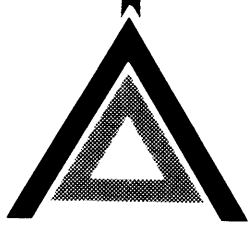
AUERBACH

Guide to Small Business Computers



AUERBACH COMPUTER TECHNOLOGY REPORTS

AUERBACH looseleaf reference services provide all of the essential information you need for the evaluation and selection of EDP systems, data communications devices, peripherals, software, and time sharing services. In addition to comprehensive reports on individual equipment, each service contains tables and charts for rapid comparisons of components and configurations, capabilities and limitations, prices, performance, and other features that can make your EDP operation more profitable. Listed below are the major units of AUERBACH Computer Technology Reports.

- **Standard EDP**—An eight-volume set which provides encyclopedic, highly detailed reports on the major computer systems available in the international marketplace. This service covers general purpose computer systems, small business computers, intelligent terminals, standard peripherals, and system software. Hardware and software are evaluated in standardized formats that enable you to directly compare competing alternatives. *Updated monthly.*
- **EDP Users' Notebook**—A three-volume, current awareness Notebook for the user of U.S. computer systems. It contains reports on general-purpose computers, small business computers, and minicomputers; commercial system software packages, major and independent peripherals; and data communications equipment. In addition, it provides search charts which pinpoint the characteristics and capabilities of 1,000 different computer systems, peripherals, and communications terminals. Designed as a working tool for the DP manager. *Updated monthly.*
- **EDP Notebook/Europe**—A three-volume service for those concerned with computer systems available in the European marketplace. This Notebook contains the same scope of coverage as the users' Notebook. *Updated monthly.*
- **EDP Users' Notebook/International**—Four volumes that cover European, Japanese and American computers, data communications equipment, peripherals and software that are sold worldwide. Scope of American coverage same as in Users' Notebook. *Updated monthly.*
- **Data Communications**—A complete reference source on digital data communications equipment and techniques. Contains individual, analytical reports on communications terminals and processing equipment, detailed reports on common-carrier facilities, and a guide to the design of effective data communications systems. *Updated monthly.*
- **Time Sharing**—A two-volume service covering all aspects of commercial time sharing. It includes reports on the state of the time sharing art, time sharing languages, applications, equipment and individual reports on commercial time sharing services. *Updated bi-monthly.*
- **Software Reports**—A service on proprietary software packages presenting detailed information on the operation and implementation of specific software packages as well as in-depth definitional reports on computer applications. Comparison charts assist the user in the selection of packages. *Updated monthly.*
- **Minicomputer Reports**—Covers small business computers, and intelligent terminals. The information is presented in detailed reports and easy-to-use comparison charts. Current pricing for each device is also listed. An abridged Notebook service is also available for both the Domestic and International markets. *Updated monthly.*
- **Input/Output Reports**—In 3 volumes, the Reports cover a wide range of computer support equipment, storage and retrieval systems, microform readers/printers, plotters, industrial and retail data collection, and phototypesetters. The information is presented in analytical reports on individual products as well as easy-to-use comparison and pricing charts. *Updated monthly.*
- **Microform**—Single-volume coverage of COM, CIM, readers/printers, retrieval systems, microform camera, processors, and duplicators. Same detailed reports and chart data as Volume 3 of Input/Output Reports. *Updated monthly.*
- **Desk Reference Series**—Computer Characteristics Digest, a concise compilation of comparison charts and price data from the corresponding looseleaf Computer Technology Reports. The Digest meets the need for convenient, single-volume references that are used as quick sources of the products and services available. It is completely revised and reissued every 6 months.
- **Data Processing Manual**—A new two-volume service that helps you solve daily problems in general management, DP administration, system development, standards, practices, and documentation, operations, technology, and case studies. A practical and handy set that is constantly useful. In portfolio format, issued monthly.

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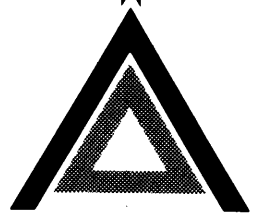
Guide to Small Business Computers

The material contained in this publication will be included in *AUERBACH Computer Technology Reports*, an analytic reference service that provides comprehensive coverage of the information processing industry.



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PREFACE

The prudent traveler to a foreign land packs a guidebook along with his checkbook, operating on the principle that what you don't know is almost certain to hurt you. Most small businessmen trying to come to grips with the world of the computer are entering a strange new land, which may be full of opportunity but also has its share of hazards. The novice needs advice and guidance, yet the vast bulk of the available literature concerns itself with medium and large computer systems, and is usually presented at a level that can only be digested by the technically sophisticated.

The AUERBACH Guide To Small Business Computers presents information in several levels of detail. A special report explains to the small businessman how to go about evaluating and selecting his own SBC. Each major SBC and some minor ones are covered in a separate analytical report.

The reader can look through the Table of Contents for a system which interests him. If the reader wants a quick view of the SBCs available on today's market, he should check the search chart. Should he want a brief overview of a specific system, he can consult the specification charts, which compare physical characteristics and performance for each system component. For more detailed information on a manufacturer's components, the reader should go to the individual product reports. One of a user's main concerns in choosing an SBC will be price, so the different vendor cost arrangements have been combined into a single price list, which also includes information about vendor-maintenance charges. When the user has evaluated the SBCs and selected the ones that seem most likely to fulfill his needs, he can consult the list of suppliers for addresses and phone numbers.

