-sharing and service bureau users, and users who are interested in owning their personal computers.

With last year's introduction of the WCS systems for the novice computer user, Wang strengthened its position in that marketplace.

HEADQUARTERS

Wang Laboratories, Inc
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Table 1. Wang 2200 PCS: Specifications

Processor	
RAM (Random Access Memory)	8-32K bytes
RAM Speed (ms)	1.6
ROM (Read-Only Memory)	42.5K bytes
CRT Display	
Size	9" diagonal
Capacity	16 lines, 64 char/line
Tape Cassette	
Record Size	256 bytes
No. of Records	300 dual
Transfer Rate	326 bytes/sec
Recording/Search Speed	7.5 ips
Optional Peripherals	
Model 2221W Line Printer	200 cps
Model 2231W Line Printer	120 cps
Model 2272-1 Digital Drum Plotter	Single pen
Model 2272-2 Digital Drum Plotter	Three pens
Language	
BASIC Interpreter	Hardwired

The WCS series are packaged 2200 systems that have a variety of applications packages available and that can be turnkey customized. In its most recent series of announcements, Wang made a pitch for the distributed processing market with the introduction of a disc workstation for the WCS systems. This option will allow up to four users to access the WCS.

Grabbing the Marketplace's Attention

With several very serious and aggressive competitors entering the desktop computer market, product survival is going to depend on two factors: special product features and price.

So far, the desktop competitors are playing one-upmanship. The newest entries — the IBM 5100 Portable Computer, the Tektronix 4051 Graphic Computing System, the Hewlett-Packard 9825, and the Wang 2200 PCS — all offer either a special feature or a special price to attract the prospective buyer.

How does the 2200 PCS match up against its competitors?

IBM 5100. IBM's General Systems Division (GSD) announced the 5100 with a great deal of fanfare and aimed its marketing efforts directly at the end user — the professional who has need for a problem-solving tool.

With the PCS, Wang has mounted a price attack against the 5100. A 16K-byte PCS with a 9-inch CRT screen is priced at $7,000, compared with $8,975 for a 16K-byte 5100 with a 5-inch CRT screen. The price differential increases when a line printer is added to the respective systems — a 16K-byte PCS with a 120-character-per-second printer is priced at $9,900, while the IBM 5100 with an 80-character-per-second bi-directional printer costs $12,650. However, the IBM 5100 has some attractive features that will be hard to beat. Namely, its APL and/or BASIC capabilities, its communications capabilities, and its IBM mystique.

Tektronix 4051. Tektronix is targeting a specialized market with its 4051 Graphic Computing System. Its strong graphic capabilities, which are implemented via the 4051's graphic software, will be attractive to a specialized group of users. Also, the Tektronix 4051 will support up to 15 devices in a daisy-chain fashion.

The 2200 PCS can also offer graphic capabilities via the optional drum plotter or specific application programs that support graphics on the CRT and printer. Two models are available — a single-pen model and a triple-pen model — that can prepare plots 16 inches wide by any length. However, the PCS can only support two peripherals (printer and/or plotter) in comparison to the large number of devices supported by Tektronix; Wang has alluded to direct peripheral interfacing capabilities for the near future.

Hewlett-Packard 9825. The HP 9825 is the newest addition to the 9800 Series line. The 9825 has been introduced to meet the new competitive situation that HP is finding itself faced with — 5100 and the Tektronix 4051. The 9825 is less expensive than the 9830 (HP's long-standing super-calculator); a basic system with 6K bytes of memory, a 32-character LED display, 16-character dot matrix printer, and tape cartridge drive sells for $5,900. The 9825 can add up to three peripherals (digitizer, card reader, paper tape reader and punch), and it is truly portable — it weighs 26 pounds.

Most likely the Wang PCS will find the HP 9825 one of its tougher competitors. Capability-wise they form a fairly even match, and traditionally they both market to the same type of customer. Like the marketing of the older Wang 2200 and the HP 9830, it will often be a case of which salesman gets to the door first, and in which direction the customer's preference leans.

SYSTEM DESIGN

The Wang 2200 PCS is a 57-pound desktop system with 8K bytes of semiconductor Random Access Memory (RAM) and 42.5K bytes of Read-Only Memory (ROM) for the hardwired BASIC interpreter. Also included in the system is a 9-inch CRT display with an upper- and lowercase

alphanumeric keyboard and a tape cassette for data storage and program loading.

System memory can be expanded to include 32K bytes (in 8K-byte increments) of RAM. Optional peripherals for the 2200 PCS include the Wang Model 2221W printer (200 characters per second), the Model 2231W printer (120 characters per second), the Model 2272-1 drum plotter (one pen), and the Model 2272-1 drum plotter (up to three pens). Two of these peripherals may be interfaced to the PCS system via built-in controllers. Option 60 for the 2200 PCS provides an auxiliary display connector for a television monitor or a Wang slave CRT monitor, and the audio alarm and keyboard clicker features.

The 2200 PCS unit is 13-1/2 inches high, 20-1/2 inches deep, and 19-3/4 inches wide.

Processor

Of the standard 8K bytes of Random Access Memory available to the user of the PCS, 700 bytes are required by the system; the rest of RAM is available for user programs and data.

A standard BASIC interpreter plus four special BASIC instruction sets are hardwired into the 2200 PCS's ROM. The special instruction sets — which include the SORT ROM, the Matrix ROM, the General I/O ROM, and the EDIT ROM — extend the power and capabilities of the BASIC language.

Instruction Set. Some of the BASIC statements and commands used with the PCS are generated with a single keystroke from the PCS keyboard. These include some commands from the subroutine group — DEFN, GOSUB, RETURN; the program control group — FOR, STEP, NEXT; and the tape handling group — SELECT, BACKSPACE, REWIND, SAVE, SKIP.

See Table 2 for a partial list of PCS standard BASIC commands and statements.

CRT

The PCS features a 9-inch integrated CRT screen that displays up to 16 lines with 64 characters in each line. Alphanumeric data (in upper- or lowercase), numeric data, or special characters may be displayed.

Under program control a fixed screen format can be implemented using display control and cursor movement codes. Under standard screen functions, when new lines are entered they appear at the bottom of the screen and push existing lines up into memory or onto the cassette.

Keyboard

The standard PCS keyboard combines an alphanumeric typewriter keyboard with BASIC keywords and special-character keys. Also included is a 10-key numeric pad with mathematical function keys, as well as 16 special-function keys for user-defined routines and editing functions.

The PCS keyboard provides two modes for entering data and programs (switch-selectable). The first mode permits alpha keys to produce BASIC words (with SHIFT key depressed) or uppercase letters (unshifted). In the second mode, unshifted alpha keys produce lowercase letters, and shifted alpha keys produce uppercase letters.

Tape Cassette

A single integrated tape cassette is included with the PCS. Data is formatted automatically in 256-byte blocks called physical records; each record is recorded twice to ensure data integrity.

The tape cassette is approximately 76,800 bytes (150 feet), and holds approximately 300 dually recorded 256-byte records. Recording/search speed is 7.5 inches per second. Transfer rate is 326 bytes per second, and rewind speed is 7.5 feet per second.

PERIPHERALS

The following optional peripherals can be used with the PCS:

- Model 2221W Line Printer — prints at 200 characters per second producing 65 to 300 lines per minute. Line length is 132 characters. The printer uses a 9 by 9 dot matrix.
- Model 2231W Line Printer — prints at 120 characters per second producing 45 to 250 lines per minute. Line length is 112 characters. The printer uses a 7 by 9 dot matrix.
- Model 2272-1 Digital Drum Plotter — provides point plotting, continuous line plotting, and alphanumeric lettering. Model 2272-1 provides a single-pen holder. Plotting area is 16 inches wide by any length (the paper moves instead of the drum). Accuracy is .01 inch plus .1 percent per inch.
- Model 2272-2 Digital Drum Plotter — provides point plotting, continuous line plotting, and alphanumeric lettering. Model 2272-2 provides a three-pen holder. Plotting area is 16 inches wide by any length (the paper moves instead of the drum). Accuracy is .01 inch plus .1 percent per inch.
- Option 60 — provides an auxiliary display connector, an audio alarm, and keyboard clicker. A slave CRT Monitor (Model 2292

Table 2. Wang 2200 PCS: BASIC Commands and Statements

BASIC Commands

CLEAR
CONTINUE
HALT/STEP
LIST
RENUMBER
RESET
RUN
LOAD

BASIC Statements

COM
COM CLEAR
DATA
DEFFN
DEFFN'
DEFFN'HEX( )
DIM
END
FOR
GOSUB
GOSUB'
GOTO
IF END THEN
IF THEN
(%) Image
INPUT
KEYIN
LET
NEXT
ON
ON ERROR
PLOT
PRINT
PRINTUSING
READ
REM
RESTORE
RETURN
RETURN CLEAR
SELECT
STOP
TRACE

Data Manipulation Statements and Functions

ADD
AND, OR, XOR
BIN
BOOL
CONVERT
HEX
HEXPRINT
INIT
LEN
NUM
PACK
POS
ROTATE
STR
UNPACK
VAL

Auxiliary Display) or a standard television set may be used with the optional display connector.

SOFTWARE

The Wang 2200 PCS uses a hardwired BASIC interpreter. Any application program on tape cassette that is available for the Wang System 2200 Computer or the Wang WCS models can be used with the PCS system.

Language

Wang claims that BASIC is the language most of its customers want, and therefore BASIC is the language used for all of the Wang computer products. The PCS uses a BASIC interpreter that is hardwired into 42.5K bytes of ROM. The BASIC used on the PCS is the standard version of BASIC with four extended BASIC instruction sets. In its extended version, the Wang BASIC facilitates text editing, arithmetic, and I/O operations. Refer to Table 2 for a listing of the PCS BASIC language statements and commands.

Applications

Any tape cassette program from the Wang program library for users is available to the PCS user. Wang reports that there are over 200 programs available from the library, and then another 200 independent software vendors who have written programs for the Wang systems. Here are some of the areas in which Wang has traditionally been strong and in which a number of the applications programs can be found:

Mathematics	Business and Finance
Statistics	Accounting
Engineering	Surveying

Wang has also introduced a new Management Planning System (MPS) that features seasonal projection, financial planning, and graphics.

PRICE DATA

Rental and lease prices are available from Wang.

Description	Purchase Price (Maint. not Included) $	Monthly Maint. $
Basic 2200 PCS-2 (8K bytes of main memory, 42.5K bytes of ROM, 9" CRT and keyboard, and 1 tape cassette)	5,400	43
2200 PCS-4 (same as Basic PCS-2 with 16K bytes of main memory)	7,000	59
2200 PCS-6 (same as Basic PCS-2 with 24K bytes of main memory)	8,400	75
2200 PCS-8 (same as Basic PCS-2 with 32K bytes of main memory)	9,800	91
Field Upgrades		
8K bytes upgrade	2,000	16
16K bytes upgrade	3,200	32
Options		
Model 2221W Line Printer (200 cps)	5,000	56
Model 2231W Line Printer (120 cps)	2,900	33
Model 2272-1 Drum Plotter (single pen)	2,900	30
Model 2272-2 Drum Plotter (three pens)	3,200	33
Option 60 Auxiliary Display Connector	100	2
Model 2292 Auxiliary Display	600	250

WANG LABORATORIES INC.

System 2200 Computer

OVERVIEW

Wang System 2200 is a small computer system that is an outgrowth of what has long been Wang's traditional strength: high-performance electronic calculators. Since the announcement of System 2200, it has grown from an extremely high powered programmable calculator to its present state of being a comprehensive product line of central processors and peripherals, capable of implementing many types of stand-alone computer applications in business and engineering.

The central element of the System 2200 is a CPU containing 40K bytes of microprogrammed control, a minimum of 4K bytes of MOS read/write memory, and a CRT display with an associated keyboard by which a user interacts with the system. The 2200 uses a variant of the popular BASIC language, which is hardwired into the control microprogram. To the central processor may be added any of a large number of peripheral devices, up to 32K bytes of read/write memory, and a number of microprogram language extensions.

Wang recently announced the WCS series, which consists of a number of system configurations built upon the System 2200 CPUs and peripherals. The WCS systems are packaged configurations of System 2200 equipment offering various levels of capability. *(See report 155.6856.100, in your service for a complete description of the WCS models.)*

System 2200 firmware contains the operating system, with which the user interacts directly, and a BASIC language interpreter. Wang BASIC is an extended version of the Dartmouth BASIC language and includes, in addition to the conventional arithmetic, trigonometric and matrix functions, a full set of string manipulation functions, field editing verbs, and support for a wide variety of peripheral devices, including several types of printers, plotters, discs, cassettes, card readers, and communication and real-time instrument interfaces.

Wang is making strong efforts to leave behind its image as a calculator company and promote its image as a small computer manufacturer. These efforts are reflected in the recent additions to its product line and in the support services it now offers. While a simple System 2200 may be purchased for under $6,000, users are presently operating System 2200 configurations in the $50,000 class, with multiple CPUs accessing a common data base. Available application software ranges from simple engineering calculations to full on-line data base operations.

The first Wang System 2200 was delivered in June 1973; more than 7,000 have been delivered to date. System specifications are listed in Table 1.

PERFORMANCE AND COMPETITIVE POSITION

At the time of its introduction, the Wang System 2200 was marketed as a sophisticated calculator. Its power and ease of use led many purchasers to employ the equipment in a large variety of "computer-like" applications and Wang, responding to this market acceptance, proceeded to augment the power and capabilities of the system. The System 2200 today offers facilities that allow it to perform such functions as data base management, real-time control, and intercomputer communications. These capabilities have not been added at the expense of the natural ease of use of the machine or of the directness of the user's control of the system.

When announced, the System 2200 had as its major competitor the Hewlett-Packard 9830 system, another

HEADQUARTERS

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Table 1. Wang System 2200: Specifications

CENTRAL PROCESSOR	
ROM Memory (20-bit words)	8-16K
Main Memory (8-bit bytes)	4K-32K, MOS
Cycle Time (msec)	1.6
No. of I/O Channels	3 or 6 std; 5 opt
AUXILIARY STORAGE, CASSETTE	
Capacity (bytes)	78,000
Transfer Rate	326 bytes/sec
Rewind Speed	90 in./sec
Attachment Limits	1/I/O slot
AUXILIARY STORAGE, DISKETTE	
Capacity (bytes)	256K
Transfer Rate	31,250 bytes/sec
Latency Time	80 msec
Average Access Time	400 msec
Attachment Limits	1, 2, or 3 per I/O slot
AUXILIARY STORAGE, MOVABLE HEAD DISC	
Capacity (bytes)	1.2, 2.4, 4.8, or 10M
Platters	1 sealed; 1 removable
Seek Time	8-82 msec; 41 msec avg
Transfer Rate	200,000 bytes/sec
Attachment Limits	1 per I/O slot
KEYBOARD ENTRY	
Keyboard Type	A/N, special BASIC, or combined
Numeric Cluster	Yes
No. of Keys	76-86
CRT DISPLAY OUTPUT	
Viewing Area	9- or 11-inch diagonal
Screen Capacity	512 char
Char/Line	64
Char Type	8 x 8 dot matrix
PRINTERS	
Speed	15 or 20 cps; 120 lpm
Col/Line	80 or 132
Upper/Lowercase	Yes
COMMUNICATIONS	
Line Facility	Switched
Line Configuration	Point to point
Line Speed (sync)	1,200-4,800 baud
Line Speed (async)	110-1,200 baud
Transmission Mode	TTY or binary sync
Transmission Code	EBCDIC (sync); ASCII (async)
Emulation	IBM 2780; TTY
OPTIONAL INPUT PERIPHERALS	
Card Reader	Mark sense or punched, 300 cpm
Paper Tape Reader	300 cps
Digitizer	20 x 20 to 36 x 48-in. tablet; 0.005-in. resolution
OPTIONAL OUTPUT PERIPHERALS	
Plotting Output Writer	Points only; 15 cps
Flatbed Plotter	10 x 15 or 31 x 48-in.; continuous line or point plotting
Auxiliary CRT Display	9 or 12" diagonal
OPTIONAL I/O PERIPHERALS	
Magnetic Tape	9-track, 800 bpi, NRZI; 12,500 bytes/sec transfer rate
Direct Interface Controller	8-bit parallel data transfer to/from external equipment
SOFTWARE	
Operating System	Firmware; macro services; utilities
Assembler	None
High-Level Language	Extended BASIC (hardwired interpreter)
Applications Packages	Yes

firmware based supercalculator; but now this system competes with the System 2200 only at the lower end of the product line. Recently, IBM announced the 5100 Portable Computer and Tektronix its 4051 Graphic Computing System. IBM offers APL and BASIC languages for the 5100. The availability of the APL language is unique for this class of product and makes the 5100 an attractive machine for the growing group of APL users. The Tektronix 4051, like the HP 9830 and the Wang 2200, offers only BASIC. These other firmware BASIC products compete at the lower end of the 2200 line, but they suffer from the relative narrowness of the product line; most offer only a minimum of optional peripherals and comparatively little software.

The strength of the System 2200 lies in Wang's ability to configure systems to meet a large variety of user application needs and to support the system devices and applications with a wide range of software. It is in the area where the user has modest but fair-sized files and a moderately complex processing requirement that the System 2200 is most effective. This is commonly termed the small business computer market, which has a large number of strong contenders: IBM with the System/32, Digital Equipment with its Datasystem line, Basic/Four, Microdata Reality, Qantel, and many others.

In the small business computer market, Wang's packaged versions of the 2200, the WCS models with movable head discs (WCS/30) in the $30,000 range tend to be slightly less expensive than the competition. At the level of diskette media systems (WCS/20) in the $15,000 range, Wang has less competition. In general, for single workstation systems, Wang claims to be more cost/effective. For multiple workstation systems, Wang must configure two or more processors to operate on a single data base (hard or floppy disc), using disc multiplexors. While this technique has benefits in terms of equipment redundancy, it tends to increase the system cost in comparison to that of conventional multiprocessor small business configurations.

A unique strength of Wang is a network of independent software vendors who, for years, have been writing custom software for the System 2200. There are over 100 of them active at present, and Wang has a comprehensive program for monitoring their work and assisting them in the sale of a large number of application packages.

USER REACTIONS

Bank. A large New York bank purchased two Wang 2200 systems to perform the stock transfer function for its corporate trust department. Faced with the familiar difficulty of a manual system that was breaking down, the corporate trust department first examined the alternative of using the large central bank data processing department, but rejected this, as it felt it would be too much a second-class citizen, with its requirements considered after the main bank's processing functions. Following evaluation of a number of small business computers, it decided on a configuration of two System 2200 processors, equipped

with tape cassettes. One small processor would be dedicated to intelligent data capture, while the other machine would perform file updating and reporting functions. The use of a diskette system was carefully considered and rejected as the file requirements of the application were such that they could easily be handled by the slower cassette media.

Auto Dealer. A southern automobile dealer has been a user of Wang products for more than 2 years and has had a System 2200 for 3 months. This business has the basic system with a Model 2222 alphanumeric keyboard and one cassette drive. The system is used to calculate automobile financing charges, insurance, and other fees related to purchasing a car. The dealer buys loan money and lends it at a higher interest rate to the customer. Customers are more likely to borrow money from the automobile dealer when they can complete all the financial arrangements at the point of sale. The CRT display enables them to view all the calculations involved in their contract. This user reports excellent service, both on the hardware from Wang and the software from the Creative Software house in nearby Atlanta.

Software Service Bureau. A software service bureau in the South bought a Wang System 2200 to develop and debug programs for its many customers in the area. They believe few business customers buying a system as inexpensive as the Wang will do their own programming. An engineer, on the other hand, will probably program his computer. Wang does not have the programming staff to customize all user programs, and users rarely use manufacturer-supplied software without some alteration.

This software company does a booming business programming for the System 2200. Its main customers have been automobile dealers, but it has also sold packages to a large number of savings and loan associations. The savings and loan applications are actually similar to those for the automobile dealers; the terminal performs calculations on loan payments. More importantly, it instantly adds extras into the payment — such as various types of insurance — so the savings institution (or automobile dealer) can make an additional profit. The software house has a special package that displays data to the salesman so he knows which extras can be shaved off to lower payments and still maximize profit on the transaction. This software house believes there is a very large market for the Wang system, particularly because of the low hardware cost.

CONFIGURATION GUIDE

Wang currently offers two versions of its central processor: the 2200S and the 2200T. The processors are essentially identical, with the T processor having added firmware capability and a greater I/O capacity. The T processor has six I/O slots, and the S processor has three I/O slots. The 2200S contains no firmware support for discs; however, other firmware facilities that are standard on the 2200T may be purchased as 2200S options: three additional I/O ports, matrix BASIC firmware, and a general I/O firmware facility. The 2200S is packaged as the WCS/10 system with 4K of user memory and an integrated CRT/keyboard/cassette console unit.

A large number of peripherals can be configured with the 2200S (or WCS/10) up to the limit of I/O slots: a Selectric-type character output printer, a Selectric-type output plotter/printer, a punched paper tape reader, synchronous or asynchronous telecommunication controllers, additional tape cassette drives, 80- or 132-column matrix printers, mark sense or punch card readers, a parallel I/O controller, a digitizer, and a plotter. (Some of these peripherals require inclusion of the appropriate firmware options.)

The 2200T processor offers the full complement of BASIC firmware and a larger I/O capacity than the 2200S. In particular, it supports BASIC firmware to drive both floppy and hard discs. It is offered in two standard system configurations: the WCS/20, a diskette drive system, and the WCS/30, a hard disc system. The 2200T systems may be configured with all the peripherals of the 2200S plus floppy and/or hard discs and a ½-inch magnetic tape drive. The WCS/20 system consists of a processor, 8K bytes of memory, a CRT/keyboard console, a single floppy disc drive, and system packaging. The WCS/30 system consists of a processor, 16K bytes of memory, a CRT/keyboard console, a single flexible disc drive, a 5-million-byte hard disc drive, and a 132-column 200 character-per-second matrix printer. All WCS systems are packaged in desk-like stands.

CENTRAL PROCESSOR

The System 2200 processor is microprogrammed with a hardwired BASIC interpreter (not a compiler) that is used for all application programs and for all communications with the system. Because there is no assembly language or machine language programming available to the user, none of the 32 internal registers can be accessed directly. Direct, indirect, and indexed addressing are all handled automatically by the CPU. The processor has no interrupt system.

Data and most instructions are stored in 8-bit bytes; floating-point numbers and certain instructions use 2 bytes. Parity checking is not offered. Floating-point operands are stored 13 digits plus sign in the mantissa, with a 2-bit exponent.

The BASIC instruction set consists of 45 single-byte program instructions, 2 double-byte instructions, and 20 mathematical functions. The 2200T has an additional 30 I/O and plot instructions. Matrix, Boolean algebra, and data manipulation instructions are standard on the 2200T. All 2200T instructions are optional on the 2200S, with the exception of the disc and plotter I/O instructions. All of the 32 standard user-defined functions can be entered by a single keystroke on both the S and T models.

In a scientific environment, these functions frequently include normal distribution, inverse normal distribution, error function, binomial distribution, linear regression, gamma function, Poisson distribution, and the like. In a

business environment, these functions can include data processing utilities such as "open file," "close file," and so on. A single key depression is also sufficient for initiating calculations on matrices if the matrix ROM option is included. Average arithmetic instruction execution times are listed in Table 2.