This selection guide presents the following information:

- Device Reports
  - — Text: describes characteristics of various small business computer systems. Each product report begins with a summary and then discusses configuration, software, design features, performance, maintenance, and company history.
  - — Product Specifications: a chart that summarizes information on the components' performance, capacity, and design.
- Charts — provide a quick way to compare the SBCs covered in the product reports.
  - — Search: lists the major peripheral devices and programming languages for all SBCs available on the market. The reports are a selection of this material.
  - — Specification: highlights of each component's technical specifications; use these to get a quick side-by-side comparative overview of each SBC system.
- Pricing Data — discusses each vendor's lease/purchase arrangement, conversion-to-purchase options, and any overtime or maintenance restrictions. Detailed price lists are also included.
- Suppliers: an alphabetical directory of SBC vendors.

To use the guide effectively, it is important to know what information is contained in each product report. Separate sections discuss a device's advantages and marketing, configuration possibilities, facilities requirements, performance characteristics, and service. The company's background is also covered.

The Summary or Overview gives the name of the company marketing the SBC, its special capabilities or unique features and their significance to the user, as well as the user group most likely to benefit from a particular SBC. The Performance section evaluates the SBC's competitive position, performance capabilities, special strengths and weaknesses, as well as its impact on other systems in the marketplace. The company history is also included, telling the date the firm was established, its major business, and noting the growth of its SBC line.

The Configuration Guide identifies the major system components, states their performance as well as any relevant interface requirements, and lists available options. This section also gives information on such factors as capacities of main and auxiliary storage, data structure, and speeds of input/output devices.

The Software section identifies the major software available to the SBC under consideration. This includes discussions of the applications software offered by the vendor.

Since maintenance is another important aspect in selecting an SBC, a section of each report specifies the company providing maintenance and its experience.

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SEARCH CHART

Small Business Computers

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
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		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

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
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
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 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
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
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						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	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 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
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	

EVALUATION AND SELECTION

Small Business Computers

INTRODUCTION

There is no ideal computer on the market, there is no small business computer 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 many good computers available, there are many computers 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 computers can do the job for the least overall cost? Unfortunately, selecting a computer for a specific job is not easy. However, if done without panic and without haste, the rewards of the search can include raising the staff's technical competence, understanding the individual application better, and building 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 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, which can be the hardest part of the selection procedure. 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; he must come to understand that computers vary in architecture because manufacturers have designed them differently for good reasons, and he must learn to think of applications vis-a-vis computers.

The computer salesman does have something to contribute and what he 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 barring a statistical accident, and is removing the solid foundation his personnel need to use the system satisfactorily once it has been installed.

The architecture of computers varies for good reasons; the computer salesman will detail these, but he cannot be expected to discuss the compromises his firm made to attain that architecture at a reasonable cost.

Architecture is not the only criterion in evaluating a small business computer. Cost is another factor as is the vendor's ability to support the installation with adequate maintenance service.

SMALL BUSINESS COMPUTER ARCHITECTURE

The major factors that distinguish one small business computer from another are the central processor and memory, input/output structure, interrupt systems, available peripheral devices, and software.

Central Processor and Memory

The central processor and memory determine to a large extent the computing power of a computer system. Important memory characteristics are word length, cycle rate, and size. Ideally, the word length should correspond to the data precision required by the application. The cycle rate determines the speed of the computer, but the user must beware of considering cycle rate alone. Also he should consider whether the instruction set's efficiency meets his specific application. What use is lightning-speed addition if a communications interface is needed and two or three input/output instructions are required for each input/output operation?

The memory size determines the complexity and size of programs the computer can run and the type of software that can be supported. Additional features that may be important are memory parity for checking data accuracy and memory protection for preventing important data from being inadvertently erased or modified.

Input/Output Structure

The input/output structure is a major factor in determining how efficiently a computer can distribute its processing power between input/output operations and internal processing demands. With an adequate balance the computer can optimize throughput (i.e., enter data into main memory, perform calculations or data manipulation, and output results to a suitable peripheral device).

The amount of processor time devoted to input/output operations is a function of the number of peripheral devices in the system, their frequency of use, and the execution time of the software

input/output handler routines. Input/output requirements for the application must be carefully analyzed and the criteria defined to eliminate from consideration all computer systems that do not have the minimum input/output facilities for a particular function.

The basic input/output facility for a small business computer consists of a channel shared by a number of peripheral devices (party-line). The input/output channel consists of data lines and control lines that synchronize the operation of the central processor and slower-speed peripheral devices.

Important factors in considering how well an input/output channel will satisfy your needs are the number of devices the channel can support, the input/output instructions, and the facilities for determining which devices need servicing. In addition, the maximum allowable distance that devices can be placed from the central processor can be particularly important to small business environments, especially if the processor will be centrally located for access by peripheral devices distributed throughout various offices.

One of the most important factors in determining input/output rates and evaluating the input/output structure for a particular application is the means for identifying the device that requires service. Generally, this can be achieved via software only or in combination with hardware.

Software routines are available for polling each device, testing its readiness for information transfer, and transferring data between the device and the computer. If many devices are connected to the input/output bus, the necessity of executing a device identification software routine can markedly increase the response time to a service request, use processor time and memory space, and cut down the number of peripheral devices the system can handle. Because of these problems, a large number of small business computer systems include groups of external priority interrupt lines as options; each line can interface to one or possibly two devices and thus eliminate a long device identification software routine.