Table 2. Wang System 2200: Average Arithmetic Execution Times, with 13-Digit Precision

Function	Avg Execution Time (msec)
Add/Subtract	0.8
Multiply	3.8
Divide	7.4
Square Root	46.4
E^X	25.3
Log^X	23.2
X^Y	45.4
Integer	0.24
Absolute Value	0.02
Sign Change	0.25
Sine	38.3
Cosine	38.9
Tangent	78.5
Arctangent	72.5

The programmable TRACE mode aids in program debugging by stepping through the program, producing a printout or display wherever a variable has been changed or a program transfer made. Entire programs or sections of programs can be saved on cassette or disc. Loading programs into the system can be done from either the keyboard or under program control. SAVE P prevents the program from being copied. Program chaining is available. Each program can use up to 286 variable names for numeric, numeric array, string, and string array variables. The COM (common data) stores the current value of certain variables for future use, or for transferring parameters between program segments. String variables and string arrays maximize storage space use. PACK and UNPACK (available on Model 2200T only) further maximize space use.

Main Memory

A 4K-byte MOS memory with a 1.6-microsecond cycle time is standard to the System 2200 processor. Memory can be added in increments of 4K bytes up to a maximum of 32K bytes, all internal to the standard chassis. Because the BASIC compiler is hardwired, only 696 bytes are used for housekeeping. Thus, 3,400 bytes of the standard 4,096 bytes are available to the user. All peripheral handling routines are also stored in hardwired ROM modules. Consequently, adding peripherals does not impact on the amount of read/write memory available to the user.

INPUT/OUTPUT

Six I/O slots for the attachment of up to six peripherals are standard to both processors. The expansion option adds five slots to attach up to five peripherals for a maximum of 11 per system. The peripheral handling routines are all hardwired ROM modules delivered with the device. The exception is the disc management routine, which is an integral part of the Model 2200T processor, regardless of whether or not the system includes a disc. Certain peripherals attach only to the T processor.

Because it has no hardware interrupt system for handling multiple requests on the simple I/O channel, the System 2200 is not well suited for real-time applications with multiple inputs. The system can be programmed to poll the various I/O devices; but simultaneous operations, such as a key entry while disc data is transferring, are impossible.

PERIPHERALS

A wide variety of peripherals can be added to the System 2200: discs, flexible discs, printers, cassette drives, Teletypes, plotters, paper tape, and both mark sense and punched card readers. The standard system usually includes a CRT and a cassette or disc drive within the CPU chassis and a portable keyboard.

CRT. Up to 1,024 characters are displayed on an 8 x 10.5-inch screen in 16 lines of 64 characters each.

Keyboards. The standard keyboard has 86 keys: a 44-key standard typewriter layout, a 10-key numeric pad, and several groups of editing and special function keys. The typewriter portion of the keyboard uses the up-shifted portion of the alphabet keys for the mnemonics of BASIC statements, allowing statement entry by a single keystroke. Alternate keyboards are available with an ordering of the alphabet from A to Z and without the upper shift BASIC verbs.

Magnetic Tape Cassette Drive. A single tape cassette drive can be included within the chassis. The 150-foot cassette reels are recorded at 522 bytes per foot, allowing for redundant recording and a 0.6-inch interrecord gap between each 256-byte record. The effective transfer rate is approximately 326 characters per second. Additional cassette drives can be attached.

Printers. Three high-speed printers, an output writer, and a plotting output writer provide a range of printing capabilities. Models 2221W, 2231, and 2261 print on pin-fed forms using dot matrix characters at rates of 200 characters per second, 165 characters per second, and 120 lines per minute, respectively. The 2231 prints up to 80 columns per line; the others print 132-character lines. The 2231 and the 2261 are manufactured by Centronics; Wang manufactures the 2221W itself. The 2201 output writer is an IBM Selectric-type unit printing pin or friction-fed forms at 15 characters per second; the 2202 adds plotting capability at approximately 400 steps per second (X or Y axis) using 0.01-inch steps.

Discs. The four disc models offered consist of one fixed and one removable disc platter. The 2230-1 stores 1.2 million bytes of data; the 2230-2 stores 2.4 million bytes; the 2230-3, 4.8 million; and the 2260 stores 10 million. Disc management routines are integral in the firmware of the 2200T processor. Disc data transfer is at a rate of 200K bytes per second. Disc firmware allows for operations at either the absolute sector address level or through the automatic disc catalog.

Three models of floppy diskette drives are offered: Models 2270-1, 2270-2, and 2270-3 support one, two, or three drives, respectively. Diskettes are all removable, and each platter has the capacity of 256K bytes. Operation of the diskette drives is identical to that of the hard discs at the program level. Floppy disc data transfer is at a rate of 31K bytes per second with an average latency of 80 milliseconds.

Conventional Peripherals. Several types of slow-speed input devices are available. These include a mark sense or punched card reader (300 cards per minute) with a stack feed, and a paper tape reader (300 characters per second). Punched paper tape data can be input to the 2200 by either an ASR TTY or a high-speed optical punched paper tape reader.

DATA COMMUNICATIONS

Data communications is offered on the System 2200 by means of either the 2227 asynchronous controller or the 2228 binary synchronous controller.

The 2227 allows the System 2200 to communicate with another System 2200 or another computer system that supports half-duplex ASCII transmission. To the foreign computer the 2200 appears as a Teletype. The controller allows transmission at rates of 110, 150, or 300 baud over voicegrade lines and 600 or 1,200 baud over dedicated lines. Both transmission rate and line turnaround character are switch selectable. By using the 2227, a Teletype may be directly connected to the System 2200 and used in place of the CRT console.

The 2228 is a buffered binary synchronous controller which emulates the transmission of an IBM 2780. Wang provides software for file transmission to or from the System 2200 and a foreign computer. Files from cassette, disc or card reader may be sent from the System 2200; files received may be printed directly or stored on cassette or disc. Transmission rates up to 4,800 baud are supported. Currently, only dialup connections are supported.

SOFTWARE

Disc-based 2200 systems offer a number of techniques for handling data files. Absolute addressing of sectors is permitted using BASIC verbs, but commonly files are handled via the disc-resident catalog. Using this facility, files may be searched by name and opened for reading and/or writing by using BASIC verbs. Data transfers may have argument lists of any length. Data within records contains information on the type of each data field (numeric- or variable-sized alpha filed). Sector spanning is performed automatically by the firmware, but no firmware record blocking is provided. Special BASIC verbs are also provided to allow the packing of several fields into a single field, and subsequent field unpacking.

Keyed files are not supported directly by the firmware, but a Keyed File Access Method (KFAM) is provided to allow any sequential file to have one or more indexes associated with the logical records. KFAM operates by means of a series of subroutine functions, written in BASIC, to allow insertion, retrieval, and logical deletion of records based on record-key value. Support utilities are available for index file creation and file reorganization. Hierarchical file structures have been implemented in some applications on the System 2200 by use of relative record indexes in high-level files, pointing to records in logically subsidiary files. No such facilities are offered as standard software, however.

Due to the single-track structure of the System 2200, Wang has a method of allowing several console stations to access a single data base via a disc multiplexor. The multiplexor permits several *central processors* to use a common disc drive controller. Two or more System 2200s are connected via the multiplexor to one or more disc drives. Special I/O commands are sent by the central processors to obtain or release exclusive control of the discs. When one processor has control of the multiplexor (e.g., during data transfer), the other processors wait for operation completion, at which time their requests are honored. Multiplexor control is at the level of the disc device, and not file or record, so programming conventions must always be established for those multiprocessor systems that use this device. This type of configuration has proven to be effective in systems in which additional entry or inquiry stations are required to capture or retrieve data with some amount of programming.

The "native" language of the System 2200 is BASIC, which makes the machine easy to program. Wang provides, at nominal cost, a series of specialized software library routines, covering both the utility and application areas.

Program libraries are offered for statistics (regression, curve fitting, analysis of variance, etc.), mathematics (linear programming, Fourier analysis, etc.), education (the Huntington programs), engineering, surveying, finance, and medicine. A comprehensive set of utilities is also available, including KFAM, a Keyed File Access Method, to allow data base operations, sort programs for disc and cassettes, telecommunications and magnetic tape control programs, plotting, file dump and file display utilities, and a high-level report generation language.

In addition to the libraries, Wang offers a large number of integrated software applications, implemented both by Wang and by independent software vendors. Among these

are such application systems as a municipal accounting package (including payroll, tax, utility, and encumbrance accounting), a comprehensive system for surveying, a series of structural engineering packages, auto dealer accounting, and general ledger packages. These packages tend to be fully turnkey, with simple installation at the user's site.

Wang also offers a set of general accounting packages, designed to be customized for each user. These basic accounting system modules are implemented for both cassette and diskette systems and handle the principal accounting functions of payroll, accounts receivable and payable, sales analysis, inventory, and general ledger. The general accounting packages are offered to vendors at modest prices; they, in turn, perform any required customization demanded by the end user and perform the installation and operator training functions.

PRICE DATA

Model Number	Description	Purchase (maint. not incl.) $	Monthly Maint. $
Central Processing Units (CPUs)/Memory			
2200S-1[1]	CPU (incl. 4,096 bytes of memory & 3 I/O slots)	2,400	19.50
2200T-1[1]	CPU (incl. 4,096 bytes of memory & 3 I/O slots)	4,000	25
—	Additional 4,096-Byte Block of Memory	1,200	8
—	Additional 8,192-Byte Block of Memory	2,000	16
CPU/Keyboard/Display Options			
OP-4	Audio Signal for 2216 & 2216A CRT	200	1
OP-20	Up to 6 I/O Slots for 2200 S&T CPUs	600	—
OP-20A	Up to 9 I/O Slots for 2200 S&T CPUs	1,200	—
OP-21	Matrix ROM	300	1.50
OP-22	Advanced Programming & Matrix ROM	800	4
OP-23	General I/O, Adv. Prog, & Matrix ROM	1,100	5.50
OP-24[2]	Disc, General I/O, Adv. Prog Sort & Matrix ROM	1,600	5.50
OP-30	Upper/Lowercase for 2220 & 2226 CRT	200	1
OP-31	Audio Signal for 2220 & 2226 CRT	200	1
OP-32	Keyboard Clicker	80	—
2290	CPU/Peripheral Stand	250	—
Keyboard/Display Peripherals			
2215	BASIC Keyword Keyboard	500	3.50
2216	CRT Executive Display	1,800	9
2216A	Upper/Lower Case CRT Display	2,000	10
2216/2217	Combined CRT Executive Display/Single Tape Cassette Drive	2,800	22.50
2216A/2217	Combined Upper/Lower Case CRT Display/Single Tape Cassette Drive	3,000	23.50
2220	Console-CRT/Keyboard/ Single Tape Cassette	3,000	15
2222	Alpha-Numeric Typewriter Keyboard	500	4
2223	Alpha-Numeric/BASIC Keyword Keyboard	800	4
2226	Console — 12" CRT and Keyboard	2,200	10
2292	Auxiliary Display w/25' Cable	600	2.50
Output Peripherals			
2201	Output Writer	2,400	24
2202	Plotting Output Writer	4,000	40
2212	Analog Flatbed Plotter (10" x 15")	3,600	36
2221	Line Printer (132 col)	5,600	56
2231	Line Printer (80 col)	3,300	33
2232A	Digital Flatbed Plotter (31" x 48")	8,000	80
2261	High Speed Printer (132 col)	7,300	73
2291	Digital Flatbed Plotter Stand	350	—
Interface Controllers			
2207A	I/O Interface Controller (RS232C) Selectable BPS	600	3
2227	Asynchronous Telecommunications Controller	900	4.50
2227N	Null Modem for 2227	50	—
2250	I/O Interface Controller (8-bit parallel)	400	2
2252A	Scanning Input Interface Controller (BCD 1-10 digit parallel)	600	3
Input Peripherals			
2203	Punched Tape Reader	1,800	18
2214	Mark Sense Card Reader	1,000	10
2234A	Hopper-Feed Punch Card Reader	4,000	40
2244A	Hopper-Feed Mark Sense/ Punch Card Reader	4,800	48
2262-1	Digitizer 20" x 20" Tablet	5,000	25
2262-2	Digitizer 30" x 40" Tablet (special order)	7,000	25
2262-3	Digitizer 36" x 48" Tablet (special order)	8,000	25
Mass Storage Peripherals			
2209	Nine-Track Tape Drive	12,000	90
2217	Single Tape Cassette Drive	1,200	13.50
2218	Dual Tape Cassette Drive	2,300	26
2224-2	Disk Multiplexor (for 2 CPUs)	2,000	10
2224-3	Disk Multiplexor (for 3 CPUs)	2,500	12.50
2224-4	Disk Multiplexor (for 4 CPUs)	3,000	15
2230-1	Fixed/Removable Disk Drive (1,228,800 bytes)	11,500	100
2230-2	Fixed/Removable Disk Drive (2,457,600 bytes)	12,000	100
2230-3	Fixed/Removable Disk Drive (5,013,504 bytes)	12,500	100
2230MXA	Daisy-Chain-Type Disk Multiplexer (1st CPU)	800	4
2230MXB	Daisy-Chain-Type Disk Multiplexer (2nd, 3rd, or 4th CPU)	500	2.50
2240-2	Dual Removable Flexible Disk Drive (524,288 bytes)	6,000	60
2242	Single Removable Flexible Disk Drive (262,144 bytes)	4,500	45
2243	Triple Removable Flexible Disk Drive (786,432 bytes)	8,000	80

PRICE DATA (Contd.)

Model Number	Description	Purchase (maint. not incl.) $	Monthly Maint. $
2270-1	Single Removable Diskette Disk Drive (262,144 bytes)	3,000	30
2270-2	Dual Removable Diskette Disk Drive (524,288 bytes)	4,500	45
2270-3	Triple Removable Diskette Disk Drive (786,432 bytes)	6,000	60
2260	Fixed/Removable Disk Drive (10,027,008 bytes)	14,500	123.75

Notes:
(1) CPU models S and T are unavailable in 20 and 28K bytes; edit function is included with both S and T; all peripherals listed can be used on the T.
(2) OP-24 capabilities are included with 2200T.

DIRECTORY OF SUPPLIERS

A

A B ADDO
DIV OF FACIT ADDO
S-200 22 Halmo 3
Sweden

A.B. DICK CO *(See Dick Co, A.B)*

ACCESS CORP
4815 Para Dr
Cincinnati OH 45237
(513) 242-4220

ACEC *(See Ateliers de Constructions Electriques de Charleroi)*

ACRODYNE INC
DATA SERVICES DIV
1217 Summit Ave
Union City NJ 07087
(201) 865-3220

ACS INC *(See Action Communication Systems Inc)*

ACTION COMMUNICATION SYSTEMS INC
10300 N Central Expwy Suite 3131
Dallas TX 75231
(214) 750-3000

ACTION/DICTOGRAPH PRODUCTS
34 Cambridge St
Meriden CT 06459
(203) 238-2326

ACTRON INDUSTRIES INC
700 Royal Oak Dr
Monrovia CA 91016
(213) 359-8216

ACTS COMPUTING CORP
29200 Southfield Rd
Southfield MI 48075
(313) 557-6800

ADAGE INC
1079 Commonwealth Ave
Boston MA 02215
(617) 783-1100

ADDRESSOGRAPH MULTIGRAPH CORP
HDQTRS
Chagrin Blvd
Cleveland OH 44117
(216) 283-3000
BRUNING DIV
1834 Walden Office Sq
Schaumburg IL 60172
(312) 397-1900
VARITYPER DIV
Rte 22
Mountainside NJ 07092
(201) 233-5930

ADL SYSTEMS INC
10 New England Executive Pk
Burlington MA 01803
(617) 272-3400

ADLER *(See Triumph-Adler AG)*

ADPAC COMPUTING LANGUAGES INC
120 Howard St, Suite 440
San Francisco CA 94105
(415) 981-2710

ADS *(See Anker Data Systems)*

ADVANCED COMPUTER SYSTEMS INC
3131 Dixie Dr
Dayton OH 45439
(513) 294-0586

ADVANCED COMPUTER TECHNIQUES CORP
HDQTRS
437 Madison Ave
New York NY 10022
(212) 421-4688
BRANCHES
1501 Wilson Blvd
Arlington VA 22209
(703) 524-8330
3225 N Central Ave, Suite 1011
Phoenix AZ 85012
(602) 264-5111

ADVANCED INFORMATION ACCESS LTD (AIA)
36 Parkside, Knightsbridge
London SWIX 7JP, England
01-235-835718

ADVANCED MEMORY SYSTEMS INC
1276 Hammerwood Ave
Sunnyvale CA 94086
(408) 734-4330

ADVANCED SYSTEMS INC
1601 Tonne Rd
Elkgrove Village IL 60007
(312) 593-1790

ADVANCED TERMINALS INC
Ft Herkimer Rd
Rte 5S E
Mohawk NY 13407
(315) 866-6900

AEG-TELEFUNKEN *(See Allgemeine Elektricitats-Gesellschaft Telefunken)*

A E I TELECOMMUNICATIONS (CANADA LTD)
419 Notre Dame Ave
Winnipeg 2, Manitoba, Canada
(204) 942-7221

AERONUTRONIC FORD
Union Meeting Rd
Blue Bell PA 19422
(215) 646-9100

AGFA-GEVAERT
275 N St
Teterboro NJ 07608
(201) 288-4100

AGT DATA SYSTEMS LTD
KEYDATA CANADA DIV
74 Victoria St
Toronto 1 Ontario, Canada
(416) 362-7681

AI DENSHI SOKKI COMPANY LTD
44 Shiraitodai 2-Chome
Fuchu-Shi
Tokyo 183, Japan

AIL INFORMATION SYSTEMS
8332 Osage Ave
Los Angeles CA 90045
(213) 670-9063

ALDEN ELECTRONIC & IRE CO INC
1 Washington Ave
Westboro MA 01581
(617) 366-8851

ALLEN PRODUCTS CO
180 Wampus La
Milford CT 06460
(203) 874-2563

ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT TELEFUNKEN FACHBEREICH INDUSTRIEELEKTRONIK
6453 Seligenstadt, Hessen
Steiheimerstrasse 117, West Germany

ALLIED BUSINESS SYSTEMS LTD (ABS)
145 Charing Cross Rd
London, WC 2,
England UK
01-437-1078

ALOS LTD
Grubenstrasse 45
PO Box 143
Zurich, Switzerland

ALPHA DATA INC
20750 Marella St
Chatsworth CA 91311
(213) 882-6500

ALPHATYPE CORP
7500 McCormick Blvd
Skokie IL 60076
(312) 675-7210

ALVAN SA
198 200 Blvd, St. Germain
75007 Paris, France
544.09.77

AMALGAMATED WIRELESS LTD
1500 Wilson Blvd, Suite 1515
Arlington VA 22209
(703) 893-2230

AMDAHL CORP
HDQTRS
1250 E Arques Ave
Sunnyvale CA 94086
(408) 735-4011

AMERICAN APPRAISAL CORP
525 E Michigan St
Milwaukee WI 53201
(414) 271-7240

AMERICAN AUTOMATIC TYPEWRITER
2323 N Pulaski Rd
Chicago IL 60639
(312) 384-5151

AMERICAN CAN CO
CORPORATE HDQTRS
American La 1a5
Greenwich CT 06830
(203) 552-2000

AMERICAN INFORMATION DEVELOPMENT
48 Peter Yorke Way
San Francisco CA 94109
(415) 441-4422

AMERICAN INFORMATION SERVICES
HDQTRS
American La
Greenwich CT 06830
(203) 552-2000

AMERICAN MICROSYSTEMS INC (AMI)
3800 Homestead Rd
Santa Clara CA 95051
(408) 246-0330

AMERICAN SOFTWARE & COMPUTER CO
2045 Peachtree St NE, Suite 325
Atlanta GA 30309
(404) 355-9727

AMERICAN TYPE FOUNDERS CO INC.
Main St
Whitinsville MA 01588
(617) 234-7455

AMERICAN USED COMPUTER CORP
PO Box 68, Kenmore Sta
Boston MA 02215
(617) 261-1100

AMERICAN VIDEONETICS CORP
795 Kifer Rd
Sunnyvale CA 94086
(408) 732-2000

AMETEK-STRAZA
790 Greenfield Dr
El Cajon CA 92021
(714) 442-3451

AMF ELECTRO SYSTEMS
PO Box 128
Vandalia OH 45377
(513) 898-5881

AMPERSAND CORP
50 N Duke St
York PA 17401
(717) 845-5602

AMPEX CORP
HDQTRS
401 Broadway
Redwood City CA 94063
(415) 367-2011
COMPUTER PRODUCTS DIV
13031 W Jefferson Blvd
Marina Del Rey CA 90291
(213) 821-8933
VIDEOFILE INFORMATION SYSTEMS DIV
1020 Kifer Rd
Sunnyvale CA 94086
(408) 738-4910

ANDERSON JACOBSON CORP
1065 Morse Ave
Sunnyvale CA 94086
(408) 734-4030

ANKER DATA SYSTEMS
SUBSIDIARY OF ANKER WERKE
2021 Swift Dr
Oak Brook IL 60521
(312) 654-4540

ANKER WERKE AG
D4800 Bielefeld (West Germany)
Am Stadtholz 39
Postfacher 1 u 3
German Democratic Republic
(0521) 3011

ANN ARBOR TERMINALS INC
HDQTRS
6107 Jackson Rd
Ann Arbor MI 48103
(313) 769-0926

APL SERVICES INC
865 Lower Ferry Rd
Trenton NJ 08628
(609) 883-0050

APPLICATIONS SOFTWARE INC
21515 Hawthorne Blvd
Torrance CA 90503
(213) 542-4381

APPLIED COMPUTER SYSTEMS *(See Columbia Scientific)*

APPLIED COMPUTER TIME SHARE INC *(See Action Communications Systems Inc)*

APPLIED COMPUTING TECHNOLOGY INC
17961 Sky Park Circle
Irvine CA 92707
(714) 557-9972

APPLIED DATA COMMUNICATIONS
1509 E McFadden Ave
Santa Ana CA 92705
(714) 547-6954

APPLIED DATA PROCESSING INC
155 Whitney Ave
New Haven CT 06510
(203) 787-4107

APPLIED DATA PROCESSING
SUBSIDIARY OF COMPUTER DATABANKS
33 Bernhard Rd
North Haven CT 06473
(203) 787-4107

APPLIED DATA RESEARCH INC
HDQTRS
Rte 206 Ctr
CN-8
Princeton NJ 08540
(609) 924-9100
CONTROL SYSTEMS DIV
390 Commonwealth Ave
Boston MA 02215
(617) 266-8100

APPLIED DIGITAL DATA SYSTEMS INC
100 Marcus Blvd
Hauppauge NY 11787
(516) 231-5400

APPLIED LOGIC
900 State Rd
Princeton NJ 08540
(609) 924-7800

APPLIED MANAGEMENT SYSTEMS INC
5821 Park Rd, Suite 308
Charlotte NC 28209
(704) 364-5235

APPLIED SYSTEMS CORP
26401 Harper
St Clair Shores MI 48081
(313) 779-8700

AQUILA BST LTD
P1 Victoria, Suite 4000
Montreal 115 PQ, Canada

ARCATA MICROFILM CORP
Rte 1, Dunn's Corners
Westerley RI 02891
(401) 322-0391

ARCTURUS ELECTRONICS LTD
Holland Way
Blandford Forum, Dorset, England

ARGONAUT INFORMATION SYSTEMS INC
2140 Shattuk Ave
Berkeley CA 94704
(415) 845-7991