The function of an interrupt system is to signal the processor that something requires attention. A priority interrupt system establishes a hierarchy for the attention-getting signals. Interrupt signals normally suspend execution of the program in progress when the current instruction is finished and begin executing the interrupt servicing routine selected by the contents of a core location dedicated to the interrupt line.

Peripheral Devices Available

Most small business computer manufacturers do not make their own peripheral devices but buy standard devices and provide the controllers and interfaces to their particular system. Most peripheral devices used with small business computers are essentially the same as those used with larger computer systems. Whereas the high cost of these peripherals is not an inordinately large fraction of the overall system cost for medium to large-scale computers, they can be fairly costly compared to small business computer central processor costs. However, manufacturers are beginning to produce these devices specifically for smaller applications. As a result each year their cost diminishes and they are now becoming more practical for use with small business computers.

Peripheral devices available for small business computers consist of input devices, output devices, and auxiliary storage memory that provides bulk storage to augment the central processor's memory.

Data Input. Data input provides the mechanism for entering the data to be processed. Three approaches most commonly used in small business computer systems for the data input function are console keyboards, punched paper tape, and punched card. Console keyboards are used in the interactive mode of operation in which the operator enters transaction data directly into the system. Input speeds are primarily a function of the operator's keying rate, typically two to four characters per second. Punched paper tape and cards are used in the batch mode of operation. Tapes or cards are prepared off-line on equipment independent of the central processor. Tape and card approaches provide faster speeds than the keyboard since the data rate is determined by the reading speed of an electromechanical device as opposed to that of an operator. Recently, however, magnetic tape cassettes have been replacing paper tape.

Printed Output. Printed output is the mechanism for presenting the processing results to the user. Three principal types of printed output units are available in small business computer systems — carriage, serial, and line. The carriage printer is limited in its printing rate by the mechanical movement of the carriage past the print station while the serial printer is restricted by the mechanical movement of the print unit across a line. Greater speeds are achieved with line printers than with carriage or serial printers. Typical capabilities available are 5 to

20 and 10 to 85 characters per second for carriage and serial printers, respectively, and 100 to over 1,000 lines per minute for line printers.

Auxiliary Storage. The auxiliary storage subsystem provides the mechanism for maintaining and accessing a master file of accounts. The access rate to master-file records is an important indicator of the total throughput of a small business computer system since it determines the number of records which can be processed. The extensive range of performance capabilities in this subsystem generates broad variations in the performance of small business computer systems.

Four approaches most commonly used in small business computer systems for the master file function are: magnetic ledger cards, punched cards, magnetic tape, and magnetic disc. Magnetic ledger cards provide the minimum capability for a master file. The access rate to records is limited to less than one every 4 seconds with an operator retrieving each card and to approximately one record per second with an automatic card reader. While very slow in potential system throughput, the ledger card provides the capability to maintain an easily retrieved printed audit trail of all transactions relative to an account. This feature is an important advantage in many business applications.

Punched cards provide a higher access rate to the master file than magnetic ledger cards. However, punched card access rates are still limited by manual handling of the card decks and by the mechanical movement of cards in a reader. Magnetic tape and disc provide the highest performance in the auxiliary storage subsystem.

A precise comparison of the performance capabilities of the latter two alternatives for auxiliary storage is complex because many variables affect their performance. However, disc systems offer one unique advantage; they permit data to be accessed randomly rather than sequentially as with the other systems.

As a result, disc systems are more flexible and provide higher computer system throughput than tape, largely because they require fewer sorting and merging operations on the data files. Disc performance does have a price, in some cases from three to four times as much as tape systems with comparable storage, or as much as one cent per character of storage, but most users find that cost outweighed by the sharply improved performance.

Interfaces Available

A number of small business computer manufacturers provide interfaces to standard data communications devices and to sense and signal modules; these can turn an external device on/off or can sense the on/off state of an external device. Some of the larger manufacturers provide extensive amounts of data communications equipment as well as the software to support the equipment.

If the application requires interfaces to special-purpose devices, the selection criteria should include interface requirements. The cost of designing special interfaces can raise the price of an overall system to several times the initial small business computer cost.

Software

Software development for a specific application is the most frequently underestimated item in the computer budget. Because the cost of small business computers is small, most manufacturers do not provide much system software. The selection criteria should include the required software. Also consider the desired features for future as well as current needs.

If the manufacturer writes off software production costs in the hardware price, the system cost increases. On the other hand, if the user needs system software not produced by the manufacturer, the cost for its development must be added to the price of his computer. This cost will be much higher than if the manufacturer distributed a software charge over many computers. In other words, well-conceived system software is much cheaper to buy from the manufacturer than to develop, and the selection criteria should reflect this view.

What are the software selection criteria? Because software criteria are tied to an application area as closely as hardware criteria, they can vary from application to application. Despite the previous disclaimers, certain general software characteristics should be included in the software criteria.

Small hardware configurations lend themselves most readily to applications where repetitive tasks are performed. Because programs may require changing from time to time, however, even the smallest hardware configuration should have the facilities for changing programs and for developing programs and incorporating them

in the system. The more the selection committee anticipates software changes, the more weight the group should give to the ease with which programs can be changed.

Utility routines should be supplied to debug source code and to edit output code. Input/output handlers should be provided. Loaders should be furnished to load all software supplied with the system and to load application programs.

Important system software components also include assemblers, compilers, and operating systems.

Assemblers. Assemblers are language translation programs that convert symbolic source language into numeric machine language usually with a one-to-one correspondence. The source language translated by an assembler is called the assembly language and is highly dependent on the computer's instruction set.

Assembly language programming is too complex for most small business computer users to perform themselves. However, assembly language capability can still be important for users who utilize packaged applications software rather than write their own programs. The flexibility of the packaged software is usually directly related to that of the assembly language.

Compilers. A compiler also translates source code into machine language, but each written statement in the computer language is translated into several machine instructions. Generally, the term "programming language" specifies the source language translated by compilers. Although programming languages are designed to be independent of any specific machine format, in most cases this goal is not completely achieved.

Compiler languages usually consist of terminology and procedures specifically to help the user write programs in a language capable of expressing concepts and relationships with which he is familiar. As a result, unless he is indeed a novice, the small business computer user can generally expect to write some programs in these languages. The two most common and useful programming languages available to business applications are Cobol, whose programs are stated in precise, easily learned English words and phrases, and RPG, a report generating language for producing programs that write reports in varying formats. Another language commonly encountered is Basic, which is used for interactive time sharing applications. Basic is so simple to learn and use that the novice programmer can begin writing programs almost immediately.

Operating Systems. An operating system is a comprehensive software facility consisting of a selection of routines that contribute to the efficient and convenient running of programs on a computer by assigning most housekeeping tasks to the computer and removing them from manual operator control.

A primary motivation for the use of operating systems results from the ability of computers to perform instructions at speeds that are orders of magnitude faster than a human being can ever achieve manually. Because of the complexity and variety of tasks an operating system is required to perform, however, the coding comprising an extensive operating system can occupy a significant portion of computer memory. Consequently, the development and growth of operating system technology are closely related to improvements in both computer memory and software technology.

The software that constitutes an operating system consists of a monitor or executive routine and a number of special-purpose housekeeping routines automatically controlled by the master routine. Actual facilities, however, vary widely. Some operating systems, designed to run on a minimum configuration system, provide only the bare essentials for controlling the operation of a computer; the user must code and insert any additional facilities desired. Other operating systems provide virtually complete control over the operating functions; operator communications with these operating systems is normally through job control statements entered via a dedicated systems device, such as a card reader, or perhaps through the console keyboard.

Operating systems for small business computers are particularly important for systems that include mass storage devices or are involved in interactive time sharing applications. However, a number of manufacturers don't offer operating systems, but incorporate control facilities via special hardware.

KNOW YOUR VENDOR

With increasing frequency, data processing personnel 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 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. Additionally, 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. Then 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 be small potatoes to those same giants, whereas his trade may be more important to a smaller outfit. The vital point to keep in mind is that once the deal is concluded, you should try to avoid being little more than an account number to the computer manufacturer. So, from the outset, try to gauge each supplier's future interest in and responsiveness to your problems, based on 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 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. This type of arrangement is a fairly recent innovation. According to our contacts in the user community, 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 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. However, 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 down-time, 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 small business computers? How are customer engineers trained (formal class, on-the-job-training, etc.)?

PRICING CONSIDERATIONS

Most vendors offer a variety of pricing arrangements. The optimum price can vary, but it reflects a balanced mixture of lease duration, maintenance and overtime terms, and cost. Generally, vendors offer a choice of short-term leases that are renewable at less than yearly intervals or longer fixed-term leases that can extend from over one year to (in some cases) five years.

Short-term contracts benefit users who decide to cancel in favor of more technologically advanced or less expensive equipment because there is no penalty. Short-term leases can also be advantageous for users who want to operate a vendor's equipment on a trial basis to test the vendor's service and maintenance capabilities as well as the reliability and performance of the equipment. On the other hand, short-term leases have disadvantages. It is usually more expensive to rent by month than for a longer term. Additionally, the user is subject to more frequent price changes if he renews his lease during each short-term interval.

Although long-term leases (extending above one year) involve smaller monthly rental rates, do you want to commit yourself so far in advance? You are protected against price increases, but you can also be prevented from taking advantage of any price decreases.

If a customer breaks his lease, he incurs a penalty. Most vendors explicitly state the penalty for cancelling, but there's still a certain amount of latitude. One vendor assures us that his company doesn't exact a penalty for upgrading if his firm provides the new equipment. The company's spokesman also said that no penalty would be applied if his firm didn't market the upgrade equipment. In this case the vendor is offering a verbal guarantee, and could change his mind after you sign an agreement. However, a check of the vendor's history and reputation should indicate his credibility.

If you decide to purchase the equipment after leasing it, can any of the rental money be applied to the purchase price? In other words, does the vendor offer a conversion-to-purchase option? If he does, you should know the formula. For example, a vendor may allow a customer to apply all rental payments to the purchase price. Other vendors set limits based on a percentage of the purchase price, the lease's duration, or the amount of rental already paid.

The overtime charge is another feature that varies in different vendors' leases. Some vendors offer unlimited usage. Others base the rental terms on a fixed number of hours per month, and charge an additional fee for use of the equipment beyond the specified time. Because overtime charges can be significant, remember to consider them when pricing a small business computer system.