ARGUS SYSTEMS *(See Ferranti Ltd)*

ARKWRIGHT INC
HDQTRS
Main St
Fiskeville RI 02823
(401) 821-1000
4100 W Side Ave
North Bergen NJ 07047
(201) 867-9310

ARLINGTON TRUST CO
78 Amesbury St
Lawrence MA 01840
(617) 681-7270

ARTEC INTERNATIONAL CORP
2585 E Bayshore Rd
Palo Alto CA 94303
(415) 321-3300

ARTHUR D. LITTLE *(See ADL Systems)*

ARTHUR S. KRANZLEY & CO *(See Kranzley & Co)*

ARVIN SYSTEMS INC
Cincinnatti St
Dayton OH 45403
(513) 258-2181

ASK COMPUTER SERVICES INC
730 Distel Dr
Los Altos CA 94022
(415) 969-4443

A/S NORSK DATA-ELECTRONIKK
PO Box 163
Okerveien
Oslo 5-Norway

ASTROCOM CORP
15012 Minnetonka Industrial Rd
Minnetonka MN 55343
(612) 933-2208

A-T-O SYSTEMS MANAGEMENT GROUP INC
4420 Sherwin Rd
Willoughby OH 44094
(216) 946-9000

AT&T CO
1776 On The Green
Morristown NJ 07960
(201) 540-6300

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI (ACEC)
PO Box 4
B-6000 Charleroi
Belgium

ATF CO *(See American Type Founders Co Inc)*

ATLANTIC RESEARCH CORP
5390 Cherokee Ave
Alexandria VA 22314
(703) 354-3400

ATLANTIC SOFTWARE INC
Lafayette Bldg, 5th & Chestnut St
Philadelphia PA 19106
(215) 922-7500

AUERBACH PUBLISHERS INC
6560 N Park Dr
Pennsauken NJ 08109
(609) 662-2070

AUTOMATED BOOKKEEPING CORP
55 W 42nd St
New York NY 10036
(212) 354-7666

AUTOMATED FINANCIAL SYSTEMS INC
1 Decker Sq
Bala Cynwyd PA 19004
(215) 667-1000

AUTOMATED QUILL INC
3501 S Corona St, Suite 7
Engelwood CO 80110
(303) 761-2722

AUTOMATIC ELECTRIC CO
PO Box 42
Northlake IL 60164
(312) 562-7100

AUTOMATION TECHNOLOGY INC *(See Gould Inc)*

AUTO TELL SERVICES INC
771 E Lancaster Ave
Villanova PA 19085
(215) 525-9526

AUTO-TROL CORP
6621 W 56th Ave
Arvada CO 80002
(303) 458-5900

AUXCO COMPUTER ENTERPRISES
HDQTRS
1345 Ave Of The Americas
New York NY 10019
(212) 489-7620
BRANCH
1478 Morris Ave
Union NJ 07083
(201) 964-1850

AVCO COMPUTER SERVICES
201 Lowell St
Wilmington MA 01887
(617) 657-5111

AZREX INC
3 Mountain Rd
Burlington MA 01803
(617) 272-8750

AZTEC DATA SYSTEMS INC
2082 SE Bristol, Suite 11
Newport Beach CA 92707
(714) 540-8445

B

BADGER METER INC
ELECTRONICS DIV
4545 W Brown Deer Rd
Milwaukee WI 53223
(414) 355-0400

BADISCHE ANILIN & SODA-FABRIK AG
6700 Ludwigshafen AM Rhein
West Germany

BALL COMPUTER PRODUCTS INC
SUBSIDIARY OF BALL CORP
724 Boston Post Rd
Madison CT 06443
(203) 245-7317

BANDATA LTD
Banda House, Cambridge Grove
London WS, England

BANK COMPUTER NETWORK CORP
SUITE 626
333 N Michigan Ave, Suite 626
Chicago IL 60601
(312) 368-8300

BARIC COMPUTING SERVICES
68 Newman St
London W1P4EH, England

BARRY WRIGHT CORP
160 Gold Star Blvd
Worcester MA 01606
(617) 852-4300

BASE INC
437 Madison Ave
New York NY 10022
(212) 421-4307

BASF AG *(See Badische Anilin & Soda-Fabrik AG)*

BASIC FOUR CORP
18552 MacArthur Blvd
Santa Ana CA 92707
(714) 833-9530

BAUSCH & LOMB INC
HOUSTON INSTRUMENT DIV
Cameron Rd
Austin TX 78753
(512) 837-1221

BAYSTATE COMPUTER CENTER INC
295 Weston St
Waltham MA 02154
(617) 899-2222

BCL *(See Business Computers Limited)*

BECKMAN INSTRUMENTS INC
2500 Harbor Blvd
Fullerton CA 92634
(714) 871-4848

BEDFORD COMPUTER SYSTEMS INC
3 Preston Ct
Bedford MA 01730
(617) 275-0870

BEEHIVE ELECTROTECH INC *(See Beehive Medical Electronics)*

BEEHIVE MEDICAL ELECTRONICS
1473 S Sixth W
Salt Lake City UT 84104
(801) 487-0741

BEEHIVE TERMINALS
870 W 2600 S
Salt Lake City UT 84119
(801) 487-0741

BELL & HOWELL
BUSINESS EQUIPMENT GROUP
6800 McCormick Rd
Chicago IL 60645
(312) 539-7300
ELECTRONICS & INSTRUMENTS GROUP
360 Sierra Madre Villa
Pasadena CA 91109
(213) 796-9381

BELOIT COMPUTER CENTER INC
PO Box 567
Beloit WI 53511
(608) 365-2206

BENDIX CORP
HDQTRS
E Joppa Rd
Baltimore MD 20204
ADVANCED PRODUCTS DIV
Bendix Ctr
Southfield MI 48075
(313) 352-5000

BENEFACTS INC
EIS DIV
Hampton Plz
300 E Joppa Rd
Baltimore MD 21204
(301) 296-5500

BENSON
1, rue Jean-Lemoine
Z.I. Petites Haies
94015 Creteil, France

BETA INSTRUMENT CORP.
20 Ossippee Rd
Newton MA 02164
(617) 969-6511

BEVERLY BANCORPORATION
1357 W 103rd St
Chicago IL 60643
(312) 881-2200

B.K. ELLIOT CO *(See Océ Industries Inc)*

BLACK AND ASSOCIATES
H W COMPASS DIV
306 Gay St
Nashville TN 37201
(615) 244-4036

BLU-RAY INC
Westbrook Rd
Essex CT 06426
(203) 767-0141

BMA DATA PROCESSING INC
1174 E 2700 S
Salt Lake City UT 84106
(801) 486-0033

BMS COMPUTER *(See Boothe Management Systems)*

BOB WHITE COMPUTING & SOFTWARE
830 Diane La
Naperville IL 60540
(312) 357-1070

BOEING COMPUTER SERVICES
CORPORATE HDQTRS
PO Box 708
Dover NJ 07801
(201) 361-2121
CORPORATE OFFICES
PO Box 24346
Seattle WA 98124
(206) 773-2121

BOISE CASCADE COMPUTING
PO Box 200
Boise ID 83701
(208) 384-6161

BOLT, BERANEK & NEWMAN INC
50 Moulton St
Cambridge MA 02138
(617) 491-1850

BONNER & MOORE ASSOCIATES INC
500 Jefferson Bldg
Houston TX 77002
(713) 659-1871

BOOLE AND BABBAGE INC
850 Stewart Dr
Sunnyvale CA 94086
(408) 735-9550

BOOTHE MANAGEMENT SYSTEMS
PO Box 3086
Walnut Creek CA 94598
(415) 938-2620

BOOZ-ALLEN & HAMILTON INC
245 Park Ave
New York NY 10017
(212) 697-1900

BOSWORTH, S., & ASSOCIATES
9 Forest Dr
Plainview NY 11803
(516) WtE8-8223

BOWMAR-ALI INC
531 Main St
Acton MA 01720
(617) 263-8365

BOWNE TIME SHARING INC
3 Pkwy
Philadelphia PA 19103
(215) 665-0980

BRAEMER COMPUTER DEVICES INC
11950-12th Ave S
Burnsville MN 55337
(612) 890-5135

BRANDON APPLIED SYSTEMS INC
1611 N Kent St, Suite 701
Arlington VA 22209
(703) 525-2620

BRENCO AUTOMATION CENTER INC
2222 Grand Ave
Des Moines IA 50312
(515) 283-2415

BRIDGE DATA PRODUCTS INC
SUBSIDIARY OF OKIDATA CORP
738 S 42nd St
Philadelphia PA 19104
(215) 382-8700

BRIGHT INDUSTRIES INC
683 W Maude Ave
Sunnyvale CA 94086
(408) 735-9868

BRISTOL INFORMATION SYSTEMS
PO Box 2133
Fall River MA 02722
(617) 679-1051

BROOMALL INDUSTRIES
700 Abbott Dr
Broomall PA 19008
(215) 353-4610

BROWN-BOVERT & CIE AG
Haselstrasse CH-5401
Baden, Switzerland

BROWN BROS ENTERPRISES
4400 Division St
Grand Rapids MI 49508
(616) 532-9079

BRYCE & ASSOCIATES INC *(See M. Bryce & Associates Inc)*

BSL NORTHROP
BUSINESS DATA SYSTEMS DIV
19000 S Vermont Ave
Torrance CA 90502
(213) 532-1510

BUNKER-RAMO CORP
BUSINESS AND INDUSTRY DIV
35 Nutmeg Dr
Trumbull CT 06609
(203) 377-4141
ELECTRONICS DIV
31717 La Tienda Dr
Westlake Village CA 91360
(213) 889-2211

BURLINGTON MANAGEMENT SERVICES CO
PO Box 21207
Greensboro NC 27420
(919) 379-2165

BURNT-HILL ELECTRONICS LTD
88 Burnt Hill Rd-Lower Bourne
Franham, Surrey, England

BAEUROMASCHINEN-EXPORT GMBH (BME)
DDR-108 Berlin, East Germany
Friedrichstrasse 61

BURROUGHS CORP
WORLD HDQTRS
1 Burroughs Pl
Detroit MI 48232
(313) 972-7000
NEW YORK CITY DATA CTR
80 Pine St, 10th Fl
New York NY 10005
(212) 952-7333

BUSINESS COMPUTERS LTD (BCL)
180 Tottonham Ct Rd
London W1POHY, England

BUSINESS EDP SERVICES
Box 5445
Tallahassee FL 32301
(904) 222-9620

BUSINESS SYSTEMS TECHNOLOGY
3015 Daimler St
Santa Ana CA 92705
(714) 549-9961

BUTELCO
BUCKEYE TELEPHONE AND SUPPLY CO
1250 Kinnear Rd
Columbus OH 43221
(614) 488-0655

C

CACI INC
12011 San Vicente Blvd, Suite 350
Brentwood CA 90049
(213) 476-6511

CALCOMP GALAXIES INC
6955 Hayvenhurst Ave
Van Nuys CA 91406
(213) 988-1570

CALCOMP INC *(See California Comp Prod Inc)*

CALCULATOR PRODUCTS *(See Hewlett-Packard)*

CALIFORNIA COMPUTER PRODUCTS
2411 W La Palma Ave
Anaheim CA 92801
(714) 821-2541

CALIFORNIA DATA PROCESSORS (CALDATA)
Sky Park Circle
Irvine CA 92664
(714) 549-0982

CALL-A-COMPUTER
36 Washington St
Wellesley Hills MA 02181
(617) 237-2940

CALLDATA SYSTEMS INC
SUBSIDIARY OF GRUMMAN DATA SYSTEMS CORP
20 Crossways Park N
Woodbury NY 11797
(516) 575-3282

CALMA CO
WESTERN OFFICE
707 Kifer Rd
Sunnyvale CA 94086
(408) 245-7522
EASTERN OFFICE
Reston International Sq
Reston VA 22070
(703) 620-3991

CAMBRIDGE COMPUTER ASSOCIATES INC
222 Alewife Brook Pkwy
Cambridge MA 02138
(617) 868-1111

CAMBRIDGE MEMORIES INC
12 Crosby Dr
Bedford MA 01730
(617) 271-6300

CANADIAN GENERAL ELECTRIC CO LTD
214 King St W
Toronto 129, Ontario, Canada
(416) 366-7311

CANBERRA INDUSTRIES INC
45 Gracey Ave
Meriden CT 06450
(203) 238-2351

CANON INC
30-2 Shimomaruko 3-Chome
Ota-Ku
Tokyo 144, Japan

CANON USA INC
10 Nevada Dr
Lake Success NY 11040
(516) 488-6700

CAPS MICROFILM LTD
7 Westmoreland Rd
London NW 9 9RG England, UK

CARTERFONE COMMUNICATIONS CORP
2639 Walnut Hill La, Suite 223
Dallas TX 75229
(214) 350-7011

CASCADE DATA INC
3000 Kraft Ave SE
Grand Rapids MI 49508
(616) 942-1420

CBM TECHNICAL COLLEGE
1121 Navarro
San Antonio TX 78205
(512) 224-9286

CBT CORP
1 Constitution Plz
Hartford CT 06103
(203) 244-5388

CDC *(See Control Data Corp)*

CEGOS INFORMATIQUE
107 Bureaux de la Colline
92213 St. Cloud, France

CEGOS TYMSHARE
106 Bureaux de la Colline
92213 St. Cloud, France

CENTRONICS DATA COMPUTER CORP
1 Wall St
Hudson NH 03051
(603) 883-0111

CENTUREX INC
9841 Airport Blvd
Los Angeles CA 90045
(213) 649-3033

CFI MEMORIES INC
305 Crescent Way
Anaheim CA 92801
(714) 776-8571

CHALCO ENGINEERING CORP
15126 S Broadway
Gardena CA 90248
(213) 323-5525

CHARLES BRUNING CO *(See Addressograph Multigraph)*

CHASE ECONOMETRIC ASSOCIATES INC
1 Chase Manhattan Plz
New York NY 10015
(212) 552-8087

CHI CORP
11000 Cedar Ave
Cleveland OH 44106
(216) 229-6400

CHILTON COMPUTER CO
2819 N Fitzhugh St
Dallas TX 75221
(214) 828-6111

CHUO ELECTRONICS CO LTD
21 Motohongo-Cho
Hachioji-Shi
Tokyo 192, Japan

CIG COMPUTER PRODUCTS INC
Washington Plz
1351 Washington Blvd
Stamford CT 06902
(203) 359-2100

CII *(See Compagnie Internationale Pour L'informatique)*

CINCINNATI MILACRON CO
Mason-Morrow Rd
Lebanon OH 45036
(513) 459-5349

CINCOM SYSTEMS INC
Robert Taft Rd
Cincinnati OH 45211
(513) 528-1333

CIPHER DATA PRODUCTS INC
Kearny Mesa
San Diego CA 92111
(714) 279-6550

CLARY DATACOMP SYSTEMS INC
Clary St
San Gabriel CA 91776
(213) 287-6111

CLASCO SYSTEMS *(See Tesdata Systems Corp)*

CMC REMCOM INC
2705 National Dr
Garland TX 75040
(214) 328-9991

CMCS CORP
PO Box 402
Monroe NC 28110
(704) 289-3128

CMG *(See Computer Mgmt Group Ltd)*

CNA/INSURANCE
310 S Michigan Ave
Chicago IL 60604
(312) 822-5000

CODEX CORP
15 Riverdale Ave
Newton MA 02195
(617) 969-0600

COGAR CORP
Cosby Manor Rd
Utica NY 13502
(315) 797-5750

COGNITRONICS CORP
HDQTRS
25 Crescent St
Stanford CT 06906
(203) 327-5307
41 E 28th St
New York NY 10016
(212) 889-3650

COHERENT COMMUNICATIONS
85D Hoffman La S
Central Islip NY
(516) 582-4044

COLLINS RADIO CO
200 Park Ave
New York NY 10017
(201) 661-6530

COLLINS RADIO CO
MODEM & MULTIPLEXOR SALES
4311 Jamboree Rd
Newport Beach CA 92663
(714) 833-4600

COLUMBIA SCIENTIFIC
APPLIED COMPUTER SYSTEMS DIV
PO Box 6190
Austin TX
(512) 258-5191

COMCET *(See Comten Inc)*

COMDATA CORP
8115 N Monticello
Skokie IL 60076
(312) 677-3900

COMGRAPHIX INC
SW MICROFILM DIV
2601 E Yandell Dr
El Paso TX 79903
(915) 566-9351

COMMONWEALTH INFORMATION CORP
5001 W Broad St
Richmond VA 23230
(804) 649-9073

COMM-PRO ASSOCIATES
638 14th St, Suite 700
Manhattan Beach CA 92066
(213) 376-1344

COMM-SCI SYSTEMS CORP *(See Argonaut Information Systems)*

COMMUNITY COMPUTER CORP
185 W School House La
Philadelphia PA 19144
(215) 849-1200

COMNET *(See Computer Network Corp)*

COMPAGNIE HONEYWELL-BULL SA
EUROPE AND LEVEL 61 DESIGN CTR
94 Ave Gambetta
75 Paris 20 France
(1) 355-44-33

COMPAGNIE INTERNATIONALE POUR L'INFORMATIQUE
68 Rte de Versailles
78- Louveciennes, Seine, France

COMPATA INC
6150 Canoga Ave
Woodland Hills CA 91364
(213) 884-5400

COMPRO CORP
3001 Red Hill Ave, Bldg V1-103
Costa Mesa CA 92626
(714) 540-7153

COMPUCORP
12312 W Olympic Blvd
Los Angeles CA 90064
(213) 820-5611

COMPUDATA ELECTRONIC GMBH
4322 Sprockhovel 1 (West Germany)
Wuppertaler Strasse 50
(02324) 7577

COMPU-DIAL
21 Diney Ave
Cherry Hill Industrial Pk
Cherry Hill NJ 08034
(609) 424-4700

COMPUGRAPHIC CORP
Industrial Way
Wilmington MA 01887
(617) 658-5000

COMPUNETICS INC
1100 Eldo Rd, Monroeville Ind Pk
Monroeville PA 15146
(412) 373-2520

COMPUSCAN INC
900 Hayler St
Teterboro NJ 07608
(201) 288-6000

COMPU-SERV NETWORK INC
5000 Arlington Ctr Blvd
Columbus OH
(614) 457-8600

COMPUTATION PLANNING
7840 Aberdeen Rd
Bethesda MD 20014
(301) 654-1800

COMPUTEK INC
143 Albany St
Cambridge MA 02139
(617) 864-5140

COMPUTEL LTD
Eastern Rd
Bracknell, Berkshire, England

COMPUTEL SYSTEM LTD
1200 St Laurent Blvd
Ottawa, Ontario, Canada K1K3B8
(613) 746-4353

COMPUTER AUTOMATION INC
18651 Von Karman St
Irvine CA 92664
(714) 833-8830

COMPUTER CO
Westmoreland Ave
Richmond VA 23219
(804) 358-2171

COMPUTER COMMUNICATIONS INC
2610 Columbia St
Torrance CA 90503
(213) 320-9101

COMPUTER COMPLEX INC *(See Tymshare Corp)*

COMPUTER CORP OF AMERICA
575 Technology Sq
Cambridge MA 02139
(617) 491-3670

COMPUTERCRAFT SERVICES INC
Hamley Industrial Ct
St. Louis MO 63119
(314) 645-6336

COMPUTER DEVICES INC
9 Ray Ave
Burlington MA 01803
(617) 273-1550

COMPUTER DYNAMICS INC
112 Shawmut Ave
Boston MA 02118
(617) 357-8170

COMPUTER ENTRY SYSTEMS CORP
2141 Industrial Pkwy
Silver Spring MD 20904
(301) 622-3500

COMPUTER EQUIPMENT CORP
14616 Southlawn Dr
Rockville MD 20850
(301) 424-4790

COMPUTER GENERATION INC
3781 NE Expwy, Suite 101
Atlanta GA 30340
(404) 458-2371

COMPUTER HARDWARE CONSULTANTS & SERVICES
10 Pheasant Run
Newtown PA 18940
(215) 968-5900

COMPUTER INFORMATION MANAGEMENT CO
325 Oak Plz Bldg
3707 Rawlins St
Dallas TX 75219
(214) 526-4280

COMPUTER INNOVATIONS
70 W Hubbard St, Suite 401
Chicago IL 60610
(312) 329-1561

COMPUTER INTERACTIONS INC
425 Northern Blvd
Great Neck NY 11021
(212) 895-7435

COMPUTER INVESTORS GROUP
DATA RECALL PRODUCTS DIV
65 Washington Ave
Stamford CT 06902
(203) 359-2100

COMPUTERISTICS *(See Uniroyal Inc)*

COMPUTER LINGUISTICS INC
HDQTRS
24 Aviation Rd
Albany NY 12205
(518) 458-1860

COMPUTER LINK CORP
PERIPHERY INC DIV
14 Cambridge St
Burlington MA 01803
(617) 272-7400

COMPUTER MACHINERY CORP
2500 Walnut Ave
Marina del Rey CA 90291
(213) 390-8411

COMPUTER MANAGEMENT CORP
4900 Water's Edge
Raleigh NC 27604
(919) 851-7300

COMPUTER MANAGEMENT GROUP LTD
Sunley House, Bedford Pk
Croydon CRO 2AP, Great Britain

COMPUTERM CORP
201 Penn Ctr Blvd
Pittsburgh PA 15235
(412) 823-6116

COMPUTER NETWORK CORP
5185 MacArthur Blvd
Washington DC 20016
(202) 244-1900

COMPUTER OPERATIONS INC
10774 Tucker St
Beltsville MD 20705
(301) 937-5377

COMPUTER OPTICS INC
Berkshire Industrial Pk
Bethel CT 06801
(203) 744-6720

COMPUTER PROCEDURES CORP
181 S Franklin Ave
Valley Stream NY 11581
(516) 791-2000

COMPUTER PROCESSING INC
200 Manhattan Bldg
Muskogee OK 74401
(918) 683-3231

COMPUTER PRODUCTS
1400 NW 70th St
PO Box 23849
Fort Lauderdale FL 33307
(305) 974-5500

COMPUTER RESEARCH INC
4 E Kings Hwy
Haddonfield NJ 08033
(609) 428-0020

COMPUTER RESOURCE SERVICES INC
6501 N Black Canyon Hwy
Phoenix AZ 85015
(602) 242-9121

COMPUTER SCIENCES CANADA LTD
Place du Canada
Montreal 101, Quebec, Canada
(416) 449-0500

COMPUTER SCIENCES CORP
650 N Sepulveda Blvd
El Segundo CA 90245
(213) 678-0311

COMPUTER SERVICES CORP
23225 Northwestern Hwy
Southfield MI 48075
(313) 354-2491

COMPUTER SHARING SERVICES
2498 W Second Ave
Denver CO 80223
(303) 934-2381

COMPUTER SIGNAL PROCESSORS INC
209 Middlesex Tpk
Burlington MA 01803
(617) 272-6020

COMPUTER SOFTWARE CO, THE
6517 Everglade Dr
Richmond VA 23225
(804) 276-9200

COMPUTER SOLUTIONS INC
PO Box 10, 69 E Main St
Little Falls NJ 07424
(201) 785-4160

COMPUTER SYSTEMS AND EDUCATION CORP
111 Ash St
East Hartford CT 06108
(203) 528-9216

COMPUTER TASK GROUP INC
HDQTRS
5586 Main St
Buffalo NY 14221
(716) 634-9090
BRANCH OFFICE
1703 South Ave
Syracuse NY 13207
(315) 475-2126