Maintenance is usually included in the lease price, but maintenance hours vary and the price changes accordingly. Just like other employees, maintenance personnel expect to be paid a larger salary for working weekends and evenings. Consequently, the customer generally pays higher maintenance fees for service outside the normal five-day, 40-hour working week. Unfortunately, the normal working week is "prime time" for most computer installations. This results in a tradeoff decision. Should you pay extra for on-call maintenance during hours that won't interrupt your installation's activity, or should you pay a smaller fee and risk system downtime during your most productive hours? That decision depends on your own constraints and requirements.

CONCLUSION

Evaluating and selecting a small business computer is not a simple task. However, its complexity can be minimized if you proceed correctly. First, define the type of jobs your small business computer will be expected to perform. Next, establish a price ceiling based upon how much money you are willing to pay for getting the job done. Finally, match a system to these criteria.

To draw on the data processing experience of other businesses, check Table 1, which presents a summary of EDP costs encountered among five major industry groups. The table defines five standard SBC configurations, lists the typical size EDP staff employed and total annual EDP expenditures for each configuration, and relates

the company size within each industry group to each SBC configuration by listing a range of the number of personnel employed.

As an additional aid, we have prepared a checklist for use during your evaluation and selection procedure. This should help you narrow the selection to several roughly similar computer systems, which can be studied further to gauge their relative value.

Table 1. SBC Configurations and EDP Costs for Five Major Industry Groups

Characteristics	Product Identifier				
	SBC-1	SBC-2	SBC-3	SBC-4	SBC-5
Data Input	Keyboard	Keyboard	Keyboard and/or low-speed punched card	Medium-speed punched card	High-speed punched card
Printed Output	Carriage printer	Serial printer	Serial or low-speed line printer	Low- or medium-speed line printer	High-speed line printer
Storage Media	Magnetic ledger	Serial (single-track) magnetic tape	Punched card, disc, or 7- or 9-track magnetic tape	Disc and/or magnetic tape	Disc and/or magnetic tape
Average Sales Price ($)	20,000	40,000	60,000	82,500	113,000
Typical Rental ($/mo)	300-600	600-1,200	1,200-1,600	1,600-2,200	2,200-3,000
Typical Size of EDP Staff	1-2	1-3	3-4	4-6	6-8
Total Annual EDP Expenditures ($)	10,000-17,500	17,500-40,000	40,000-53,000	53,000-73,500	73,500-100,000
Employee Range					
Financial	13-23	24-53	54-70	71-97	98-131
Wholesale	32-56	57-129	130-171	172-237	238-322
Manufacturing	50-87	88-200	201-265	266-368	369-500
Retail	74-130	131-296	297-392	393-545	546-740
Transportation, Communications, and Public Utilities	38-66	67-151	152-200	201-278	279-378

SMALL BUSINESS COMPUTER SELECTION 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_____, have a good record of resolving problems_____, meet commitments_____, deliver system on time_____.

Vendor's Control over Product

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 (Kbytes)_____,

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

No. of instructions_____, Hardware multiply/divide_____,

Hardware multiple precision_____, No. programmable registers_____.

Addressing: Indirect_____, indexed _____, relative _____.

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	_____	_____	_____
Other	_____	_____	_____

Auxiliary Storage

	Model No.	Capacity	Speed
Disc			
Drum			
Tape			
Magnetic Ledger			
Other			

SOFTWARE

	Name	Description
Assembler		
Compiler		
Operating System		
Application Library		

USER SUPPORT

Coding Assistance _____

	Title	Length (days)
Training Courses		

	Title	Type
Documentation	_____	_____
	_____	_____
	_____	_____
	_____	_____

MAINTENANCE

Preventive

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

Emergency

Quoted response time (hours) _____, hours of availability _____.

Customer Engineer Experience

Training: formal _____, on the job _____.

Prior experience: previous work with small business computers _____.

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 _____.

Effect of future price change _____

Delivery guarantees _____

Performance guarantees _____

Purchase options _____

Order cancellation before delivery _____

Acceptance period (days) _____

Policy on replacement hardware _____

SPECIFICATION CHART

Small Business Computers (A-C)

SYSTEM IDENTITY	Basic/Four Model 350/400/500	Burroughs B 700 Series Model 705 and 711
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	350/400/500	705/71
Word Length (bits)	8	8
I/O Channels	2	2-8
Type of Storage	Core	Core
Capacity (words)	8K-64K	32K-40K
Cycle Time (μ sec)	1.0	1.0
SOFTWARE		
Assembler	No	No
Operating System	Yes	Yes
Compilers	Basic	Cobol; RPG

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	2200	4.2M	NA	A9480 A9481	4.6 mb 9.2 mb	193K 193K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	6100 6200 6201 6202	Reel (9) Reel (7) Reel (7) Reel (7)	800 556/800 200/800 200/556	10,000 10,000 10,000 10,000	A9490-25 A9491-2	Cassette 9	100 100	1,000 10,000

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	4100 4200	Reader (80-col) Reader (80-/96-col)	400 400/800	A9114-1 A9119-1 A9419-2 A9419-6	80-col 96-col 96-col rdr/pnch 96-col rdr/pnch	200 300 300/60 300/60

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	3100 3400	Dot matrix Line	132 132	165 cps 200 lpm	A9249-1 A9249-2 A988 A9247-2	Chain Chain Chain Train	132 132 120 120	90/60 lpm 180/120 lpm 164 lpm 400 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	5100 5200 5210	Reader Punch (std) Punch (adv)	300 75 75	A9122-1 A9222-1	11/16 or 1 in. 11 or 1 in.	40 40

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None			

OTHER PERIPHERALS; COMMENTS	Video display terminal (Model 350/400/500)	AE300 Audit Entry

NA Not Available

SPEC CHART — SMALL BUSINESS COMPUTERS (A–C)

SYSTEM IDENTITY	Burroughs B 1700			Burroughs B 1700		
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	 B 1712 24 – Integrated circuit 6K-40K bytes 0.666			 B 1714 24 – Integrated circuit 16K-65K bytes 0.666		
SOFTWARE Assembler Operating System Compilers	 Yes Yes Cobol; RPG; Fortran; Basic			 Yes Yes Cobol; RPG; Fortran; Basic		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	9480	2.3M	NA	9480	2.3M	NA
MAGNETIC TAPE	Model	Type (trks) / Char/In.	Peak Xfer, cps	Model	Type (trks) / Char/In.	Peak Xfer, cps
	9381 Series	Reel (9) / 800	10K/18K/ 36K	9381 Series	Reel (9) / 800	10K/18K/ 36K
CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	9115/9116 9119 9210 9319	Reader Reader Punch Read/punch/print	300/600 300 100 300/60	9115/9116 9119 9210 9319	Reader Reader Punch Read/punch/print	300/600 300 100 300/60
PRINTERS	Model	Type / Columns	Peak Speed	Model	Type / Columns	Peak Speed
	9240 9245 9247 9249	Line / 132 Line / 132 Line / 132 Line / 132	475/700 lpm 300/400 lpm 750 lpm 90/180 lpm	9240 9245 9247 9249	Line / 132 Line / 132 Line / 132 Line / 132	475/700 lpm 300/400 lpm 750 lpm 90/180 lpm
PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			None		
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe		Model	Capacity, char/stripe	
	None			None		
OTHER PERIPHERALS; COMMENTS	MICR reader-sorters; data communications					

– Not Applicable NA Not Available

SYSTEM IDENTITY	Burroughs B 1700				Burroughs B 1700			
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	 B 1726 24 — Integrated circuit 24K-98K bytes 0.666				 B 1728 24 — Integrated circuit 16K-65K 0.667			
SOFTWARE Assembler Operating System Compilers	Yes Yes Cobol; RPG; Fortran; Basic				No Yes Cobol; Fortran; RPG; Basic			
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	9480 9486 9371	2.3M 47.8M From 7M		NA NA NA	NA	8.1M		NA
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	9381 Series	Reel (9)	800	10K/18K/ 36K	NA NA	9 7	NA NA	96K 72K
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	9115/9116 9119 9210 9319	Reader Reader Punch Read/punch/print		300/600 300 100 300/60	NA NA	96-col rdr/pch 80-col rdr/pch		NA 800/300
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	9240 9245 9247 9249 9240-3	Line Line Line Line Line	132 132 132 132 132	475/700 lpm 300/400 lpm 750 lpm 90/180 lpm 1,040 lpm	NA NA	Line Line	48 NA	400 lpm 1,040 lpm
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	None				NA NA	Reader Punch		1,000 100
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				None			
OTHER PERIPHERALS; COMMENTS					Multiline controller; disc cartridge; MICR; console printer			

— Not Applicable NA Not Available

SPEC CHART — SMALL BUSINESS COMPUTERS (A–C)

SYSTEM IDENTITY	Burroughs L2000/3000			Burroughs L4000/5000		
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	 NA 64 Integral Magnetic disc 1, 024 5			 NA 64 Integral Magnetic disc 1, 280 5		
SOFTWARE Assembler Operating System Compilers	 Yes Yes Cobol			 Yes Yes Cobol		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	NA			NA		
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				None			
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	A595/596 A149	Reader Punch		100 19	A595/596 A149	Reader Punch		100 19
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	NA	Serial	150	20 cps	NA	Serial	255	20 cps
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	A9122 A9222	Reader Punch		40 40	A9122 A9222	Reader Punch		40 40
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				Yes L5000 Only			
OTHER PERIPHERALS; COMMENTS								

NA Not Available

SYSTEM IDENTITY	Burroughs L7000			Burroughs L8000		
CENTRAL PROCESSOR & WORKING STORAGE						
CPU Model No.	NA			8200; 8300; 8400; 8500		
Word Length (bits)	16			16		
I/O Channels	Integral			6		
Type of Storage	Magnetic disc			MOS/LSI semiconductor		
Capacity (words)	2,560-8,704			4,000-48,000		
Cycle Time (μ sec)	5			1.5		
SOFTWARE						
Assembler	Yes			No		
Operating System	Yes			No		
Compilers	Cobol			Cobol		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	NA	5,120	15,360	NA		
MAGNETIC TAPE	Model	Type (trks) / Char/In.	Peak Xfer, cps	Model	Type (trks) / Char/In.	Peak Xfer, cps
	None			A9490-25	Cassette / 100	1,000
CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	A149 A9114	Punch Reader	19 200	NA A9114-1	96-col 80-col reader	NA 200 cpm
PRINTERS	Model	Type / Columns	Peak Speed	Model	Type / Columns	Peak Speed
	NA A9289	Serial / 150/255 Line / 132	20 cps 60 lpm	A9249-1 NA	Line / 132 Line / 132	90 180
PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	A9122 A9222	Reader Punch	40 40	NA	5-, 6-, 7-, or 8-channel	NA
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe		Model	Capacity, char/stripe	
	Yes			None		
OTHER PERIPHERALS; COMMENTS				Forms handler; communications; edged punched card; magnetic record reader (single or dual track)		