COMPUTER TECHNOLOGY LTD (CTL)
Eaton Rd
Hemel Hempstead, Herts HP2 7EQ
England
(0442) 3272

COMPUTER TERMINAL CORP *(See Datapoint Corp)*

COMPUTER TERMINAL SYSTEMS INC
22 Newton Pl
Plainview NY 11803
(516) 293-6611

COMPUTER TRANSCEIVER SYSTEMS INC
PO Box 15
Paramus NJ 07652
(201) 261-6800

COMPUTER TRANSMISSION CORP
2352 Utah Ave
El Segundo CA 90245
(213) 973-2222

COMPUTER WARES INTL *(See General Computer Services)*

COMPUTERWISE INC
13124 S 71 Hwy
Grandview MO 64030
(816) 765-3330

COMPU-TIME INC
PO Box 960
Daytona Beach FL 32014
(904) 255-2486

COMPUTING TECHNOLOGY CO *(See Informatics Inc)*

COMPUTONE SYSTEMS INC
361 E Paces Ferry Rd NE
Atlanta GA 30305
(404) 261-0070

COMRESS *(See Comten Inc)*

COMSERV CORP
METRO OFFICE PK
3050 Metro Dr
Minneapolis MN 55420
(612) 854-2020

COM-SHARE INC
CORPORATE HDQRTRS
900 Wolverine Tower
PO Box 1588
Ann Arbor MI 48106
(313) 994-4800

COM-SHARE LTD
230 Galaxy Blvd
Rexdale, Ontario M9W 5R8, Canada

COMSTAR CORP
7413 Washington Ave S
Edina MN 55435
(612) 941-4454

COM-TECH INC
PO Box 784
Reston VA 22070
(703) 471-7141

COMTEN INC
PERFORMANCE & EVALUATION DIV
2 Research Ct
Rockville MD 20850
(301) 948-8000

COMTERM LTD
147 Hymus Blvd
Montreal 730, Quebec, Canada
(514) 697-0810

CONCAP COMPUTING SYSTEMS
303 Hegenberger Rd
Oakland CA 94621
(415) 635-5750

CONCORD COMPUTING CORP
7 Alfred Circle
Bedford MA 01730
(617) 275-1730

CONDATA INC
Alison Bldg
1809 Walnut St
Philadelphia PA 19103
(215) 569-4240

CONRAC CORP
Mill Rock Rd
Old Saybrook CT 06475
(203) 388-3574

CONRAC CORP
600 N Rimsdale Ave
Covina CA 91722
(213) 966-3511

CONSCO ENTERPRISES
1180 Ave of the Americas
New York NY 10036
(212) 575-8084

CONSOLIDATED ANALYSIS CENTERS INC
12011 San Vicente Blvd, Suite 350
Los Angeles CA 90049
(213) 476-6511

CONSOLIDATED COMPUTER INC
50 Gervaid Dr
Don Mills, Ontario, M3C 1Z3 Canada
(416) 449-1120

CONSTRUCTION COMPUTER CONTROL CORP
615 E Michigan St
Milwaukee WI 53202
(414) 272-6112

CONTINENTAL ILLINOIS NAT'L BANK/TST
231 S LaSalle St
Chicago IL 60690
(312) 828-2345

CONTROL DATA CORP
CORPORATE HDQTRS
8100 S 34th Ave
Minneapolis MN 55440
(612) 853-8100
CYBERNET SERVICE DIV
2401 N Fairview Ave
St Paul MN 55113
(612) 633-0371
MDM COMMUNICATIONS DIV
3519 W Warner Ave
Santa Ana CA 92704
(714) 540-2820

CONTROL INFORMATION INC
9575 W Higgins Rd
Rosemont IL 60018
(312) 696-1844

CONTROL LOGIC INC
9 Tech Circle
Natick MA 01760
(617) 655-1170

CORDELL ENGINEERING INC
210 Broadway
Everett MA 02149
(617) 289-4200

COSSOR ELECTRONICS LTD
The Pinnacles, Elizabeth Way
Harlow, Essex, England

COURIER TERMINAL SYSTEMS INC
2202 E University Dr
Phoenix AZ 85034
(602) 244-1392

COVER-ALL COMPUTER SERVICES LTD
1468 Victoria Pk Ave
Toronto 375, Ontario, Canada

CPC SYSTEMS INC
PO Box 328
East Hanover NJ 07936
(201) 887-9220

CPT CORP
HDQTRS
1001 2nd St S
Hopkins MN 55343
(612) 935-0381
E 79th St
Minneapolis MN 55807
(612) 854-7101

CRAMER ELECTRONICS INC
85 Wells Ave
Newton MA 02159
(617) 969-7700

CRAWFORD AND GRAUER
10 Surryhill Pl
Huntington NY 11743
(516) 368-5051

CREED & CO LTD
Hollingbury
Brighton, Sussex BN1 8AL, England

C S COMPUTER SYSTEMS INC
116 John St
New York NY 10038
(212) 349-3535

CTL *(See Computer Technology Ltd)*

CTM-COMPUTER TECHNIK MULLER GMBH
775 Konstanz-Litzelstetten
Komturweg 12, West Germany

CTRAC INC
20325 Ctr Ridge Rd
Rocky River OH 44116
(216) 333-3475

CUBIC INDUSTRIAL CORP
9233 Balboa Ave
San Diego CA 92138
(714) 279-7400

CULLINANE CORP
Wellesley Office Pk
20 William St
Wellesley MA 02181
(617) 237-6600

CUMMINS-ALLISON CORP
800 Waukegan Rd
Glenview IL 60025
(312) 724-8000

CUSTOM PROGRAMMING INC
W 51st St
Shaunee Mission KS 66222
(913) 262-6333

CUTLER WILLIAMS INC
2655 Villa Creek Dr
Dallas TX 75234
(214) 243-3421

CYBERNET TIME-SHARING LTD
47 Berners St
London W1, England

CYBORG SYSTEMS
2 N Riverside Plz, Suite 2400
Chicago IL 60606
(312) 454-1865

CYPHERNETICS CORP
175 Jackson Plz
Ann Arbor MI 48106
(313) 769-6800

C3 INC
11425 Isaac-Newton Sq
South Reston VA 22090
(703) 437-0200

D

DACONICS CORP
DATA & COMPUTER SYSTEMS
350 Potrero Ave
Sunnyvale CA 94086
(408) 738-4800

DAKOTA GRAPHICS
9655 W Colfax Ave
Lakewood CO 80215
(303) 237-0408

DANIEL J. EDELMAN INC
777 Third Ave
New York NY 10017
(212) 557-1020

DARTEX *(See Tally Corp)*

DATA 100 CORP
HDQTRS
7725 Washington Ave S
Edina MN 55435
(612) 941-6500

DATA ACCESS SYSTEMS INC
100 Rte 46
Mountain Lakes NJ 07046
(201) 335-3322

DATA ARCHITECTS INC
460 Totten Pond Rd
Waltham MA 02154
(617) 890-7730

DATA CARD CORP
7625 Parklawn Ave
Minneapolis MN 55435
(612) 835-5511

DATACHRON
174 Fifth Ave
New York NY 10010
(212) 675-5333

DATACOM
PO Box 278
Fort Walton Beach FL 32548
(904) 244-6121

DATA COMPUTER INC *(See Tally Corp)*

DATACROWN LTD
650 McNicoll Ave
Willowdale, Ontario, Canada
(416) 499-1012

DATA DESIGN ASSOCIATES
1229 Rousseau Dr
Sunnyvale CA 94087
(408) 732-3442

DATA DISC INC
686 W. Maude Ave
Sunnyvale CA 94086
(408) 732-7330

DATA DYNAMICS LTD
Data House, Springfield Rd
Hayes, Middx, England

DATA FINANCIAL SYSTEMS INC
PO Box 15411
4350 E Camelback Rd
Phoenix AZ 85018
(602) 959-9240

DATAFLUX CORP
1195 E Arques Ave
Sunnyvale CA 94086
(408) 732-7070

DATA FOR MANAGEMENT DECISIONS
22335 Governors Hwy
Richton Park IL 60471
(312) 784-2900

DATA GENERAL CORP
Rte 9
Southboro MA 01772
(617) 485-9100

DATA INPUT INC
4401 West 76 St
Minneapolis MN 55423
(612) 831-6500

DATA INSTRUMENTS
16611 Roscoe Pl
Sepulveda CA 91343
(213) 893-6464

DATALINE SYSTEMS LTD
40 St. Clair Ave W
Toronto, Ontario, Canada
(416) 964-9515

DATALOG
DIV OF LITTON SYSTEMS
1770 Walt Whitman Rd
Melville NY 11746
(516) 694-8300

DATALOGICS
University Circle Research Ctr
11001 Cedar Ave
Cleveland OH 44106
(216) 229-1300

DATA-MAN LTD
PO Box 9234
Bow Valley Sq II
205-5th Ave SW
Calgary, Alberta T2P 2W4 Canada
(403) 266-6358

DATAMARK INC *(See Bright Industries)*

DATA MEASUREMENTS CORP
2115 De La Cruz Blvd
Santa Clara CA 95050
(408) 249-1111

DATAMEDIA CORP
7300 N Crescent Blvd
Pennsauken NJ 08110
(609) 665-2382

DATA NUMERICS INC
141-A Central Ave
Farmingdale NY 11735
(516) 293-6600

DATA PATHING INC
370 San Aleso Ave
Sunnyvale CA 94086
(408) 734-0100

DATAPOINT CORP (FORMERLY COMPUTER TERMINAL CORP)
8400 Data Point Dr
San Antonio TX 78229
(512) 690-7000

DATA PRINTER CORP
600 Memorial Dr
Cambridge MA 02139
(617) 354-4700

DATA PROCESSING ENTERPRISES
914 S Hoover St
Los Angeles CA 90006
(213) 380-7200

DATAPRODUCTS CORP
HDQTRS
6219 De Soto Ave
Woodland Hills CA 91364
(213) 887-8000
STELMA DIV
17 Amelia Pl
Stamford CT 06904
(203) 325-4161

DATARAM CORP
Princeton-Hightstown Rd
Cranbury NJ 08512
(609) 799-0071

DATA RECALL PRODUCTS *(See Computer Investors Group)*

DATA RESOURCES INC
29 Hartwell Ave
Lexington MA 02173
(617) 861-0165

DATAROYAL INC
235 Main Dunstable Rd
Nashua NH 03060
(603) 883-4157

DATASAAB SYSTEMS INC
USA HDQTRS
437 Madison Ave
New York NY 10022
(212) 754-0680

DATA SCIENCES INC
HDQTRS
1 Indiana Sq, Suite 1755
Indianapolis IN 46204
(317) 632-3916

DATASERV
770 Airport Blvd
Burlingame CA 94010
(415) 342-0877

DATA SYNECTICS CORP
41 B St
Burlington MA 01803
(617) 273-0220

DATA SYSTEMS DESIGN INC
1122 University Ave
Berkeley CA 94702
(415) 849-1102

DATA TECHNOLOGY INC
4 Gill St
Woburn MA 01801
(617) 935-8830

DATA-TEK CORP
1211 Chestnut St
Philadelphia PA 19107
(215) 564-4133

DATA TERMINALS & COMMUNICATIONS INC
1190 Dell Ave
Campbell CA 95008
(408) 378-1112

DATA TERMINAL SYSTEMS INC
HDQTRS
124 Acton St
Maynard MA 01754
(617) 897-3221

DATATROL INC
Kane Industrial Dr
Hudson MA 01749
(617) 568-1411

DATA-TRONICS CORP
310 Towson Ave
Fort Smith AR 72901
(501) 785-6331

DATATYPE
1050 NW 163rd St
Miami FL 33169
(305) 625-8451

DATA VIEW INC
PO Box 537
Mexomonee Falls WI 53051
(414) 255-3200

DATENFERN VERARBEITUNG MBH *(See Gesellschaft Fur Datenfern Verarbeitung MBH)*

DATUM INC
1363 S State College Blvd
Anaheim CA 92806
(714) 533-6333

DEARBORN COMPUTER LEASING CORP
4849 N Scott St, Suite 401
Schiller Park IL 60176
(312) 671-4410

DEC *(See Digital Equipment Corp)*

DECISION CONCEPTS INC
280 Park Ave
New York NY 10017
(212) 752-1000

DECISION DATA COMPUTER CORP
100 Witmer Rd
Horsham PA 19044
(215) 674-3300

DECISION INC
5601 College Ave
Oakland CA 94618
(415) 654-8626

DECISION STRATEGY CORP
708 Third Ave
New York NY 10017
(212) 687-2660

DECITEK
DIV OF JAMESBURY CORP
250 Chandler St
Worcester MA 01602
(617) 798-8731

DELTA DATA SYSTEMS
Woodhaven Industrial Pk
Cornwells Heights PA 19020
(215) 639-9400

DESIGN AUTOMATION CORP
809 Massachusetts Ave
Lexington MA 02173
(617) 862-8998

DESIGN ELEMENTS INC *(See MI2 Data Systems*

DESK TOP COMPUTER *(See Eugene Dietzgen Co)*

DEST DATA CORP
1285 Forgewood Ave
Sunnyvale CA
(408) 734-1234

DIABLO SYSTEMS INC
900 W State Hwy 70
Marlton NJ 08053
(609) 983-3353

DIABLO SYSTEMS INC
26460 Corporate Ave
Hayward CA 94545
(415) 786-5000

DIALCOM INC
1104 Spring St
Silver Spring MD 20910
(301) 588-1572

DI/AN CONTROLS INC
944 Dorchester Ave
Boston MA 02125
(617) 288-7700

DICK CO, A. B.
5700 W Touhy Ave
Chicago IL 60648
(312) 775-7766

DICOM INDUSTRIES
715 N Pastoria Ave
Sunnyvale CA 94086
(408) 732-1060

DICTAPHONE CORP
120 Old Post Rd
Rye NY 10580
(914) 967-7300

DIEBOLD INC
818 Mulberry Rd
Canton OH 44702
(216) 453-4592

DIETZ & CO *(See Heinrich Dietz Industrie-Elecktronik)*

DIETZGEN CO EUGENE *(See Eugene Dietzgen Co)*

DIGICO LTD
St. Michaels House, Norton Way S
Letchworth, Herts, England

DIGI-DATA CORP
8580 Dorsey Run Rd
Jessup MD 20794
(301) 498-0200

DIGI-LOG SYSTEMS INC
Babylon Rd
Horsham PA 19044
(215) 672-0800

DIGITAL COMPUTER CONTROLS
12 Industrial Rd
Fairfield NJ 07006
(201) 575-9100

DIGITAL EQUIPMENT CORP
HDQTRS
146 Main St, Bldg PK3-1
Maynard MA 01754
(617) 897-5111
COMPONENTS GROUP
1 Iron Way
Marlborough MA 01752
(617) 481-7400

DIGITAL LABORATORIES
377 Putnam Ave
Cambridge MA 02139
(617) 876-6220

DIGITAL METHODS LTD
1716 Woodward Dr
Ottawa K2C OP8, Ontario, Canada
(613) 225-1171

DIGITAL SCIENTIFIC CORP
11455 Sorrento Valley Rd
San Diego CA 92121
(714) 453-6050

DIGITAL SOLUTIONS INC
100 Menlo Pk
Edison NJ 08817
(201) 549-1700

DIGITAL TELEPHONE SYSTEMS INC
1 Commerce Blvd
Novato CA 94947
(415) 883-5981

DIGITECH DATA INDUSTRIES INC
HDQTRS
66 Grove St
Ridgefield CT 06877
(203) 438-3731

DIGITEK CORP
15303 S Broadway
Gardena CA 90248
(213) 327-5410

DISTRONICS COMPUTER LOGISTICS
1060 Kings Hwy N
Cherry Hill NJ 08002
(609) 667-6233

DIVA INC
607 Industrial Way W
Eatontown NJ 07724
(201) 544-9000

DIVERSIFIEDATA SERVICES
PO Box 8922
Greensboro NC 27410
(919) 299-6948

DIVERSIFIED COMPUTER APPLICATIONS
2525 E Bayshore Rd
Palo Alto CA 94303
(415) 324-2523

DIVERSIFIED DATA SYSTEMS INC
2601 N Fairview Ave
Tuscon AZ 85705
(602) 792-3250

DNA SYSTEMS INC
1258 S Washington
Saginaw MI 48601
(517) 793-0185

DOCUMATION INC
PO Box 1240
Melbourne FL 32901
(305) 724-1111

DOCUMENTOR SCIENCES CORP
2921 S Daimler St
Santa Ana CA 92705
(714) 836-8608

DOCUTEL CORP
2615 E Grauwyler Rd
Irving TX 75061
(214) 438-1818

DRESSER SYSTEMS INC
PO Box 2928
Houston TX 77001
(713) 784-6011

D.R. MCCORD ASSOCIATES INC
1949 N Stemmons Frwy
Dallas TX 75207
(214) 630-2670

DUKANE CORP
2900 Dukane Dr
St. Charles IL 60174
(312) 584-2300

DUQUESNE SYSTEMS INC
355 5th Ave
Pittsburgh PA 15222
(412) 281-9055

DYMAT PHOTOMATRIX CORP
2225 Colorado Ave
Santa Monica CA 90404
(213) 828-9585

DYMO GRAPHIC SYSTEMS INC
355 Middlesex Ave
Wilmington MA 01887
(617) 658-9146

DYNABANK CORP
PO Box 4148
Atlanta GA 30302
(404) 433-2425

DYNASTOR INC
5867 N Broadway
Denver CO 80216
(303) 572-1170

DYNATRONICS CORP
Pierre LaClede Ctr
St. Louis MO 63105
(314) 862-2440

E

EAI *(See Electronic Associates Inc)*

EASTERN AIRLINES INC
COMMERCIAL COMPUTER SYSTEMS
Miami International Airport
Miami FL 33148
(305) 873-2211

EASTMAN KODAK CO
GENERAL OFFICES
343 State St
Rochester NY 14650
(716) 325-2000

EBELING ASSOCIATES INC
Sanders Ave
Scotia NY 12302
(518) 377-8862

ECCO CONSULTING INC
607 Washington Rd
Pittsburgh PA 15228
(412) 561-5509

ECONOCOM INC
PO Box 17825
1255 Lynnfield Rd
Memphis TN 38117
(901) 767-9130

ECRM INC
205 Burlington Rd
Bedford MA 01730
(617) 275-1760

EDELMAN DANIEL J. INC *(See Daniel J. Edelman)*

EDELMAN SYSTEMS INC
244 Peachtree Blvd, Suite 301
Baton Rouge LA 70806
(504) 387-1441

EDIT SYSTEMS INC
205500 Vernier Rd
Harper Woods MI 48225
(313) 886-6543

EDNALITE CORP
MEMORY DISPLAY SYSTEMS DIV
200 N Water St
Peekskill NY 10566
(914) 737-4100

EDP INDUSTRIES LTD
1132 Homer St
Vancouver 3, British Columbia, Canada

ELBIT COMPUTERS LTD
86-88 Hagiborim St
Haifa, Israel

ELECTRONIC ASSOCIATES INC
185 Monmouth Pkwy
W Long Branch NJ 07764
(201) 229-1100

ELECTRONIC ENGINEERING CO OF CALIFORNIA (EE CO)
1441 E Chestnut Ave
Santa Ana CA 92701
(714) 835-6000

ELECTRONIC INSTRUMENTATION *(See Lear Siegler Inc)*

ELECTRONIC MEMORIES
DIV OF ELECTRONIC MEMORIES & MAGNETICS CORP
12621 Chadron Ave
Hawthorne CA 90250
(213) 644-9881

ELECTRONIC PROCESSORS INC
5050 S Federal Blvd
Englewood CO 80110
(303) 761-8540

ELLIOT CO, B K *(See Océ Industries Inc)*

E MARSHALL SMITH LTD *(See Smith Ltd, E Marshall)*

EMM
PO Box 5522
San Jose CA 95150
(408) 298-7090

ENGINEERING COMPUTER SYSTEMS INC
21 Worthen Rd
Lexington MA 02173
(617) 862-6550
(213) 829-3696

ENM *(See Rank Organization Ltd)*

ENTREX INC
168 Middlesex Tpk
Burlington MA 01803
(617) 273-0480

EQUIMATICS
600 Kingsbridge Rd
Fairfield NJ 07006
(201) 575-9610

EQUIMATICS INC
1025 Elm St
Dallas TX 75202
(214) 744-4342

ERICSSON *(See L.M. Ericsson)*

ESE LTD
1780 Elbion Rd, Rexdale 610
Toronto, Ontario, Canada
(416) 749-2271

EUGENE DIETZGEN CO
DESK TOP COMPUTER DIV
2425 N Sheffield Ave
Chicago IL 60614
(312) 549-3300

EVANS & SUTHERLAND COMPUTER CORP
3 Research Rd
Salt Lake City UT 84112
(801) 582-5847

EVANSVILLE DATA PROCESSING CORP
1010 S Weinbach Ave
Evansville IN 47714
(812) 479-6951

EXECUTONE INC
CORPORATE HDQTRS
29-10 Thomson Ave
Long Island City NY 11101
(212) 392-4800

EXTEK MICROSYSTEMS INC
6955 Haybenhurst Ave
Van Nuys CA 91406
(213) 989-2630

F

FABRI-TEK
5901 S County Rd 18
Minneapolis MN 55436
(612) 935-8811

FACIT-ADDO AB
DATA PRODUCTS DIV
S-171
84 Solna, Sweden

FAIRCHILD SEMICONDUCTOR
464 Ellis St
Mountain View CA 94040
(415) 962-5011

FALL RIVER NATIONAL BANK
55 N Main St
Fall River MA 02722
(617) 678-8343

FDS/I
DIV OF TRW INC
3606 Silver Star Rd
Orlando FL 32808
(305) 299-6200

FEDDER DATA CENTERS INC
412 W Redwood
Baltimore MD 21201
(301) 685-6773

FEILER RECHENSELECTRONIC GMBH UND CO KG DATENVERARBEITUNGSMASCHINEN
1 Berlin 36
Wienerstrasse 46
West Germany

FERRAFLUX CORP
1801 E Newport Circle
Santa Ana CA 92705
(714) 979-0225

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E Bethpage Rd
Plainview NY 11803
(516) 293-8383

FERRANTI LTD
WYTHENSHAWE DIV
Simonsway, Wythenshawe
Manchester M22 5LA
England
(061) 428-3644

FERRANTI PACKARD LTD
ELECTRONICS DIV
121 Industry St
Toronto 15, Ontario, Canada
(416) 762-3661

FERROXCUBE CORP
Mount Marion Rd
Saugerties NY 12477
(914) 246-2811

FINANCIAL DATA SYSTEMS INC
763 New Ballas Rd S
St. Louis MO 63141
(314) 567-1940

FINANCIAL SYSTEMS CONSULTANTS
915 S Clinton
Ft Wayne IN 46802
(219) 422-5415

FINANCIAL TECHNOLOGY INC
612 N Michigan Ave
Chicago IL 60611
(312) 751-2600

FIRST DATA CORP
400 Totten Pond Rd
Waltham MA 02154
(617) 890-6701

FIRST NATIONAL BANK
COMPUTER DIV
PO Box 81008
Lincoln NB 68501
(402) 471-1021

FIRST NATIONAL BANK IN DALLAS
1401 Elm St
Dallas TX 75222
(214) 744-8000

FIRST NATIONAL BANK OF ATLANTA
PO Box 4148
Atlanta GA 30303
(404) 588-5000

FIRST NATIONAL BANK OF DENVER
SOFTWARE MARKETING SECTION
PO Box 5808, Terminal Annex
Denver CO 80217
(303) 893-2211

FIRST NATIONAL BANK OF MEMPHIS
COMPUTER CTR
PO Box 62
Memphis TN 38111
(901) 523-5442

FIRST WESTLAND NATIONAL BANK
10405 W Colfax
Lakewood CO 80215
(303) 232-2000

FLORIDA COMPUTER INC
99 NW 183rd St
Suite 122
North Miami FL 33169
(305) 652-1710

FLORIDA POWER CORP
PO Box 14042
St Petersburg FL 33733
(813) 866-5151

FLORIDA SOFTWARE SERVICES INC
PO Box 2269
Orlando FL 32802
(305) 831-3001

FONDILLER
200 W 58th St
New York NY 10019
(212) 586-6650

FORD INDUSTRIES INC
5001 SE Johnston Creek Blvd
Portland OR 97206
(503) 774-1104

FORTEX DATA CORP
10 S Riverside Plz
Chicago IL 60606
(312) 454-1650

FOUR-PHASE SYSTEMS
19333 Vallco Pkwy
Cupertino CA 95014
(408) 255-0900

FOXBORO COMPANY
DIGITAL SYSTEMS DIV
38 Neponsat Ave
Foxboro MA 02035
(617) 543-8750

FREDRICK ELECTRONICS
PO Box 502
Fredrick MD 21701
(301) 662-5901

FRIDEN *(See Singer Co. Business Mach Div)*

FROST NAT'L BANK
PO Box 1600
San Antonio TX 78296
(512) 220-4011

FUJITSU LTD
680 Fifth Ave
New York NY 10019
(212) 265-5360
2-8 Marunouchi, Chiyoda-Ku
Tokyo, Japan

FULTON NATIONAL BANK
55 Marietta St
Atlanta GA 30302
(404) 577-3500

G

GAF CORP
140 W 51st St
New York NY 10020
(212) 582-7600

GAIN COMPUTER SERVICES
20 Freeport St
Boston MA 02122
(617) 288-2530

GBA INTAL
2670 Leavenworth St
San Francisco CA 94133
(415) 673-5400

GE *(See General Electric Company)*

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Elstree Way
Herts WD6 1RX, England
01-953-2030

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2306 Cotner Ave
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Cunard Bldg
Liverpool L3 1E, England

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1055 S East St
Anaheim CA 92805
(714) 778-4800

GENERAL COMPUTER SERVICES
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Huntsville AL 35805
(205) 539-9492

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16600 Dooley Rd
Addison TX 75001
(214) 233-5800

GENERAL COMPUTING CORP
444 Park Ave S
New York NY 10011
(212) 889-1600

GENERAL DATACOMM INDUSTRIES
131 Danbury
Wilton CT 06897
(203) 762-0711

GENERAL ELECTRIC CO
CORPORATE HDQTRS
777 14th St NW
Washington DC 20005
(202) 637-4000
DATA COMMUNICATIONS PRODUCTS DEPT
Waynesboro VA 22980
(703) 942-8161
INFO SERVICES BUSINESS DIV
401 N Washington St
Rockville MD 20850
(301) 340-4000

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PO Box 76
Lyons IL 60534
(312) 447-4515

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600 W John St
Hicksville NY 11802
(516) 733-3000
SYSTEMATICS DIV
13040 S Cerise Ave
Hawthorne CA 90250
(213) 973-1741

GENERATED SYSTEMS INC
108 W Liberty Dr
Wheaton IL 60187
(312) 668-0506

GENESEE COMPUTER CENTER INC
20 University Ave
Rochester NY 14605
(716) 232-7050

GENESIS ONE COMPUTER CORP
300 E 44th St
New York NY 10017
(212) 557-3500

GEO SPACE CORP
5803 Glenmont Dr
Houston TX 77036
(713) 666-1611

GERBER SCIENTIFIC INSTRUMENT CO
PO Box 305
Hartford CT 06101
(203) 644-1551

GESELLSCHAFT FUER DATENFERN VERARBEITUNG MBH DEUTSCHE DATEL
6100 Darmstadt Postfach 120
Nieder-Ramstadter Strasse 18-20
West Germany

GOLDEN GATE SYSTEMS
320 Vista Linda Dr
Mill Valley CA 94941
(415) 398-2623

GOODYEAR AEROSPACE CORP
HDQTRS
1210 Massillon Rd
Akron OH 44315
(216) 794-2601

GORDON & GOTCH COMPUTING CTR LTD
75 Farrington St
London EC4, England

GOULD DATA SYSTEMS *(See Gould Inc)*

GOULD INC
3631 Perkins Ave
Cleveland OH 44114
(216) 361-3315
DATA SYSTEMS DIV
20 Ossipee Rd
Newton MA 02164
(617) 969-6510

GRAPHIC SCIENCES INC
Corporate Dr & Commerce Pk
Danbury CT 06810
(203) 792-6000

GRAPHIC SYSTEMS INC
Executive Dr
Hudson NH 03051
(603) 889-8550

GRENOBLE UNIVERSITY
Universite de Grenoble
Grenoble Isere, France

GREYHOUND COMPUTER CORP
Greyhound Tower
111 W. Clararendon
Phoenix AZ 85077
(602) 248-2900

GRI COMPUTER CORP
320 Needham St
Newton MA 02164
(617) 969-0800

GROUP OPERATIONS INC
2025 Eye St NW
Washington DC 20006
(202) 331-7474

GROUP SIX LTD
Winterhay La
Ilminster, Somerset,
England: U.K.

GRUMMAN DATA SYSTEMS CORP
(See CallData Systems Inc)

GTE AUTOMATIC ELECTRIC INC
400 N Wolf Rd
Northlake IL 60163
(312) 562-7100

GTE DATA SERVICES INC
PO Box 1548
Tampa FL 33601
(813) 224-3131

GTE INFORMATION SYSTEMS
1 Stamford Forum
Stamford CT 06940
(203) 357-2000

GTE LENKURT
1105 County Rd
San Carlos CA 94070
(415) 591-8461

GULF COMPUTER SCIENCES CORP
1775 St. James Pl, Suite 160
Houston TX 77056
(713) 627-9320

GULTON INDUSTRIES INC
COMPUTER SYSTEMS DIV
13041 Cerise Ave
Hawthorne CA 90250
(213) 679-0111

H

HAMILTON COMMUNICATIONS INC
22 N 159 Pepper Rd
PO Box 791
Barrington IL 60010
(312) 381-5820

HANSCO DATA PROCESSING INC
Box 236
Wilbraham MA 01095
(413) 732-9613

HARRIS CORP
COMPUTER SYSTEMS DIV
1200 NW 70th St
Fort Lauderdale FL 33307
(305) 974-1700
DATA COMMUNICATIONS DIV
11262 Indian Trl
PO Box 44076
Dallas TX 75234
(214) 620-4400

HAVERLY SYSTEMS INC
70 Broadway
Denville NJ 07834
(201) 627-1496

HAZELTINE CORP
Pulaski Rd
Greenlawn NY 11740
(516) 261-7000

HB *(See Compagnie Honeywell-Bull)*

HDR SYSTEMS INC
8404 Indian Hills Dr
Omaha NB 68114
(402) 399-1400

HECON CORP
PO Box 247
Eatontown NJ 07724
(201) 542-9200

HEINRICH DIETZ INDUSTRIE-ELECKTRONIK
D-4330 Mulheim a.D. Ruhr 13
Solinger Strasse 9
West Germany
(0 21 33) 48 50 24

HEITZ INC, KARL *(See Karl Heitz Inc)*

HENDRIX ELECTRONICS INC
Grenier Industrial Village
Londonderry NH 03053
(603) 699-9050

HENDRIX ELECTRONICS INC
645 Harvey Rd
Manchester NH 03103
(603) 669-9050

HERMES-PAILLARD SA
Yverdon Vaud
Switzerland

HETRA
1151 Eddie Allen Rd
Melbourne AL 32901
(305) 723-7731

HEWITT ASSOCIATES
102 Wilmont Rd
Deerfield, IL 60015
(312) 945-8000

HEWLETT-PACKARD CO
HDQTRS
1501 Page Mill Rd
Palo Alto CA 94304
(415) 493-1501
CALCULATOR PRODUCTS DIV
PO Box 301
Loveland CO 80537
(303) 667-5000
DATA SYSTEMS DIV
11000 Wolfe Rd
Cupertino CA 95014
(408) 257-7000

HF PHOTO SYSTEMS *(See Technology Inc)*

HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 Dupont Ave
Cleveland OH 44108
(216) 541-8060

HIS *(See Honeywell Information Systems Inc)*

HITACHI AMERICA LTD
USA OFFICE
NEW YORK HEAD OFFICE
437 Madison Ave
New York NY 10022
(212) 758-5420
COMPUTER LIAISON OFFICE
2672 Bayshore, Frontage Rd
Mountain View CA 94043
(415) 968-7309

HITACHI LTD
WORLD HDQTRS
6-2 2-Chome Otemachi Chiyoda-Ku
Tokyo 100, Japan
(03) 765-3111

HITTMAN ASSOCIATES INC
DISC DIV
9190 Red Branch Rd
Columbia MD 21045
(301) 730-7800

HOHNER *(See Ruf-Buchhaltung AG)*

HOKUSHIN ELECTRIC WORDS LTD
30-1 Shimomaruko 3-Chome
Ota-Ku, Tokyo 144, Japan

HOLLANDER ASSOCIATES
PO Box 2276
Fullerton CA 92633
(714) 879-9000

HOLLINBECK ENTERPRISES
MICROLOGIC SYSTEMS
12 Walden
Burnsville MN 55337
(612) 890-0983

HONEYWELL-BULL, COMPAGNIE
(See Compagnie Honeywell-Bull)

HONEYWELL INFORMATION SYSTEMS INC
WORLD CORPORATE HDQTRS
2701 Fourth Ave S
Minneapolis MN 55408
(612) 870-5200
COMPUTER CONTROL DIV
Old Connecticut Path
Framingham MA 01701
(617) 879-2600
HDQTRS OF N AMERICAN OPERATIONS
200 Smith St
Waltham MA 02154
(617) 890-8400
INFORMATION SYSTEMS
60 Walnut St
Wellesley Hills MA 02181
(617) 237-4100
INFORMATION SYSTEMS
PO Box 6000
Phoenix AZ 85005
(602) 993-6000
PROCESS CONTROL DIV
2255 W Desert Cove Rd
Phoenix AZ 85029
(602) 943-2341
ITALIA S.P.A.
32 via Pirelli
20124 Milano
Italy

HORACE MANN EDUCATORS
216 E Monroe St
Springfield IL 62701
(217) 789-2500

HORIZONS RESEARCH INC
23800 Mercantile Rd
Cleveland OH 44122
(216) 464-2424

HOSKYNS INC
75 Rockefeller Plz
New York NY 10019
(212) 541-4740

HOUSTON COMPLEX INC
537 Steamboat Rd
Greenwich CT 06803
(203) 661-7984

HOUSTON-FEARLESS IMAGE SYSTEMS INC
11244 Playa Ct
Culver City CA 90230
(213) 479-3941

HOUSTON INSTRUMENT *(See Bausch & Lomb Inc)*

HUGHES INDUSTRIAL PRODUCTS DIV
6155 El Camino Real
Carlsbad CA 92018
(714) 438-9191

HUNTINGTON NATIONAL BANK
PO Box 1558
Columbus OH 43216
(614) 469-7000

HYDRA COMPUTER CORP
PO Box 17883
Raleigh NC 27609
(919) 782-1051

I

IBM *(See Int'l Business Machines Corp)*

IBM CANADA LTD
1150 Eglington Ave E
Don Mills 402, Ontario, Canada
(416) 433-2111

IBM FRANCE
SERVICE BUREAU
5 Pl Vendome
Paris 1 ER, France
508-7436

IBM LTD
DATA CTR SERVICES
58 Newman St
London W1, England
01-636-7788
HEAD OFFICE
389 Chiswick High Rd
London W4, England
01-995-1441

ICL *(See Int'l Computers Ltd)*

ICS *(See Information Computer Systems Ltd)*

IMAGE INFORMATION INC
4 Old Newtown Rd
Danbury CT 06810
(203) 792-0804

IMAGING TECHNOLOGY LTD
Woodfield House
Honeypot Lane
Stanmore, Middlesex, England: U.K.

IME *(See Industria Machine Electroniche)*

IMLAC CORP
150 A St
New England Industrial Ctr
Needham MA 02194
(617) 449-4600

IMPERIAL TECHNOLOGY INC
831 S Douglas St, Suite 102
El Segundo CA 90245
(213) 679-9501

IMS ASSOCIATES INC
1922 Republic Ave
San Leandro CA 94577
(415) 483-2093

IMSL
GNB Bldg
7500 Bellaire
Houston TX 77036
(713) 772-1927

INCOTERM CORP
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6 Strathmore Rd
Natick MA 01760
(617) 655-6100

INDEPENDENT BUSINESS TELEPHONES
PO Box 23866
Tampa FL 33622
(813) 961-1351

INDIANA BANK & TRUST CO *(See Financial Systems Consultants)*

INDUSTRIA MACHINE ELECTRONICHE
Via Tito Speri 4
Pomezia
Rome, Italy

INDUSTRIE ELETTRONICHE ASSOCIATE SPA
AUTOMATION DIV, VIA TIBURTINA KM
PO Box 7083
00100 Rome, Italy

INFODATA SYSTEMS INC
HDQTRS
30-A State St
Pittsford NY 14534
(716) 381-7430

INFODATA SYSTEMS INC
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5205 Leesburg Pike, Suite 701
Falls Church VA 22041
(703) 578-3430

INFONATIONAL
6626 Convoy Ct
San Diego CA 92111
(714) 560-7070

INFOREX INC
21 North Ave
Burlington MA 01803
(617) 272-6470

INFORMATEK SA
Zone Industrielle de Bures/Yvette
BP 12, Arsay, France

INFORMATICS INC
HDQTRS
21031 Ventura Blvd
Woodland Hills CA 91364
(213) 887-9040
COMPUTING TECHNOLOGY CO
65 Rte 4
River Edge NJ 07661
(201) 488-2100
INFORMATION SYSTEMS CO
6000 Executive Blvd
Rockville MD 20852
(301) 770-3000
MARK IV SYSTEMS CO
21050 Vanowen St
Canoga Park CA 91303
(213) 887-9121
PROGRAMMING METHODS CO
1301 Ave of the Americas
New York NY 10019
(212) 489-7200
WESTERN SYSTEMS CO
21050 Vanowen St
Canoga Park CA 91303
(213) 887-9121

INFORMATION ASSOCIATES INC
HDQTRS
97 Humboldt St
Rochester NY 14609
(716) 288-6900

INFORMATION COMPUTER SYSTEMS LTD
19 Marylebone Rd
London NW1, England

INFORMATION CONSULTANTS INC
2011 I St NW
Washington DC 20006
(202) 785-0115

INFORMATION CONTROL CORP
9610 Ballanca Ave
Los Angeles CA 90045
(213) 641-8520

INFORMATION CONTROL SYSTEMS INC
313 N First
PO Box 280
Ann Arbor MI 48107
(313) 761-1600

INFORMATION DATA SYSTEMS
23874 Kean Ave
Dearborn MI 48124
(313) 563-3277

INFORMATION DESIGN INC
Civil Air Terminal
Bedford MA 01730
(617) 274-0190

INFORMATION DESIGN INC
3247 Middlefield Rd
Menlo Park CA 94025
(415) 369-2962

INFORMATION DISPLAYS INC
333 N Bedford Rd
Mount Kisco NY 10549
(914) 592-2025

INFORMATION DYNAMICS CORP
1711 Dallas N Pkwy
Plano TX 75074
(214) 423-1555

INFORMATION EQUITIES INC
4140 Redwood Hwy
San Rafael CA 94903
(415) 983-7609

INFORMATION INTERNATIONAL
Slauer Ave
Culver City CA 90230
(213) 870-2647

INFORMATION MANAGEMENT INC
1101 S Winchester
San Jose CA 95128
(408) 248-8250

INFORMATION RESEARCH & TECHNOLOGY INC
4660 Kenmore Ave
(703) 370-8111

INFORMATION RESOURCES INC
2970 Peachtree Rd
Atlanta GA 30305
(404) 262-1851

INFORMATION SCIENCE INC
97 Chestnut Ridge Rd
Montvale NJ 07645
(201) 391-1600

INFORMATION SCIENCES INC
100 SW Market St
Portland OR 97201
(503) 224-5600

INFORMATION STORAGE SYSTEMS INC
10324 N Tautau Ave
Cupertino CA 95014
(408) 257-6220

INFORMATION SYSTEMS CO *(See Informatics Inc)*

INFORMER COMPUTER TERMINALS
2218 Cotner Ave
Los Angeles CA 90064
(213) 477-4216

INFOTON INC
Second Ave
Burlington MA 01803
(617) 272-6660

INFOTRON SYSTEMS
HDQTRS
7300 N Crescent Blvd
Pennsauken NJ 08110
(609) 665-3864

INNOVATION DATA PROCESSING
925 Clifton Ave
Clifton NJ 07013
(201) 777-1940

INNOVATIVE MANAGEMENT INC
7149 Fauna St
Houston TX 77017
(713) 644-2166

INNOVEX CORP
75 Wiggins Ave
Bedford MA 01730
(617) 275-2110

INSCO SYSTEMS CORP
3501 Rte 66
Neptune NJ 07753
(201) 922-1100

INSEL SPA
Largo Messico 4
Roma, Italy
Tel. (06) 86 66 63

INSTRONICS LTD
PO Box 100
Stittsville, Ontario, Canada
(613) 836-4411

INTEL CORP
3065 Bowers Ave
Santa Clara CA 95051
(408) 246-7501

INTEL MEMORY SYSTEMS
DIV OF INTEL CORP
1302 N Mathilda Ave
Sunnyvale CA 94086
(408) 734-8102

INTERACTIVE DATA CORP
406 Totten Pond Rd
Waltham MA 02154
(617) 890-1234

INTERACTIVE DATA SYSTEMS *(See Telefile Computer Products)*

INTERACTIVE SCIENCES CORP
60 Brooks Dr
Braintree MA 02184
(617) 848-2660

INTERDATA INC
2 Crescent Pl
Oceanport NJ 07757
(201) 229-4040

INTERDYNE
14761 Calffa St
Van Nuys CA 91401
(213) 787-6800

INTERFACE MECHANISMS INC
5503 232nd St SW
Mountlake Terrace WA 98043
(206) 774-3511

INTERMEM CORP
Market St
Wappingers Falls NY 12590
(914) 297-5996

INTERNATIONAL BUSINESS MACHINES CORP
DATA PROCESSING DIV
1133 Westchester Ave
White Plains NY 10604
(914) 696-1900
GENERAL SERVICES DIV
875 Johnson Ferry Rd NE
Atlanta GA 30301
(404) 256-7000
GENERAL SYSTEMS DIV
400 Colony Sq
Atlanta GA 30301
(404) 885-6111
OCR PRODUCTS HDQTRS
3605 Hwy 52 N
Rochester MN 55901
(507) 286-4011
OFFICE PRODUCTS DIV
Parson's Pond Dr
Franklin Lakes NJ 07417
(201) 848-1900

INTERNATIONAL COMPUTER PRODUCTS INC
PO Box 34484
Dallas TX 75234
(214) 350-6951

INTERNATIONAL COMMUNICATIONS CORP
8600 NW 41st St
Miami FL 33166
(305) 592-7654

INTERNATIONAL COMPUTERS LTD
WORLD MARKETING
ICL House, Putney,
London SW 15 1SW, England
01-788-7272

INTERNATIONAL COMPUTERS USA LTD
555 Madison Ave
New York NY 10022
(212) 486-7400

INTERNATIONAL COMPUTER TERMINALS INC *(See Incoterm Corp)*

INTERNATIONAL DATA SCIENCES
HDQTRS
100 Nashua St
Providence RI 02904
(401) 274-5100

INTERNATIONALE POUR L'INFORMATIQUE COMPAGNIE *(See Compagnie Internationale pour l'informatique)*

INTERNATIONAL MANAGEMENT SYSTEMS CORP
4676 Admiralty Way
Marina Del Ray CA 90291
(213) 822-2022

INTERNATIONAL MEMORY SYSTEMS
14609 Scottsdale Rd
Scottsdale AZ 85260
(602) 991-4090

INTERNATIONAL TIMESHARING CORP
Jonathan Industrex, ITS Bldg
Chaska MN 55318
(612) 448-3061

INTERSTATE BUSINESS SERVICES
6 W Third St
PO Box 1028
Mansfield OH 44901
(419) 524-6161

INTERTECHNIQUE SA
B.P. No 1
78 Plaisir, Seine, France

INTERTEL INC.
6 Vine Brook Pk
Burlington MA 01803
(617) 273-0950

INTERTYPE CO *(See Harris Intertype Corp)*

INZ C. OLIVETTI & CO S.P.A.
Palazzo Uffici, Via G. Jervis 77
10015 Ivrea nr Turin, Italy

I/ONEX *(See Sonex Inc)*

I.P. SHARP ASSOCIATES LTD
PO Box 1900
320 Queen St
Ottawa, Ontario, Canada
(613) 236-9942

ISC/PRYOR COMPUTER INC
400 N Michigan Ave
Chicago IL 60611
(312) 644-5650

ISE COMPUTER GBRUEDER SAMMETINGER ELECTRONIC
87-Wuerzburg
Gneisenaustrasse 18-24
West Germany

ITEK BUSINESS PRODUCTS *(See Itek Corp)*

ITEK CORP
BUSINESS PRODUCTS DIV
1001 Jefferson Rd
Rochester NY 14603
(716) 244-5600

ITEL CORP
CORPORATE HDQTRS
1 Embarcadero Ctr
San Francisco CA 94111
(415) 983-0000

ITT 204
DATA EQUIPMENT & SYSTEMS DIV
157 E Union Ave
E Rutherford NJ 07073
(201) 935-3517

ITT (BUSINESS SYSTEMS GROUP)
DATA EQUIPMENT & SYSTEMS DIV
Holbrook House, Cockfosters Rd
Barnet, Herts EN 40 DU England
01-440-4141

ITT EUROPE INC
Blvd de l'Empereur
Brussels, Belgium B-1000

ITT STANDARD ELEKTRIK LORENZ *(See Standard Elekrik Lorenz)*

ITT STANDARD TELEPHONES & CABLES *(See Standard Telephone & Cables Ltd)*

ITT WORLD COMMUNICATIONS INC
67 Broad St
New York NY 10004
(212) 797-7510

IWATSU ELECTRIC CO LTD
Asahiseimei Bldg 2-1-3 Nihonbashi
Chuo-Ku
Tokyo, 103, Japan

J

JEFFERSON FINANCIAL SYSTEMS INC
177 N Franklin St
Chicago IL 60606
(312) 372-8411

JENOPTIK JENA GMBH
P.O.B. 190
69 Jena
German Democratic Republic

J. H. MULLENS B V
Newtonstraat 417
The Hague, Netherlands

JOHNSON SYSTEMS INC
Westgate Research Pk, Grant Bldg
1657 Old Meadow Rd
McLean VA 22101
(703) 893-8700

J. TOELLNER & ASSOCIATES
4311 Wilshire Blvd
Los Angeles CA 90010
(213) 931-1127

K

KABEL-UND-METALLWERKE GUTEHOFFNUNGSHUTTE AG
Datentechnische Elektronik (Kel)
Postfach 260 Hannover 3000
West Germany