NA Not Available

SPEC CHART — SMALL BUSINESS COMPUTERS (A–C)

SYSTEM IDENTITY	Cascade Data Concept II Series			Codon CB100 Distribution Management System		
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	8001-8013 8; 16 — Core 8K-64K; 4K-32K; 16K-65K 0.900			CB100 12 12 Core disc 32K; 13.5K 1.4		
SOFTWARE Assembler Operating System Compilers	Yes Yes RPG			DEAL Distribution Extended Assembler COS Codon Operating System RPG		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	412	5M	195,000	CB100	6.4M	1562K
MAGNETIC TAPE	Model	Type (trks) / Char/In.	Peak Xfer, cps	Model	Type (trks) / Char/In.	Peak Xfer, cps
	421 4005	9 / 800/1,600 — / 1,800	6,000-18,000 —	CM800	9 / 800/1,600	36K/72K
CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	650 660	Reader Optical reader	300 300	None		
PRINTERS	Model	Type / Columns	Peak Speed	Model	Type / Columns	Peak Speed
	601 610A 620 —	Console / 132 Matrix / 132 Line / 128 Line / —	30 cps 165 cps 200 cps 600 cps	CB101 CB102 CB104 CB105	Drum / 80 Drum / 132 Matrix / 80 Matrix / 132	350 lpm 250 lpm 30 cps 165 cps
PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	760 675	Reader Punch	300 75	—		
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe		Model	Capacity, char/stripe	
				None		
OTHER PERIPHERALS; COMMENTS	695-CRT 640-char display; 696-CRT 1,280-char display			Up to 12 CRTs; 1,200 or 4,800 baud		

— Not Applicable

SPECIFICATION CHART

Small Business Computers (D-H)

SYSTEM IDENTITY	Datapoint 2200	Digital Equipment Datasystems 300 Series
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	 2200 8 Parallel I/O system Core 16K 1.2	 PDP-8 family of computers 12 (2 char/wd) OMNIBUS Core 8K-32K 1.2
SOFTWARE Assembler Operating System Compilers	 Yes COS; TOS; DOS Basic; RPG	 None COS 300 Dibol (Mini-Cobol)

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	Cartridge	2.4M		RK05-AA DECpack cartridge	3.2M	250K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
		7 or 9 cassette	100	750	TD8-EM	Reel	178	17K

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
		Reader (80-col)	600	CRF-8 (opt)	Reader	300

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
		Impact Line Thermal	132	30 cps 135 lpm 30 cps	LS8-EA LE8-JA (opt)	Line Line	132 132	60-210 lpm 245-1,110 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			PC8-E	Reader Punch	300 50

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS	Display unit available; A/N keyboard std	VT05 CRT keyboard; optional binary synch communications; foreground/background capability with 4 data entry terminals and batch processing

SYSTEM IDENTITY	Digital Equipment Datasystems 500 Series	Eldorado Electrodata 140
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	PDP-11 family of computers	ee200
Word Length (bits)	16 (2 char/wd)	8/16
I/O Channels	UNIBUS	256
Type of Storage	Core or semiconductor	Core
Capacity (words)	16K-128K	8K-32K
Cycle Time (μ sec)	0.9	1.2
SOFTWARE	3 choices of operating systems: (1) COS 500 includes Macro assembler, RPG II, and Fortran IV compilers. (2) CTS 500 includes Basic-Plus compiler. (3) CDMS includes MUMPS compiler.	
Assembler		Yes
Operating System		Keyboard exec
Compilers		Eldorado String Processor (ESP)

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	RK05-AA RP03-AS (t/s)	2.4M (8-bit char) 40M (8-bit char)	188K 271K	2002 IOMEC	5M	48K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	TU 56 TU 10-EE TU 10-FE	3.9 9 7	140 800 200/556/800	10K 36K 9K-36K	Sykes Pec Pec	Cassette 7 9	1,000 bpi 556/800 800	456 10K 10K

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	CR11	Reader	300	Documation 200	Reader	300

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	LS11-A LP11-JA (opt)	Line Line	132 132	60-210 lpm 245-1,110 lpm	Potter Data Printer	Line Line	132 132	132 lpm 600 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	PC11	Reader Punch	300 50	Digitronics	Reader	300

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS	VT05 CRT keyboard; LA30 DECwriter data terminal; LT33-DC Teletype ASR 33 hard-copy terminal with paper tape rdr/pnch. CTS 500 supports 16 time-sharing users; CDMS up to 10 on-line users.	