KALVAR CORP
907 S Broad St
New Orleans LA 70125
(504) 822-1600

KAMAN SCIENCES CORP
1700 Garden of the Gods Rd
Colorado Springs CO 80907
(303) 598-5880

KANSAS STATE UNIVERSITY
DEPT OF COMPUTER SCIENCE
Fairchild Hall
Manhattan KS 66502
(913) 532-6011

KARL HEITZ INC
979 Third Ave
New York NY 10022
(212) 421-5220

KENNEDY CO
540 W Woodbury Rd
Altadena CA 91001
(213) 798-0953

KERONIX CORP
COMPUTER PRODUCTS DIV
1752 Cloverfield Blvd
Santa Monica CA 90404
(213) 829-3594

KEUFFEL & ESSER CO
20 Whippany Rd
Morristown NJ 07960
(201) 285-5000

KEYDATA CORP
108 Water St
Watertown MA 02172
(617) 924-1200

KEY TRONIC CORP
Spokane Industrial Park, Bldg 14
Spokane WA 99216
(509) 928-8000

KIENZLE APPARATE GMBH
Bereich Datensysteme
D-7730 Villingen im Schwarzwald
West Germany
Postfach 1640
0 7721-862 76/376

KIMBALL SYSTEMS *(See Litton Industries)*

KLEER-VE INDUSTRIES
MICROFILM DIV
878 Sussex Blvd
Broomall PA 19008
(215) 544-9070

KLEINSCHMIDT *(See SCM Corp)*

KODAK COMPANY *(See Eastman Kodak Company)*

KODE INTERNATIONAL LTD
Carne, Wiltshire, England

KOMBINAT VEB PENTACON
Dresden, German Democratic Republic

KONGSBERG SYSTEMS INC
10 Deangelo Dr
Bedford MA 01730
(617) 275-9606

KRALL MANAGEMENT INC
Sta Sq Three
Paoli PA 19301
(215) 647-5445

KRANTZ COMPUTER
171-175 Julicher Strasse PO 830
Aachen, West Germany D-5100

KRANZLEY & CO
1010 S Kings Hwy
Cherry Hill NJ 08034
(609) 795-1515

KRUPP ATLAS-ELECTRONIK
28 Bremen 44
Sebaldsbrocker Heerstrasse 235
Postfach 448545
West Germany

KUSTOM ELECTRONICS INC
DATA COMMUNICATIONS DIV
1010 W Chestnut
Chanute KS 66720
(316) 431-4380

KYBE CORP
132 Calvary St
Waltham MA 02154
(617) 899-0012

L

LAMSON-VIATRON LTD
928 High Rd, Finchley
London N 12, England

LAMPERTZ ORGANISATION
1000 Berlin 44
Postfach 320 German Democratic Republic

LA TELEMECANIQUE ELECTRIQUE SA
DIRECTION DIV INFORMATIQUE
Rue De Provence
38130 Echirolles (Nr Grenoble)
France
(76) 09.80.55

LCS CORP
31 Elm St
Springfield MO 01103
(413) 781-6741

LEAR SIEGLER INC
ELECTRONIC INSTRUMENTATION DIV
714 N Brookhurst St
Anaheim CA 92803
(714) 774-1010

LEASCO RESPONSE
20030 Century Blvd
Germantown MD 20767
(301) 428-0500

LEEDS & NORTHROP
Sumney Town Pike
North Wales PA 19454
(215) 643-2000

LE FEBURE CORP
GENERAL OFFICES
308 29th St NE
Cedar Rapids IA 52406
(319) 366-2771

LENKURT ELECTRIC *(See GTE Lenkurt)*

LEXICON INC
60 Turner St
Waltham MA 02154
(617) 891-6790

LEXIDATA CORP
803 Massachusetts Ave
Lexington MA 02173
(617) 861-6134

LEXITRON CORP
9600 DeSoto Ave
Chatsworth CA 91311
(213) 882-5040

LINCOLN LAND SOFTWARE SYSTEMS
PO Box 2238
Springfield IL 62705
(217) 522-1747

LINOLEX SYSTEMS INC
DIV OF 3M CO
5 Esquire Rd
North Billerica MA 01862
(617) 667-4151

LISS PUBLIC RELATIONS INC
Station Plz
250 E Hartsdale Ave
Hartsdale NY 10530
(914) 472-5900

LITTON INDUSTRIES *(Also See Royal Typewriter Co)*
AUTOMATED BUSINESS SYSTEMS DIV
34 Maple Ave
Pine Brook NJ 07058
(201) 575-8100
MEMORY PRODUCTS DIV
8020 Deering Ave
Canoga Park CA 91304
(213) 884-4600
KIMBALL SYSTEMS DIV
151 Cortlandt St
Belleville IL 07109
(201) 759-6500
LITCOM DIV
1770 Walt Whitman Rd
Melville NY 11746
(516) 694-8300

LIVERMORE DATA SYSTEMS INC
PO Box 945
Livermore CA 94550
(415) 447-2252

L.M. ERICSSON TELEFONAKTIEBOLAGET
Box 32046 5-126-11
Stockholm, Sweden 32

LOCKHEED ELECTRONICS CO
DATA PRODUCTS DIV
6201 E Randolph St
Los Angeles CA 90040
(213) 722-6810

LOGABAX
146 Avenue des Champs-Elysees
75008 Paris 8E, France
359.61.24

LOGICON INC
21535 Hawthorne Blvd, Room 440
Torrance CA 90503
(213) 542-7313

LOGICON-INTERCOMP
PO Box 2933
24225 Garnier St
Torrance CA 90505
(213) 325-6060

LONDON UNIV COMPUTING SERVICES LTD
39 Gordon Sq
London WC1, England

LUNDY ELECTRONICS & SYSTEMS INC
LUNDY-FARRINGTON DIV
Robert La
Glen Head NY 11545
(516) 676-1440

LYNCH COMMUNICATION SYSTEMS INC
601 California St, Suite 802
San Francisco CA 94108
(415) 397-1471

LYNWOOD SCIENTIFIC DEVELOPMENTS LTD
Caker Stream Rd, Mill La
Alton, Hants, England
(0420) 84888

M

3M CO
MICROFILM PRODUCTS DIV
3M Ctr
St. Paul MN 55101
(612) 733-1110

MACHINE TABULATING SERVICE
357 F St
PO Box 1834
Idaho Falls ID 83401
(208) 523-2627

MAI EQUIPMENT CORP
300 E 44th St
New York NY 10017
(212) 557-3500

MANAGEMENT & COMPUTER SERVICES INC
790 Valley Forge Plz
Valley Forge PA 19482
(215) 265-2910

MANAGEMENT CONTROL
100 Putnam Green
Greenwich CT 06830
(203) 531-5351

MANAGEMENT INFORMATION SERVICE
PO Box 336
Ramsey NJ 07446
(201) 327-8510

MANAGEMENT DATA SYSTEMS
1641 Universal Rd
Columbus OH 43207
(614) 443-9487

MANAGEMENT SCIENCE AMERICA
3445 Peachtree Rd NE, Suite 1300
Atlanta GA 30326
(404) 262-2376

MANAGEMENT SYSTEMS CORP
Carlisle Ave
Dallas TX 75205
(214) 651-0987

M&M COMPUTER INDUSTRIES INC
2201 N Glasell
Orange CA 92665
(714) 998-1551

MANN EDUCATORS, HORACE *(See Horace Mann Educators)*

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320 N Main St
Ann Arbor MI 48104
(313) 761-7750

MANUFACTURING MGMT SCIENCES INC *(See Software International Corp)*

MARCONI-ELLIOTT COMPUTER SYS LTD *(See GEC Computers Ltd)*

MARCUS POWELL ASSOCIATES
1736 Franklin St
Oakland CA 94612
(415) 893-7598

MARK COMPUTER SYSTEMS INC
63 Austin Blvd
Commack NY 11725
(516) 543-6660

MARK IV SYSTEMS CO *(See Informatics Inc)*

MARK/OPS
475 Commonwealth Ave
Boston MA 02215
(617) 266-1930

MARMESA
26-28 rue Sedaine
750-11 Paris, France
700.37.17, 700.80.51

MARSHALL DATA SYSTEMS *(See Marshall Industries)*

MARSHALL INDUSTRIES
DATA SYSTEMS DIV
2065 Huntington Dr
San Marino CA 91108
(213) 684-1530

MARTIN MARIETTA CORP
11300 Rockville Pike
Rockville MD 20852
(301) 881-0770

MARTIN RESEARCH
3336 Commercial Ave
Northbrook IL 60062
(312) 498-5060

MARTIN WOLFE INC
8369 Vickers St
San Diego CA 92111
(714) 277-3700

MATHEMA AB
Strand BGSG 57
5 11251 Stockholm, Sweden

MATHEMATICA
PO Box 2392
Princeton NJ 08540
(609) 799-2600

MATRA-ENGINS
Avenue Louis Breguet
78 Velizy, France

MATSUSHITA COMMUNICATION INDUSTRIAL CO LTD
880 Tsunashima-Cho
Kohoku-Ku
Yokohama 222, Japan

MATTH-HOHNER AG
D7218 Trossingen 1
Postfach 160
West Germany

MBM COMPUTERS LTD
MBM House
Northampton NN1 5BU, England
0604-21911

MB-METALS LTD
Victoria Rd, Portslade
Sussex BN4 1Y4, England

M. BRYCE & ASSOCIATES INC
PO Box 15459
Cincinnati OH 45215
(513) 761-8400

MCCORD ASSOCIATES INC D.R. *(See D.R. McCord)*

MCDONNELL DOUGLAS AUTOMATION COMPANY
PO Box 516
St Louis MO 63166
(314) 232-0232

MDM COMMUNICATIONS *(See Control Data Corp)*

MDS ATRON *(See Mohawk Data Sciences Corp)*

MEADE TECHNOLOGY LABS
3481 Dayton-Xenia Rd
Dayton OH 45432
(513) 426-3111

MEDIA III
2259 Via Burton Ave
Anaheim CA 92806
(714) 870-7660

MEDICAL INFO TECH
Bent St
Cambridge MA 02142
(617) 354-3000

MEGADATA COMPUTER & COMMUNICATIONS CORP
35 Orville Dr
Bohemia NY 11716
(516) 589-6800

MEGATEK CORP
1055 Shafter St
San Diego CA 92106
(714) 224-2721

MELCOM SYSTEMS LTD
Bridge House, Bridge St
Godalming Surrey, England

MELLON BANK NA
E Towns St & Columbus
Columbus OH 43207
(614) 228-6931

MEMODYNEF CORP
369-375 Elliot St
Newton Upper Falls MA 02164
(617) 527-6600

MEMOREX CORP
San Tomas & Central Expwy
Santa Clara CA 95052
(408) 987-1000

MEMOREX CORP
SALES & SERVICE DIV
1700 Broadway
New York NY 10019
(212) 541-7780

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MERC/PENTAMATION DATA CENTER
C/O PENTAMATION ENTERPRISES INC
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Bethlehem PA 18015
(215) 865-6446

MERGENTHALER LINOTYPE CO
Mergenthaler Dr
Plainview NY 11803
(516) 694-1300

MERLIN SYSTEMS CORP
1044 Northern Blvd
Roslyn NY 11576
(516) 484-4545

META-EDUCATIONAL SYSTEM
4 E 43rd St
New York NY 10017
(212) 661-5115

METRA INSTRUMENTS INC
2257 Old Middlefield Way
Mountain View CA 94040
(415) 961-7249

METRIDATA COMPUTING INC
6600 Grade La
Louisville KY 40221
(502) 361-7161

METROPROCESSING CORP
64 Prospect St
White Plains NY 10606
(914) 949-0890

MGA
9952 Santa Monica Blvd
Beverly Hills CA 90212
(213) 553-0376

MI2 DATA SYSTEMS
1212 Kinnear Rd
Columbus OH 43212
(614) 481-8131

MICOBRA CORP
PO Box 1187
176 King St
Hanover MA 02339
(617) 871-2610

MICRO COMPUTER MACHINES INC
PO Box 310
133 Dalton St
Kingston, Ontario, Canada

MICRO COMPUTER SYSTEMS LTD
Boundary Rd
Woking, Surrey, England

MICRO CONSULTANTS LTD
70 Croydon Rd
Caterham, Surrey, England

MICRODATA CORP
17481 Red Hill Ave
Irvine CA 92705
(714) 540-6730

MICROFILM PRODUCTS INC
40 W 15th St
New York NY 10011
(212) 741-8300

MICROFORM DATA SYSTEMS INC
Maude Ave
Mountain View CA 94042
(415) 964-6435

MICROKIT INC
2180 Colorado Ave
Santa Monica CA 90404
(213) 828-1722

MICROSEAL CORP
2000 Louis Ave
Zion IL 60099
(312) 872-1666

MICRO SYSTEMS INC *(See Microdata Corp)*

MIDLAND NATIONAL BANK
201 W Wisconsin Ave
Milwaukee WI 53203
(414) 278-6000

MIDWEST ADVANCED COMPUTER SERVICES INC
2409 John B St
Warren MI 48091
(313) 759-2900

MINICOMPUTER RESOURCES
402 Rio St, Suite 106
Tampa FL 33609
(813) 251-0661

MINNESOTA MINING & MFG CO *(See 3M Company)*

MITE CORP
446 Blake St
New Haven CT 06515
(203) 387-2572

MITS
6328 Linn NE
Albuquerque NM 87108
(505) 265-7553

MITSUBISHI ELECTRIC CO
ELECTRONICS DIV
12, 2-Chome, Marunouchi
Chiyoda-Ku, Tokyo, Japan

MKD CORP
961 Bethel Ave
Pennsauken NJ 08110
(609) 663-3211

MNEMOTECH COMPUTER SYSTEMS INC
15 Maiden La
New York NY 10005
(212) 577-0370

MODCOMP *(See Modular Computer Systems)*

MODULAR COMPUTER SYSTEMS
1650 W McNab Rd
Fort Lauderdale FL 33309
(305) 974-1380

MOHAWK DATA SCIENCES CORP
EXECUTIVE HDQTRS
1599 Littleton Rd
Parsippany NJ 07054
(201) 540-9080

MOHAWK INDUSTRIAL LABORATORIES INC
1 Ward St
Vernon NY 13476
(315) 829-2781

MONITOR SYSTEMS
401 Commerce Dr
Fort Washington PA 19034
(215) 646-8100

MONOLITHIC MEMORIES
1165 E Arques Ave
Sunnyvale CA 94086
(408) 739-3535

MONTEDEL SPA
LABEN DIV
20133 Milano
Via Bassini 15
Italy

MONTICANTI EDISON ELETTRONICA
SPA LABEN DIV (LABORATORI ELETTRONICI E
Via Edouardo Bassini 15
Milano, Italy

MORGAN GUARANTEE TRUST
23 Wall St
New York NY 10005
(212) 483-2323

MORGAN INFORMATION SYSTEMS INC *(See Extek Microsystems Inc)*

MOSLER
INFORMATION SYSTEMS DIV
Rte 50
Milford OH 45150
(513) 831-6100

MOSLER TELLER-MATIS
Rte 50
Milford OH 45150
(513) 831-6100

MRI SYSTEMS CORP
PO Box 9510
Austin TX 78766
(512) 258-5171
SEMICONDUCTOR PRODUCTS DIV
PO Box 20912
Phoenix AZ 85036
(602) 244-6900

MSI DATA CORP
1381 Fischer Ave
Costa Mesa CA 92627
(714) 549-6600

MULLENS B V, J.H. *(See J.H. Mullens BV)*

MULTICOMPINC *(See Call-A-Computer)*

MULTIDATA INC *(See Systems Engineering Laboratories)*

MULTIPLE ACCESS INC
HDQTRS
747 Third Ave, 26th Floor
New York NY 10017
(212) 832-3224

MULTIPLE ACCESS LTD
885 Don Mills Rd
Don Mills 403, Ontario, Canada
(416) 443-3900

MULTIPLE FUNDING CORP OF AMERICA
50 E 42nd St, Suite 1505
New York NY 10017
(212) 867-7373

MYCRO-TEK INC
6631 E Kellogg, Suite 214
Wichita KS 67207
(316) 265-5277

N

N.A. PHILIPS *(See North American Philips Corp)*

NATIONAL CASH REGISTER CO *(See NCR)*

NATIONAL COMPUTER ANALYSTS INC
US Hwy No. 1 At Farber Rd
Princeton NJ 08540
(609) 452-2800

NATIONAL COMPUTER NETWORK OF CHICAGO
1929 N Harlem Ave
Chicago IL 60635
(312) 622-6666

NATIONAL COMPUTER PRODUCTS INC
Chesapeake Ave
Towson MD 21204
(301) 823-2248

NATIONAL COMPUTER SYSTEMS
4401 W 76th St
Minneapolis MN 55435
(612) 831-4100

NATIONAL COMPUTING INDUSTRIES
6075 Roswell Rd NE
Atlanta GA 30328
(404) 252-9479

NATIONAL CSS INC
300 Westport Ave
Norwalk CT 06851
(203) 853-7200

NATIONAL MICRONETICS
PACIFIC DIV
5600 Kearney Mesa Rd
San Diego CA 92111
(714) 279-7500

NATIONAL SEMICONDUCTOR CORP
2900 Semiconductor Dr
Santa Clara CA 95051
(408) 732-5000

NCB COMPUTER POWER
Cannock, Staffs, England

NCR
WORLDWIDE HDQTRS
Main & K Sts
Dayton OH 45409
(513) 449-2000

NETWORK DATA PROCESSING CORP
321 Third St SE
Cedar Rapids IA 52403
(319) 365-8691

NEW ENGLAND TELEPHONE & TELEGRAPH
Franklin St
Boston MA 02109
(617) 227-9950

NEW MAX
720 Old Willets Pass
Hauppauge NY 11787
(516) 582-3311

NEW YORK CITY DATA CENTER *(See Burroughs Corp)*

NICHOLS & COMPANY
1888 Century Park E
Los Angeles CA 90067
(213) 556-2757

NIHON ICL MACHINERY CO LTD
102 Kyomachibori 5-Chome
Nishi-Ku, Osaka 550, Japan

NIPPON COLUMBIA CORP OF AMERICA
6 E 43rd St
New York NY 10017
(212) 682-5060

NIPPON ELECTRIC CO
5-33-1 Shiba Minato-Ku
Tokyo, Japan
454-1111
AMERICAN I L C HEAD OFFICE
Pan Am Bldg
200 Park Ave, Suite 4321
New York NY 10017
(212) 758-1666

NIPPON TIME SHARE CO LTD
17th Mqri Bldg
2, Sakuragawa-Cho, Shiba Nishikubo
Minatoku, Tokyo, Japan
(03) 562-0551

NIXDORF COMPUTER AG
USA HDQTRS
O'Hare Plz Mall
5725 E River Rd
Chicago IL 60631
(312) 693-6600
WORLD HDQTRS
4790 Paderborn, West Germany
Fuerstenweg
(05251) 2001

NOLLER CONTROL SYSTEMS *(See Badger Meter Inc)*

NORAND CORP
550 Second St SE
Cedar Rapids IA 52401
(319) 366-7611

NORD *(See A/S Norsk Data-Electronikk)*

NORELCO

NORTH AMERICAN PHILIPS CORP
(Also See Philips Business Systems Inc)
EXECUTIVE OFFICES
100 E 42nd St
New York NY 10017
(212) 697-3600
NORTH AMERICAN PHILIPS CORP DIV
91 McKee Dr, Box C
Mahwah NJ 07430
(201) 529-3800

NORTHEASTERN SYS ASSOCIATES INC *(See Mark/Ops)*

NORTH ELECTRIC CO
PO Box 688
Galion OH 44833
(419) 468-8100

NORTHERN ELECTRIC CO LTD
140 Federal St
Boston MA 02110
(617) 482-0995

NORTHERN RADIO CO
Beaver St
New York NY 10011
(212) 269-7124

NORTHWEST MANAGEMENT SERVICES
2300 Eastlake Ave E
Seattle WA 98102
(206) 329-9990

NOVATION INC
18664 Oxnard St
Tarzana CA 91356
(213) 996-5060

NUCLEAR DATA INC
Golf & Meacham Rds
Schaumburg IL 60172
(312) 884-3600

NUMERI/COMP
1330 E State St
Rockford IL 61108
(815) 963-2435

NV PHILIPS ELECTROLOGICA
IG COMPUTER SYSTEMS
Utrecht, Netherlands
IG OFFICE MACHINES
Bldg 'Hertoghof' HSM
Eindhoven, Netherlands
(040) 79 1111

NV PHILIPS-ELECTROLOGICA BV
WORLD MARKETING
GENERAL SYSTEMS
Bldg HSM Hertoghof
Eindhoven, Netherlands
040-755024

NV PHILIPS ELECTROLOGICA NEDERLAND
TIME SHARING DIV
Mariahove, De Horst 4
The Hague, Netherlands

NV PHILIPS GLOEILAMPENFABRIEKEN
HDQTRS
Eindhoven, Netherlands

O

OBBO
2 Rue Hippolyte-Lebas
Paris 9E, France

OCCIDENTAL COMPUTER SYSTEMS
10202 Riverside Dr
North Hollywood CA 91602
(213) 763-5144

OCÉ INDUSTRIES INC
HDQTRS
6500 N Lincoln Ave
Chicago IL 60645
(312) 338-1700

ODEC COMPUTER SYSTEMS
25 Graystone St
Warwick RI 02886
(401) 738-9500

OHIO VALLEY DATA CONTROL INC
2505 Washington Blvd
Belpre OH 45714
(614) 423-9501

OKIDATA CORP
111 Garther Dr
Moorestown NJ 08057
(609) 235-2600

OKI ELECTRIC INDUSTRY CO LTD
10 Shiba Kotohira-Cho
Mimami-Ku, Tokyo 105, Japan

OKI ELECTRONICS INC
500 SE 24th St
Fort Lauderdale FL 33316
(305) 563-6234

OLD STONE BANK COMPUTER CENTER
443 Jefferson Blvd
Warwick RI 02886
(401) 274-7800

OLIVETTI CORP OF AMERICA *(Also See Inz C. Olivetti And Co, S.P.A.)*
EXECUTIVE & GENERAL OFFICES
500 Park Ave
New York NY 10022
(212) 371-5500

OLIVETTI & CO S.P.A. *(See Inz C. Olivetti & Co S.P.A.)*

OLIVETTI UNDERWOOD CORP
500 Park Ave
New York NY 10022
(212) 371-5500

OLYMPIA INTERNATIONAL OLYMPIA
AG FACHBEREICH SYSTEM UND DATENTECHNIK
6232 Neuenhain BEI
Frankfurt am Main
West Germany

OLYMPIA USA INC
Box 22
Somerville NJ 08876
(201) 722-7000

OMEGA-T SYSTEMS INC
300 Terrace Village
Richardson TX 75080
(214) 231-9303

OMNIS CORP
500 S Ervay
Dallas TX 75201
(214) 651-0201

OMNITEC CORP
2405 S 20th St
Phoenix AZ 85034
(602) 258-8244

OMRON SYSTEMS INC
432 Toyama Dr
Sunnyvale CA 94086
(408) 734-8400

ON-LINE SYSTEMS INC
115 Evergreen Heights Dr
Pittsburgh PA 15229
(412) 931-7600

ONTEL CORP
3 Fairchild Ct
Plainview NY 11803
(516) 822-7800

OPSCAN *(See Optical Scanning Corp)*

OPTICAL RECOGNITION SYSTEMS INC
1928 Isaac Newton Sq W
Reston VA 22090
(703) 471-5060

OPTICAL SCANNING CORP
Newtown Industrial Commons
Newtown PA 18940
(215) 968-4611

ORBIS SYSTEMS INC
Franklin St
Tustin CA 92680
(714) 838-1491

ORBITAL SYSTEMS INC
Church & Fellowship Rds
Moorestown NJ 08057
(609) 234-1700

ORDO *(See Societe des Ordoprocesseurs)*

OXFORD SOFTWARE CORP
1567 Palisade Ave
Fort Lee NJ 07024
(201) 944-0083

P

PACE APPLIED TECHNOLOGY
Telstar Ct
Arlington VA 22209
(703) 573-9131

PACIFIC INTERNATIONAL COMPUTING CORP
50 Beale St
San Francisco CA 94105
(415) 764-9990

PACIFIC PLANTRONICS
111C Josephine St
Santa Cruz CA 95060
(408) 426-5858

PACIFIC STOCK EXCHANGE
301 Pine St
San Francisco CA 94104
(415) 392-6533

PANSOPHIC SYSTEMS INC
709 Enterprise Dr
Oak Brook IL 60521
(312) 986-6000

PARADYNE CORP
8550 Ulmerton Rd
Largo FL 33540
(813) 536-4771

PCS (PROCESS COMPUTER SYSTEMS)
5467 Hill 23 Dr
Flint MI 48507
(313) 767-8920

PENRIL DATA COMMUNICATIONS INC
520 Randolph Rd
Rockville MD 20852
(301) 881-8151

PEOPLES BANK OF BLOOMINGTON
120 N Center St
Bloomington IL 61701
(309) 828-5211

PEOPLES TRUST BANK
913 S Calhoun St
Fort Wayne IN 46820
(219) 743-0383

PEOPLES-MERCHANTS TRUST CO, THE
237 W Tuscarawas St
Canton OH 44702
(216) 455-6741

PERIPHERAL BUSINESS EQUIPMENT INC *(See Pertec Business Systems)*

PERIPHERAL DYNAMICS INC
1030 W Germantown Pike
Norristown PA 19401
(215) 539-5500

PERIPHERALS GENERAL INC
1724 Marlton Pike E
Cherry Hill NJ 08003
(609) 474-2008

PERIPHERAL TECHNOLOGY INC *(See Pertec Business Systems)*

PERIPHERY INC *(See Computer Link Corp)*

PERIPHONICS CORP
75 Orville Dr, Airport International Plz
Bohemia NY 11716
(516) 567-1000

PERRY ELECTRONICS INC
PO Box 10217
Raleigh NC 27605
(919) 821-3700

PERSONNEL DATA SYSTEMS
Whitemarsh Plz
15 E Ridge Pike
Conshohocken PA 19428
(215) 828-4294

PERTEC BUSINESS SYSTEMS
17112 Armstrong Ave
Santa Ana CA 92705
(714) 540-8340

PERTEC CORP
9600 Irondale Ave
Chatsworth CA 91311
(213) 882-0030

PHI COMPUTER SERVICES *(See Wang Computer Services)*

PHILCO-FORD CORP
COMMUNICATIONS & ELECTRONICS DIV
3900 Welsh Rd
Willow Grove PA 19090
(215) 659-7700

PHILIPS BUSINESS SYSTEMS INC
(Also See North American Philips Corp)
175 Frochlich Farms Blvd
Woodbury NY 11797
(516) 921-9310

PHILIPS ELECTROLOGICA *(See Nv Philips Electrologica)*

PHOTON INC *(See Dymo Graphic Systems Inc)*

PIEDMONT CALL-A-COMPUTER
1001 Wade Ave
Raleigh NC 27605
(919) 828-6831

PITNEY-BOWES ALPEX INC
Commerce Pk
Danbury CT 06810
(203) 792-1600

PITTSBURGH NATIONAL BANK
960 Ft Duquesne Blvd
Pittsburgh PA 15230
(412) 355-2000

PLANTRONICS INC
385 Reed St
Santa Clara CA 95050
(408) 249-1160

PLESSEY COMMUNICATIONS SYSTEMS
1413 Chestnut Ave
Hillside NJ 07205
(201) 628-0050

PLESSEY COMPANY LTD
AUTOMATION GROUP
64 Brewery Rd
London N7, England
COMMUNICATIONS SYSTEMS DIV
9 Dallington St
London EC1V OJO, England

PLESSY ELECTRONIC CORP
170 Finn Ct
Farmingdale NY 11735
(516) 694-7900

PLESSEY MICROSYSTEMS
1674 McGaw Ave
Irvine CA 92714
(714) 540-9945

PLESSEY TELECOMMUNICATIONS DATA SYSTEMS
Sopers La
Poole, Dorset BH177ER England
(02013) 5161

PMC *(See Princeton Microfilm Corp)*

PM COMPUTER SERVICES
630 30th St NW
Canton OH 44709
(216) 455-6741

POLYCOM SYSTEMS LTD
133 Wynford Dr
Don Mills, Ontario, Canada
(416) 449-3400

POTTER INSTRUMENT CO INC
151 Sunnyside Ave
Plainview RI 19103
(516) 681-3200

POWER COMPUTER SYSTEMS
Rte 3 at Meadow Rd
Rutherford NJ 07070
(201) 933-1650

PRC COMPUTER CENTER INC
7670 Old Springhouse Rd
McLean VA 22101
(703) 893-4880

PRECISION INSTRUMENT CO
2323 Owen St
Santa Clara CA 95051
(408) 249-5801

PRENTICE ELECTRONICS CORP
795 San Antonio Rd
Palo Alto CA 93403
(415) 494-7225

PRIME COMPUTER INC
PO Box 2600
145 Pennsylvania Ave
Framingham MA 01701
(617) 879-2960

PRINCETON ELECTRONIC PRODUCTS INC
PO Box 101
North Brunswick NJ 08902
(201) 297-4448

PRINCETON MICROFILM CORP
Alexander Rd
Princeton NJ 08540
(609) 452-2066

PRINTER TECHNOLOGY
Woburn Industrial Pk
Sixth Rd
Woburn MA 01801
(617) 935-4246

PROCTOR AND ASSOCIATES
Overlake Industrial Pk
Redmond WA 98502
(206) 885-4171

PROGRAMART CORP
133 Mt Auburn St
Cambridge MA 02138
(617) 661-3020

PROGRAMMING METHODS INC *(See Informatics Inc)*

PROGRAM PRODUCTS INC
95 Chestnut Ridge Rd
Montvale NJ 07645
(201) 391-9800

PROGRAMS AND ANALYSIS INC
21 Ray Ave
Burlington MA 01803
(617) 272-7723

PROGRESSIVE SYSTEMS
PO Box 445
215 First St
Ridgewood NJ 07423
(201) 652-0909

PRO-LOG CORP
2411 Garden Rd
Monterey CA 93940
(408) 372-4593

PROMODATA SA
1 Rue Lord Byron
75 Paris 8E, France

PROPRIETARY COMPUTER SYSTEMS INC
16625 Saticoy St
Van Nuys CA 91406
(213) 781-8221

PRYOR COMPUTER INDUSTRIES
400 N Michigan Ave
Chicago IL 60611
(312) 644-5650

PRYOR-TIM INC *(See ISC/Pryor Computer Inc)*

PULSE COMMUNICATIONS INC
5714 Columbia Pike
Falls Church VA 22041
(703) 820-0657

Q

QANTEL CORP
3525 Breakwater Ave
Hayward CA 94545
(415) 783-3410

QUANTOR CORP
520 Logue Ave
Mountain View CA 94043
(415) 965-3700

R

RAIR INC
465 Castro St
Mountain View CA 94040
(415) 964-0413

R2E MICRAL MICROCOMPUTERS
38 Garden Rd
Wellesley Hills MA 02181
(617) 235-8830

RANDOLPH COMPUTER CO
MID-WEST DIV
8050 Hosbrook Rd
Cincinnati OH 45236
(513) 793-6060
NORTH-EAST DIV
537 Steamboat Rd
Greenwich CT 06830
(203) 661-4200

RANK ENGLISH NUMBERING MACHINES LTD *(See Rank Organization Ltd)*

RANK ENM *(See Rank Organization Ltd)*

RANK ORGANIZATION LTD
RANK ENM DIV
Adam House, 1 Fitzroy Sq
London W1P6DS, England
01-804-8121

RANK-XEROX DATA SYSTEMS *(See Rank-Xerox Ltd)*

RANK-XEROX LTD
RANK-XEROX DATA SYSTEMS DIV
York House, Empire Way
Wembley, Middlesex, England

RAPIDATA CO
20 New Dutch La
Fairfield NJ 07006
(201) 227-0035

RATH & STRONG
21 Worthen Rd
Lexington MA 02173
(617) 861-1700

RAYMOND ENGINEERING INC
217 Smith St
Middletown CT 06457
(203) 632-1000

RAYTHEON-COSSOR
The Pinnacles, Elizabeth Way
Harlow, Essex CM19 5 BB England
(02796) 26862

RAYTHEON DATA SYSTEMS CO
1415 Boston-Providence Tpk
Norwood MA 02062
(617) 762-6700

RC *(See Regnecentralen Scandinavian)*

RCA COMPUTER SYSTEMS
TECHNICAL PRODUCTS & SERVICE
Building 204-2, Rte 38
Camden NJ 08101
(609) 963-8000

RCA CORP
SOLID STATE DIV
Rte 202
Somerville NJ 08876
(201) 722-3200

RCA GLOBAL COMMUNICATIONS INC
60 Broad St
New York NY 10004
(212) 363-2121

RCA SERVICE CO
Building 203-3
Dept 1614
Camden NJ 08101
(609) 963-8000

READ INC
PO Box 2231
Princeton NJ 08540
(609) 452-2270

REALISATIONS ET ETUDES ELECTRONIQUES
Zone Industrielle de Courtaboeuf
91400
Orsay France

REALIST INC
N93 W 16288 Megal Dr
Menomonee Falls WI 53051
(414) 251-8100

REAL/TIME COMPUTER SYSTEMS
3720 Main St
Bridgeport CT 06606
(203) 372-6621

RECOGNITION EQUIPMENT CORP
PO Box 22307
Dallas TX 75222
(214) 438-8611

REDACTRON
100 Pkwy Dr S
Hauppauge NY 11787
(516) 694-7323

REDIFON LTD
DATA SYSTEMS DIV
1723 Kelvin Way
Crawley, Sussex, England

REGISCOPE CORP OF AMERICA
7 E 43rd St
New York NY 10017
(212) 661-1730

REGMA
Societé La Cellophane
110 Blvd Haussman
75360 Paris Cedix 08, France

REGNECENTRALEN
SCANDINAVIAN INFO PROCESSING SYSTEM
Hovedvejen 9
DK-2600 Gloustrup, Denmark

REI *(See Recognition Equipment Corp)*

RELIABLE COMMUNICATIONS PRODUCTS
11333 Addison St
Franklin Park IL 60131
(312) 455-8520

REMCOM SYSTEMS INC *(See CMC Remcom Inc)*

REMEX
1733 Alton St
Santa Ana CA 92705
(714) 557-6860

REMINGTON RAND OFFICE SYSTEMS *(See Sperry Rand Corp)*

REMOTE DATA TERMINALS INC
TTS DIV
2928 Nebraska Ave
Santa Monica CA 90404
(213) 829-2611

REPCO INC
1940 Lockwood Way
Orlando FL 32804
(305) 843-8484

RESEARCH INC
Box 24064
Minneapolis MN 55424
(612) 941-3300

REYNOLDS & REYNOLDS CO
800 Germantown St
Dayton OH 45401
(513) 226-0808

RFL INDUSTRIES INC
COMMUNICATIONS DIV
Powerville Rd
Boonton NJ 07005
(201) 334-3100

RICOH CO LTD
3-6 Nagamagome 1-Chome
Ota-Ku
Tokyo 143, Japan

RIXON INC
SUBSIDIARY OF SANGAMO
2120 Industrial Pkwy
Silver Springs MD 20904
(301) 622-2121

ROCKINGHAM NAT'L BANK COMPUTER SERVICES
PO Box 455
Harrisonburg VA 22801
(703) 434-1331

ROCKWELL INTERNATIONAL
INFORMATION SYSTEMS DEPT
PO Box 2515
2201 Seal Beach Blvd
Seal Beach CA 90740
(213) 594-3311
MICRO-ELECTRONICS DEVICES DIV
3310 Miraloma Ave
Anaheim CA 92803
(714) 632-8111
SPACE DIV
12214 Lakewood Blvd
Downey CA 90241
(213) 922-2111

ROLM CORP
10300 N Tantau Ave
Cupertino CA 95014
(408) 257-6440

ROYAL TYPEWRITER CO
DIV OF LITTON INDUSTRIES
150 New Park Ave
Hartford CT 06106
(203) 523-4881

RUF-BUCHHALTUNG AG
CH-8040 Zurich
Badenerstrasse 595
Postfach
Switzerland

RXDS *(See Rank-Xerox Ltd)*

S

SAAB-SCANIA AB
EUROPEAN HDQTRS
DATASAAB DIV
S-581 88 Linkoping, Sweden
013-11 15 00

SAC *(See Science Accessories Corp)*

SAGEM *(See Societe d' Applications Generales d' Electricite et de Mecanique)*

SANDERS ASSOCIATES INC
Canal St
Nashua NH 03060
(603) 885-4321

SANGAMO ELECTRIC CO
PO Box 359
Springfield IL 62075
(217) 544-6411

SAVIN BUSINESS MACHINES CORP
400 Columbus
Valhalla NY 10595
(914) 769-9500

SCAN-DATA CORP
800 E Main St
Norristown PA 19401
(215) 277-0500

SCANIPS *(See Regnecentralen Scandinavian)*

SCAN-OPTICS INC
100 Prestige Pk
East Hartford CT 06108
(203) 289-6001

SCICON *(See Scientific Control System Ltd)*

SCIENCE ACCESSORIES CORP
970 Kings Hwy W
Southport CT 06490
(203) 255-1526

SCIENTIFIC CONTROL SYSTEMS LTD
Sanderson House, 49/57 Berners St
London W1P4AO, England

SCIENTIFIC MEASUREMENT
26 Olney Ave
Cherry Hill NJ 08003
(609) 424-5220

SCIENTIFIC MICRO SYSTEMS
520 Clyde Ave
Mountain View CA 94043
(415) 964-5700

SCIENTIFIC SYSTEMS TECH
3530 Forest La
Dallas TX 75234
(214) 238-7291

SCM CORP
299 Park Ave
New York NY 10017
(212) 752-2700

SCM CORP
KLEINSCHMIDT DIV
Lake-Cook Rd
Deerfield IL 60015
(312) 945-1000

SCOPE DATA INC
3728 Silver Star Rd
Orlando FL 32808
(305) 298-0500

SCORPIO DATA SYSTEMS INC
445 Sadde River Rd
Monsey NY 10956
(914) 356-8089

SCOTT GRAPHICS INC
PO Box 391
Holyoke MA 01040
(413) 536-7800

SDL INTERNATIONAL
437 Madison Ave
New York NY 10022
(212) 758-2058

SDSI PERIPHERALS AG
US OPERATIONS DIV
PO Box 77
Wyckoff NJ 07481
(201) 447-5321

SEACO COMPUTER-DISPLAY INC
2714 National Circle
Garland TX 75040
(214) 276-1153

SECRE *(See Societe d'Etudes de Constructions et de Recherches en Electronique)*

SEIN *(See Societe d'Electronique Industrielle ete Nucleaire)*

SEL *(See Systems Engineering Laboratories)*

S.E. LABORATORIES LTD
COMPUTER PERIPHERALS GROUP
Spur Rd
Feltham, Middlesex, England

SELECTERM INC
Audubon Rd
Wakefield MA 01880
(617) 246-1300

SELENIA *(See Industrie Electtroniche Associate SPA)*

SEQUENTIAL INFORMATION SYSTEMS INC
249 N Saw Mill River Rd
Elmsford NY 10523
(914) 592-5930

SHANE UNIFORM CO INC
PO Box 6106
Evansville IN 47702
(812) 423-1133

SHARED COMPUTER SYSTEMS
14 NE First Ave
Miami FL 33132
(305) 379-0781

SHARED MEDICAL SYSTEMS
650 Park Ave
King of Prussia PA 19406
(215) 265-7600

SHINTRON CO INC
144 Rogers St
Cambridge MA 02142
(617) 491-8700

SIEMENS AG
Bereich Mess-Und Prozesstechnik
D-7500 Karlsruke 21
West Germany
Rheinhruckenstrasse 50
0721-5951

SIEMENS AKTIENGESELLSCHAFT
FACHBEREICH DATENTECHNIK
8000 Munich 70, West Germany
Hofmannstrasse 51
Postfach 700072
(089) 722-1

SIEMENS CORP
186 Wood Ave S
Iselin NJ 08830
(201) 494-1000

SIERRA RESEARCH CORP
PO Box 222
Buffalo NY 14225
(716) 632-8823

SIGMA DATA COMPUTING CORP
Twinbrook Pkwy
Bethesda MD 20014
(301) 881-4451

SIGMA SCIENCES INC
Bishop Hollow Ct
Atlanta GA 30326
(404) 458-0286

SIGNETICS CORP
811 E Arques St
Sunnyvale CA 94086
(408) 739-7700

SINGER CO
BUSINESS MACHINES DIV-WEST
EXECUTIVE OFFICES
2350 Washington Ave
San Leandro CA 94577
(415) 357-6800
KEARFOTT DIV
1150 McBride Ave
Little Falls NJ 07424
(201) 254-4000
LIBRASCOPE DIV
833 Sonora Ave
Glendale CA 91201
(213) 244-6541
SIMULATION PRODUCTS DIV
1077 E Arques Ave
Sunnyvale CA 94086
(408) 732-3800
INSTRUMENTATION DIV
280 Crossways Park Dr
Woodbury, Long Island NY 11797
(516) 921-9400

SINGER CO-EAST
BUSINESS MACHINES DIV
HDQTRS
30 Rockefeller Plz
New York NY 10020
(212) 581-4800
OFFICE PRODUCTS DIV
211 E 43rd St
New York NY 10017
(212) 557-0123

SINGER/M&M COMPUTER INDUSTRIES
2201 N Glassell St
Orange CA 92665
(714) 998-1551

SINTRA *(See Societe Industrielle des Nouvelles Techniques Radio-Elect. et de l'Elect Francaise)*

SJV DATA SERVICES INC
202 Industrial Pkwy
Elkhart IN 36514
(219) 294-6621

SMA INC
700 Quest Rue Lagauchetiere
Montreal, Quebec, Canada
(514) 875-6000

SMI INC
8120 Gravois
St. Louis MO 63123
(314) 353-4900

SMITH LTD, E MARSHALL
Clubman House
64-74 Norwich Ave
Bournemouth, Hants BH2 6AR
Great Britain UK

SOCIETE D'APPLICATIONS GENERALES D'ELECTRICITE ET DE MECANIQUE
PO Box 445
35 S Main St
Derry NH 03038
(603) 432-2013

SOCIETE D'ELECTRONIQUE INDUSTRIELLE ET NUCLEAIRE
171 Rue Veron
94 Alfortville, France

SOCIETE DES ORDOPROCESSEURS
28 Rue Maurice-Tenine
94 Fresnes, France

SOCIETE DE TRAITEMENT AUTOMATIQUE DE DONNES (STAD)
11 Rue de la Vistule
75013 Paris, France
Paris 707-3719 or 589-0903

SOCIETE D'ETUDES ET DE CONSTRUCTION ET DE RECHERCHES EN ELECTRONIQUES
214 Rue du Faubourg-Saint-Martin
75 Paris 10 eme, France

SOCIETE INDUSTRIELLE DES NOUVELLES TECHNIQUES RADIOELECTRIQUES ET DE L'ELECTRONIQUE FRANCAISE
26 Rue Malakoff
92 Asnieres, France

SOFT-PAK SERVICES
267 Sea Cliff Ave
Sea Cliff NY 11579
(516) 671-8112

SOFTWARE AG INTERNATIONAL
Reston International Ctr
11800 Sunrise Valley Dr
Reston VA 22091
(703) 620-9577

SOFTWARE DESIGN INC
PO Box 5854
San Mateo CA 94402
(415) 697-3660
EASTERN REGIONAL OFFICE
2460 Lemoine Ave
Fort Lee NJ 07024
(201) 461-3130

SOFTWARE DEVELOPMENT/ CANADA
PO Box 32
Station S
Toronto, Ontario, Canada
(416) 485-7715

SOFTWARE ENGINEERING
1945 Pauline, Suite 16
Ann Arbor MI 48103
(313) 761-3997

SOFTWARE INTERNATIONAL CORP
2 Elm Sq
Andover MA 01810
(617) 475-5040

SOFTWARE MODULE MARKETING INC
Crocker Bank Bldg/Penthouse
1007 7th Ave
Sacramento CA 95814
(916) 441-7234

SOFTWARE TECHNIQUES
PO Box 55
Old Bethpage NY 11004
(516) 643-3013

SONEX INC
I/ONEX DIV
2337 Philmont Ave
Bethayres PA 19004
(215) 947-6100

SOREMEC-CEHESS
143 Rue de Versailles
F-92 Antony, France

SOUTHERN PACIFIC COMMUNICATIONS CO
1 Adrian Ct
Burlingame CA 94010
(415) 692-5600

SPACE AGE COMPUTATION SYSTEMS
500 N Washington Rd
McMurray PA 15317
(412) 343-8733

SPATIAL DATA SYSTEMS INC
132 Aero Camino
Goleta CA 93017
(805) 967-2383

SPECTRON CORP
Church Rd & Roland Ave
Mount Laurel NJ 08057
(609) 234-5700

SPERRY RAND CORP
COMMUNICATIONS & TERMINAL DIV
322 N 2200 W
Salt Lake City UT 84116
(801) 328-8066
ROSEVILLE OPERATION
2276 Highcrest Dr
Roseville MN 55113
(612) 633-6170

SPERRY REMINGTON
OFFICE MACHINES
PO Box 1000
Blue Bell PA 19422
(215) 542-4011

SPUR PRODUCTS
2928 Santa Monica Blvd
Santa Monica CA 90404
(213) 828-8924

STAD *(See Societe de Traitement Automatique de Donnes)*

STANDARD DATA CORP
1540 Broadway
New York NY 10036
(212) 586-3100

STANDARD ELECTRIK LORENZ
40 (Zuffenhausen) Hellmut Hirth St
Stuttgart, West Germany D-7000

STANDARD LOGIC SYSTEMS INC
3841 S Main St
Santa Ana CA 92707
(714) 979-4770

STANDARD MEMORIES INC
HDQTRS
4120 Birch St, Suite 105
Newport Beach CA 92660
(714) 752-8455
SUBSIDIARY OF APPLIED MAGNETICS CORP
2801 E Oakland Park Blvd, Suite 307
Fort Lauderdale FL 33306
(305) 566-7611

STANDARD REGISTER CO
626 Albany St, Box 1167
Dayton OH 45401
(513) 223-6181

STANDARD TELEPHONE & CABLES LTD
DATA EQUIPMENT & SYSTEMS DIV
Holbrook House
Cockfosters, Herts, England

STANSAAB ELEKTRONIK AB
S-17065 Gafalla
Sweden

STAR GRAPHIC SYSTEMS INC *(See Dymo Graphic Systems Inc)*

STC *(See Storage Technology Corp)*

STELMA *(See Data Products Corp)*

STEVENSON & KELLOGG LTD
150 Eglinton Ave E
Toronto 12, Ontario, Canada
(604) 681-6167

STEWART-WARNER CORP
ELECTRONICS DIV
1300 N Kostner Ave
Chicago IL 60651
(312) 292-3000

STORAGE TECHNOLOGY CORP
PO Box 98
2270 S 88th St
Louisville CO 80027
(303) 666-6581

STROMBERG CARLSON CORP
PO Box 778
Rochester NY 14603
(716) 482-2200

STROMBERG DATAGRAPHIX INC
PO Box 82449
San Diego CA 92138
(714) 291-9960

STRUCTURAL DYNAMICS RESEARCH CORP
5729 Dragon Way
Cincinnati OH 45227
(513) 272-1100

SUBSYSTEMS INC
175 San Gabriel Dr
Sunnyvale CA 94086
(408) 733-0190

SUMLOCK COMPTOMETER LTD
COMPUTER SALES DIV
Northway House, High Rd, Whetstone
London N 20, England

SVENSKA AB PHILIPS
DESIGN & MFG TERMINAL SYSTEMS
Siktgatan 11
S-162 10 Stockholm-Vällingby,
Sweden
08-89 00 10

SWEDA INTERNATIONAL
34 Maple Ave
Pine Brook NJ 07058
(201) 575-8100

SYCOR INC
100 Phoenix Dr
Ann Arbor MI 48104
(313) 971-0900

SYKES DATATRONICS INC
375 Orchard St
Rochester NY 14606
(716) 458-8000

SYNELEC
379 Avenue de General de Gaulle
92 Clamart, France
(1) 644.55.30

SYNERGETICS CORP
1 Garfield Circle
Burlington MA 01803
(617) 272-3450

SYNTECH CORP
11810 Parklawn Dr
Rockville MD 20852
(301) 770-0550

SYS CON INC
125 Ottawa Ave NW
Grand Rapids MI 49502
(616) 451-8471

SYSTEMATICS *(See General Instrument Corp)*

SYSTEM DEVELOPMENT CORP
2500 Colorado Ave
Santa Monica CA 90406
(213) 829-7511

SYSTEM INDUSTRIES
535 Del Rey Ave
Sunnyvale CA 94086
(408) 732-1650

SYSTEMS ARCHITECTS INC
45 Diauto Dr
Randolph MA 02368
(617) 961-4840

SYSTEMS DIMENSIONS LTD
770 Brookfield Rd
Ottawa 8, Ontario, Canada
(613) 731-6910

SYSTEMS ENGINEERING LABORATORIES
6901 W Sunrise Blvd
Fort Lauderdale FL 33313
(305) 587-2900

SYSTEMS MANAGEMENT TECHNOLOGY INC
650 Palisades Ave
Englewood Cliffs NJ 07632
(201) 568-6001

SYSTEM SUPPORT SOFTWARE INC
28 E Rahn Rd
Dayton OH 45429
(513) 435-9514

SYSTIME LTD
Concourse Computer Ctr
432 Dewsbury Rd
Leeds LS11 7DF, England
0532-707411

SYSTONETICS
600 N Euclid St
Anaheim CA 92801
(714) 778-1600

T

TAB PRODUCTS CO
2690 Hanover St
Palo Alto CA 94304
(415) 493-5790

TAKACHIHO KOHEKI CO LTD
27 Komatsubara-Machi
Kita-Ku
Osaka 530, Japan

TALLY CORP
HDQTRS
8301 S 180th St
Kent WA 98031
(206) 251-5500
DARTEX DIV
1222 E Pomona St
Santa Ana CA 92707
(714) 542-1195

TANDEM COMPUTERS INC
Valley Green Dr
Cupertino CA 95014
(408) 255-4800

TANO CORP
4521 W Napoleon Ave
Metairie LA 70001
(504) 888-4884

TCC INSURANCE SERVICES
3429 Executive Ctr Dr
Austin TX 78731
(512) 345-5700

TEAC CORP
7-3 Naka-Cho 3-Chome
Musashino-Shi
Tokyo 180, Japan

TEC INC
HDQTRS
2727 N Fairview Ave
Tucson AZ 85705
(602) 792-2230

TECHNICAL ADVISORS INC
4455 Fletcher St
Wayne MI 48184
(313) 722-5010

TECHNICAL COMMUNICATIONS CORP
442 Marrett Rd
Lexington MA 02173
(617) 862-6035

TECHNICAL ECONOMICS INC
HDQTRS
573 The Alameda
Berkeley CA 94707
(415) 525-7774
PO Box 9033
Berkeley CA 91709
(415) 525-7774

TECHNOLOGY INC
HF PHOTO SYSTEMS DIV
11801 W Olympic Blvd
Los Angeles CA 90064
(213) 479-3941

TECHTRAN INDUSTRIES INC
580 Jefferson Rd
Rochester NY 14623
(716) 271-7953

TEKTRONIX INC
PO Box 500
Beaverton OR 97005
(503) 644-0161

TEL-A-DATA INC
PO Box 3326
Miami Beach FL 33169
(305) 625-8266

TELAUTOGRAPH CORP
8700 Bellanca Ave
Los Angeles CA 90045
(213) 776-5022

TELECOMMUNICATIONS INDUSTRIES INC
7670 Old Springhouse Rd
McLean VA 22101
(703) 893-2400

TELECOMMUNICATIONS RADIOELECTRIQUES ET TELEPHONIQUES
88 Rue Brillat-Savarin
75640 Paris Cedex 13
France

TELE-DYNAMICS CORP
HDQTRS
525 Virginia Dr
Fort Washington PA 19034
(215) 643-3900

TELEDYNE FREDERICK POST
700 Northwest Hwy
Lane IL 60016
(312) 694-3590

TELEDYNE SYSTEMS CO
19601 Nordhoff St
Northridge CA 91324
(213) 886-2211

TELEDYNE TELE-SYSTEMS
19601 Nordhoff St
Northridge CA 91324
(213) 886-2211

TELEFILE COMPUTER PRODUCTS INC
17131 Daimler St
Irvine CA 92664
(714) 557-6660

TELEFUNKEN COMPUTER GMBH FACHBEREICH INFORMATIONSTECHNIK
775 Konstanz BW, West Germany
Bucklestrasse 1-5

TELEGEST
68 Rue Jouffroy
75017 Paris, France

TELEMECANIQUE SA
DEPT INFORMATIQUE INDUSTRIELLE
33 Avenue de Chatou
92 Rueil, France
(01) 967-2530

TELENET COMMUNICATIONS CORP
1666 K St NW
Washington DC 20006
(202) 785-8444

TELE-PATH INDUSTRIES
PO Box 4622
Roanoke VA 24015
(703) 345-4917

TELEPROCESSING INDUSTRIES *(See Distronics Computer Logistics)*

TELE/RESOURCES INC
1 N Broadway
White Plains NY 10603
(914) 428-5440

TELESWITCHER CORP
4320 Sigma Rd
Dallas TX 75240
(214) 233-2971

TELESYSTEMES
43 Rue de l'ancienne Mairie
92100 Boulogne, France

TELETYPE CORP
CORPORATE HDQTRS
5555 Touhy Ave
Skokie IL 60076
(312) 982-2000

TELEX COMPUTER PRODUCTS INC
COMPUTER PRODUCTS DIV
6422 E 41st St
Tulsa OK 74135
(918) 627-1111

TELSTAT SYSTEMS INC
150 E 58th St
New York NY 10022
(212) 826-0640

TEL-TEX INC
7547 Convoy Ct
San Diego CA 92111
(714) 279-5690

TELXON CORP
3726 Dacoma St
Houston TX 77018
(713) 686-8656

TEMPO COMPUTERS INC
4005 W Artesia Ave
Fullerton CA 92633
(714) 994-0400

TENNECOMP SYSTEMS INC
795 Oak Ridge Tpk
Oak Ridge TN 37830
(615) 482-3491

TERMIFLEX CORP
PO Box 1123
17 Airport Rd
Nashua NH 03060
(603) 889-3883

TERMINAL COMMUNICATIONS INC
PO Box 27228
Raleigh NC 27603
(919) 834-5251

TERMINAL DISPLAY SYSTEMS LTD (TDS)
Hillside, Whitebirk Estate
Blackburn, Lancs BB1 55N, England
0254-64051

TESDATA SYSTEMS CORP
7900 Westpark Dr
McLean VA 22101
(703) 790-5580

TESSERACT CORP
Box 7658
Rincon Annex
San Francisco CA 94120
(415) 543-9320

TEVCO INC
3260 J St
Sacramento CA 95816
(916) 441-6977

TEXAS INSTRUMENTS INC
HDQTRS
PO Box 1444
12201 SW Frwy
Houston TX 77001
(713) 494-5115
DIGITAL CIRCUITS DIV
PO Box 1443
Houston TX 77001
(713) 494-5115

THIRD NATIONAL BANK OF HAMPTON COUNTY
PO Box 711
West Springfield MA 01101
(413) 737-5323

THOMSON CSF *(See T-VT)*

THREE PHOENIX CO
10632 N 21st Ave
Phoenix AZ 85029
(602) 944-2221

THRESHOLD TECHNOLOGY INC
1829 Underwood Blvd
Delran NJ 08075
(609) 829-8900

TIME SHARE CORP
Lyme Rd
Hanover NH 03755
(603) 643-3640

TIME SHARING LTD
179/193 Great Portland St
London W1N 5TB, England

TIME SHARING RESOURCES INC
777 Northern Blvd
Great Neck NY 11022
(516) 487-0101

TIME SHARING SYSTEMS INC
1840 N Farwell
Milwaukee WI 53202
(414) 276-6776

TOELLNER J. AND ASSOCIATES *(See J. Toellner and Associates)*

TOKYO ELECTRON LABS INC (TEL)
Meiho Bldg, 1-21 Nishi-Shinjuku
Shinjuku-Ku, Tokyo, Japan
343-4411

TOMPKINS COUNTY TRUST CO
PO Box 307
Ithaca NY 14850
(607) 273-3210

TOSHIBA AMERICA INC
280 Park Ave
New York NY 10017
(212) 557-0200

TOSHIBA AMPEX CO LTD
555 Toriyama-Cho
Kohoku-Ku
Yokohama-Shi
Kanagawa-Ken 222, Japan

TOSHIBA ELECTRIC CO
72 Horikawa-Cho, Saiwai-Ku,
Kawasaki
Kanagaura, Japan
(044) 522-2111

PHOENIX OFFICE
PO Box 6000 MDC-19
Phoenix AZ 85005
(602) 993-3651

TRACOR DATA SYSTEMS
6500 Tracor La
Austin TX 78721
(512) 926-2800

TRANSCOM INC
580 Spring St
Windsor Locks CT 06096
(203) 243-1486

TRANSCOMM DATA SYSTEMS INC
3946 Nantasket St
Pittsburgh PA 15207
(412) 421-6770

TRANSITEL COMPUTER SUPPORT SYSTEMS *(See Sangamo Electric Co.)*

TRANSITRON ELECTRONIC CORP
MICROCOMPUTER DIV
168 Albion St
Wakefield MA 01880
(617) 245-4500

TRANSNET CORP
2005 Rte 22
Union NJ 07083
(201) 688-7800

TRANSPORT DATA COMMUNICATIONS INC
1707 Gilpin Ave
Wilmington DE 19899
(302) 658-2431

TRANSPORTATION CONSULTANTS INC
2409 John B St
Warren MI 48091
(313) 759-2770

TRANS TECH
Suite 7415, 74 Perimeter Ctr E
Atlanta GA 30346
(404) 394-8600

TRANTI SYSTEMS INC
1 Chelmsford Rd
North Billerica MA 01862
(617) 667-8321

TRENDATA COMPUTER SYSTEMS CORP
610 Palomar Ave
Sunnyvale CA 95207
(408) 732-1790

TREND ELECTRONICS LTD
St. John's Rd, Tylers Green
High Wycombe, Bucks, England

TRES COMPUTER SYSTEMS INC
4255 LBJ Frwy
Dallas TX 75234
(214) 233-4341

TRI-DATA CORP
800 Maude Ave
Mountain View CA 94040
(415) 969-3700

TRIUMPH-ADLER AG
85 Nurnberg
Fuerther Strasse 212
West Germany
09 11/3 2021

TRIVEX INC
TERMINAL SYSTEMS DIV
3180 Red Hill Ave
Costa Mesta CA 92626
(714) 546-7781

TRT TELECOMMUNICATIONS CORP
1747 Pennsylvania Ave NW
Washington DC 20006
(202) 785-5635

TRW SYSTEMS GROUP
7600 Colshire Dr
McLean VA 22101
(703) 790-8884

TSC COMPUTER LTD
50 Gervais Dr
Don Mills 403, Ontario, Canada
(416) 449-8824

TTS CORP *(See Remote Data Terminals Inc)*

TUCK ELECTRONICS
4409 Carlyle Pike
Camp Hill PA 17011
(717) 697-8506

TURNKEY SYSTEMS INC
111 East Ave
Norwalk CT 06851
(203) 853-2884

T-VT (THOMSON-CSF VISUALISATION ET TRAITMENT DES INFORMATIONS)
40 rue de la Grange Dame Roge
BP 34
92360 Meudon-La-Forêt, France
630 23 80

TYCOM SYSTEMS CORP
TERMINAL EQUIPMENT CORP DIV
26 Just Rd
Fairfield NJ 07006
(201) 227-4141

TY-DATA INC
HDQTRS
109 Northeastern Blvd
Nashua NH 03060
(603) 889-1155

TYMSHARE CORP
CORPORATE HDQTRS
10340 Bubb Rd
Cupertino CA 95014
(408) 257-6550

BIRMINGHAM DATA CENTER
11 W Oxmoor Rd
Homewood AL 35209
(205) 942-6700

U

UARCO INC
W County Line Rd
Barrington IL 60010
(312) 381-7000

UCHIDA YOKO CO LTD
4-7 Shinkawa 2-Chome
Chuo-Ku, Tokyo 104
Japan

ULTIMACC SYSTEMS INC
E 210 State Hwy 4
Paramus NJ 07652
(201) 843-8263

ULTRONIC DATA SYSTEMS LTD
35/37 Park Royal Rd
London NW 10, England

UMF SYSTEMS INC
5521 Grosvenor Blvd
Los Angeles CA 90066
(213) 391-7286

UNI-COLL CORP
3401 Science Ctr
Philadelphia PA 19104
(215) 387-3890

UNICOM INC
PO Box 723
Montclair NJ 07042
(201) 783-6932

UNICORN SYSTEMS CO
3807 Wilshire Blvd
Los Angeles CA 90010
(213) 380-6974

UNIDATA *(See C11, Siemens, Philips)*

UNION NATIONAL BANK
Park Central Sq
Springfield MO 65805
(417) 869-3511

UNIROYAL INC
COMPUTERISTICS DIV
1230 Ave of the Americas
New York NY 10020
(212) 489-4000

UNITECH CORP
1005 E St Elmo Rd
Austin TX 78745
(512) 444-0541

UNITED AIR LINES MAINTENANCE BASE
San Francisco International Airport
San Francisco CA
(415) 588-2424

UNITED BUSINESS COMMUNICATIONS
6405 Metcalf Ave
Shawnee Mission KS 66202
(913) 888-6604

UNITED CALIFORNIA BANK
600 S Spring St
Los Angeles CA 90014
(213) 614-4111

UNITED COMPUTING CORP
22500 S Avalon Blvd
Carson CA 90744
(213) 830-7720

UNITED COMPUTING SYSTEMS
Washington Ave
Kansas City MO 64111
(816) 221-9700

UNITED TECHNICAL PUBLICATIONS INC
645 Stewart Ave
Garden City NY 11533
(516) 248-9700

UNITED TELECOM
UNITED BUSINESS COMMUNICATIONS DIV
6405 Metcalf Ave
Shawnee Mission KS 66202
(913) 384-7400

UNIVAC
DIV OF SPERRY RAND
HDQTRS
PO Box 500
Blue Bell PA 19422
(215) 542-4011

UNIVAC COMPUTER CENTER
UNIVERSITY OF ALABAMA
301 Sparkman Dr
Huntsville AL 35807
(205) 895-6060

UNIVERSAL COMMUNICATIONS SYSTEMS
1401 Municipal Rd
Roanoke VA 24002
(703) 362-3701

UNIVERSAL SOFTWARE INC
136 White St
Danbury CT 06810
(203) 792-5100

UNIVERSITY COMPUTING CO
7200 N Stemmons Frwy
Dallas TX 75247
(214) 637-5010
SCIENTIFIC & ENGINEERING DIV
PO Box 6171
1930 Hi-Line Dr
Dallas TX 75225
(214) 655-8822

UNIVERSITY MICROFILMS INC
300 N Zeeb Rd
Ann Arbor MI 48106
(313) 761-4700

USAC ELECTRONIC INDUSTRY CO LTD
Unoki-Cho
Kohoku-Gun
Ishikawa-Ken 929-11

USS ENGINEERS AND CONSULTANTS
600 Grant St
Pittsburgh PA 15230
(412) 391-8115

UTILITY NETWORK OF AMERICA
7540 LBJ Frwy, Suite 830
Dallas TX 75240
(214) 233-0679

V

VADIC CORP
505 E Middlefield Rd
Mountain View CA 94040
(415) 965-1620

VALUE COMPUTING
300 VCI Bldg
W Marlton Pike
Cherry Hill NJ 08034
(609) 429-4200

VANTAGE COMPUTER SYSTEMS INC
381 Farmington Ave
Hartford CT 06105
(203) 528-9528

VARIAN DATA MACHINES
2722 Michelson Dr
Irvine CA 92664
(714) 833-2400
PERIPHERAL PRODUCTS DIV
12062 Valley View, Suite 204
Garden Grove CA 92645
(714) 894-7530

VARISYSTEMS
207 Newtown Rd
Plainview NY 11803
(516) 931-7200

VARITYPER CORP *(See Addressograph Multigraph)*

VERMONT RESEARCH CORP
Precision Pk
North Springfield VT 05150
(802) 886-2256

VICTOR COMPTOMETER CORP
3900 N Rockwell St
Chicago IL 60618
(312) 539-8200

VICTOR GRAPHIC SYSTEMS
3900 N Rockwell St
Chicago IL 60618
(312) 539-8200

VIDAR
VITEL DIV
77 Ortega Ave
Mountain View CA 94040
(415) 961-1000

VIDEOFILE INFORMATION SYSTEMS *(See Ampex Corp)*

VIDEO SYSTEMS CORP
7300 N Crescent Blvd
Pennsauken NJ 08110
(609) 665-6688

VITAL COMPUTER SERVICES CORP
18 E 41st St, Suite 1704
New York NY 10017
(212) 725-2895

VITEL
DIVISION OF VIDAR
77 Ortega Ave
Mountain View CA 94040
(415) 961-1150

VOGUE INSTRUMENT CORP
131st St & Jamaica Ave
Richmond Hill NY 11418
(212) 641-8800

VORIAN ASSOCIATES OF CANADA LTD
45 River Dr
Georgetown, Ontario, Canada
(416) 457-4130

VYDEC INC
9 Vreeland Rd
Florham Park NJ 07932
(201) 822-2100

W

WANGCO INC
5404 Jandy Pl
Los Angeles CA 90066
(213) 390-8081

WANG COMPUTER SERVICES
836 North St
Tewksbury MA 01876
(617) 851-4111

WANG LABORATORIES INC
836 North St
Tewksbury MA 01876
(617) 851-4111

WARNER & SWASEY CO (COMSTAR)
30300 Solon Industrial Pkwy
Solon OH 44139
(216) 368-6200

WARRINGTON ASSOCIATES INC
5600 Lincoln Dr
Minneapolis MN 55435
(612) 935-3300

WAVETEK DATA COMMUNICATIONS
HDQTRS
9045 Balboa Ave
San Diego CA 92123
(714) 279-2200

WEILAND COMPUTER GROUP INC, THE
814 Commerce Dr, Suite 101
Oak Brook IL 60521
(312) 325-9300

WESTCOM INC
501 Rogers St
Downers Grove IL 60515
(312) 971-2010

WESTERN DATA SCIENCES INC
5055 N 12th St
Phoenix AZ 85014
(602) 264-2630

WESTERN DIGITAL CORP
19242 Red Hill
Newport Beach CA 95051
(714) 557-3550

WESTERN SYSTEMS CO *(See Informatics Inc)*

WESTERN TELEMATIC INC
TELEPROCESSING DIV
Bldg 5-107
3001 Red Hill Ave
Costa Mesa CA 92626
(714) 979-0363

WESTERN UNION DATA SERVICES
90 McKee Dr
Mahwah NJ 07430
(201) 529-6000

WESTINGHOUSE CANADA, LTD
Box 510
Hamilton, Ontario, Canada

WESTINGHOUSE ELECTRIC CORP
COMPUTER & INSTRUMENT DIV
2040 Ardmore Blvd
Pittsburgh PA 15221
(412) 256-5583

WHEELOCK SIGNALS INC
273 Branchport Ave
Long Branch NJ 07740
(201) 222-6880

WILLIAM D. WITTER INC
1 Battery Park Pl
New York NY 10004
(212) 483-0000

WILLMORE ACCOUNTING & TAX SERVICE
2624 Chestnut St
Columbus IN 47201
(812) 372-3217

WILTEK INC
Glover Ave
Norwalk CT 06850
(203) 853-7400

WINTEK CORP
902 N 9th St
Lafayette IN 47904
(317) 742-6802

WITTER, WILLIAM D. INC *(See William D. Witter Inc)*

WOLF RESEARCH AND DEVELOPMENT CORP
6801 Kenilworth Ave
Riverdale MD 20840
(301) 779-2800

WORLD WIDE TIME SHARING INC *(See Reynolds & Reynolds)*

WRIGHT CORP, BARRY *(See Barry Wright Corp)*

WYLE COMPUTER PRODUCTS
128 Maryland St
El Segundo CA 90245
(213) 322-1763

WYLY CORP (FORMERLY UNIVERSITY COMPUTING COMPANY)
1500 Ucc Tower, Box 6228
Dallas TX 75222
(214) 637-5181

X

XEBEC SYSTEMS INC
566 San Xavier Ave
Sunnyvale CA 94086
(408) 732-9444

XEROX COMPUTER SERVICES *(See Xerox Corp)*

XEROX CORP
COMPUTERS, ADMINISTRATION & ENGINEERING DIV
701 S Aviation Blvd
El Segundo CA 90245
(213) 679-4511
COMPUTER SERVICES DIV
5310 Beethoven St
Los Angeles CA 90066
(213) 390-3461
HDQTRS
Xerox Sq
Rochester NY 14644
(716) 423-9200
OFFICE SYSTEMS DIV
1341 W Mockingbird La
Dallas TX 75247
(214) 630-2611

Y

YASUKAWA ELECTRIC MFG CO LTD
(Yasukawa Denki Seisakusho)
Otemachi Bldg
6-1 Otemachi
1-Chome, Chiyoda-Ku
Tokyo, Japan

Z

ZENTEC CORP
2368-C Walsh Ave
Santa Clara CA 95050
(408) 246-7662

ZETA RESEARCH
1043 Stuart St
Lafayette CA 94549
(415) 284-5200

ZUSE KG
Grosse Industrie Strasse 19-21-D
Bad Hersfeld, West Germany