SYSTEM IDENTITY	Four-Phase IV/40				Four-Phase IV/70			
CENTRAL PROCESSOR & WORKING STORAGE								
CPU Model No.	4300; 4500				7001; 7002			
Word Length (bits)	24				24			
I/O Channels	8				8			
Type of Storage	MOS/LSI				MOS/LSI			
Capacity (words)	24K				8K; 32K			
Cycle Time (μ sec)	2				2			
SOFTWARE								
Assembler	Yes				Yes			
Operating System	Yes				Yes			
Compilers	Cobol				Cobol			
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	NA	290M (floppy)		NA	NA	290M (floppy)		NA
	NA	2.5M (cartridge)		NA	NA	2.5M (cartridge)		NA
					NA	50M (7002 only)		NA
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				NA	7	556/800	NA
					NA	9	800	NA
					NA	9	1,600	NA
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	None				NA	Reader		300
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	NA	Serial	132	30 cps	NA	Serial	132	30 cps
	NA	Line	132	300 lpm	NA	Line	132	300 lpm
					NA	Line	132	245-700 lpm
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	None				None			
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				None			
OTHER PERIPHERALS; COMMENTS								

NA Not Available

SPEC CHART — SMALL BUSINESS COMPUTERS (D–H)

SYSTEM IDENTITY	HIS Series 50 Model 58			HIS Series 100 Model 15		
CENTRAL PROCESSOR & WORKING STORAGE						
CPU Model No.	58-1			IMI560		
Word Length (bits)	8			8		
I/O Channels	1-8			3		
Type of Storage	Core/ROM			Core		
Capacity (words)	5K-10K/7K			16K-64K		
Cycle Time (μ sec)	1.2/0.35			2 or 4		
SOFTWARE						
Assembler	Yes			Yes		
Operating System	Yes			Yes		
Compilers	Mini-Cobol			Cobol; Fortran; RPG		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	DSS 058	1.73M	156K/250K	DSS 164	2.8M	312K
MAGNETIC TAPE	Model	Type (trks) / Char/In.	Peak Xfer, cps	Model	Type (trks) / Char/In.	Peak Xfer, cps
	None			MTS 163/166	Reel (7; 9) / 200/556/800; 800/1,600	60K
CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	NA CPA 050	Reader Punch	100/200 120	NA NA CRZ 111	Reader Punch Reader	400/600 200 400
PRINTERS	Model	Type / Columns	Peak Speed	Model	Type / Columns	Peak Speed
	NA	Line / 96/128	100/200 lpm	PRT 110/120/130	Line / 120	600/780 1,100 lpm
PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			PTR 100 PTP 120	Reader Punch	500 150
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe		Model	Capacity, char/stripe	
	None			None		
OTHER PERIPHERALS; COMMENTS	Communications controller; digital display; optical mark reader			Magnetic ink document sorter; communications controller; console		

NA Not Available

SYSTEM IDENTITY	HIS Series 200 Model 105				HIS Series 200 Model 115			
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	106 6 2 or 3 Core 16K-32K 3.5				116 6 2 or 3 Core 16K-32K 2.75			
SOFTWARE Assembler Operating System Compilers	Yes Yes Cobol; RPG; Fortran				Yes Yes Cobol; RPG; Fortran			
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	170-2 173-2	4.6M 9.2M		147,500 147,500	155 172 171 276-2	3.6M 9.2M 4.6M 74.8M		147,500 208,000 —
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	204B-23/24	Reel (7)	200/556/800	9,200	204B Series	Reel (7/9)	200/1,600	149,300
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	123 214-1 214-2	Reader Punch Reader/punch		400 100-400 400/100-400	123 214-1 214-2 123-2 123-4	Reader Punch Reader/punch Reader Reader		400 100-400 400/100-400 600 1,050
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	112-3	Line	120	650 lpm	112-3 122	Line Line	120	650 lpm 650-1,100 lpm
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	209-2 210	Reader Punch		600 120	209-2 210	Reader Punch		600 120
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				None			
OTHER PERIPHERALS; COMMENTS	Communications controller; console; MICR reader/sorter; OCR reader/sorter				MICR reader/sorter; OCR reader/sorter; remote terminals; teller terminals; console			

— Not Applicable

SPEC CHART — SMALL BUSINESS COMPUTERS (D–H)

SYSTEM IDENTITY	HIS Series 2000 Model 2020	HIS Series 2000 Model 2030
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	2021	2032
Word Length (bits)	6	6
I/O Channels	3 or 4	6
Type of Storage	Core	Core
Capacity (words)	24K-65K	40K-98K
Cycle Time (μ sec)	2.75	2.0
SOFTWARE		
Assembler	Yes	Yes
Operating System	Yes	Yes
Compilers	Cobol; Fortran; RPG	Cobol; Fortran; RPG

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	NA	9.2 to 149.6 mb/ controller	NA	NA	9.2 to 512.0 mb/ controller	500

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	204-B Series	9	200/556	10/20/30	204-B Series	9	200/556	10/20/30
					NA	9	200/556/ 800/1,600	149.3

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	NA	Reader	400, 600, 1,050	NA	Reader	400, 600, 1,050
	NA	Punch	100-400	NA	Punch	100-400

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	NA	Line	NA	450, 650, 950, 1,100 lpm	NA	Line	NA	300, 450, 650, 950, 1,100 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	NA	Reader	NA	NA	Reader	NA
	NA	Punch	NA	NA	Punch	NA

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None			

OTHER PERIPHERALS; COMMENTS	OCR; MICR; communications	OCR; MICR; communications

NA Not Available

SPECIFICATION CHART

Small Business Computers (I-N)

SYSTEM IDENTITY	IBM System/3 Model 6	IBM System/3 Model 10
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	5406	5410
Word Length (bits)	8	8
I/O Channels	Internal	Internal
Type of Storage	Core	Core
Capacity (words)	8K-16K	8K-49K
Cycle Time (μ sec)	1.52	1.52
SOFTWARE		
Assembler	No	Yes
Operating System	Yes	Yes
Compilers	Basic; RPG II	RPG II; Cobol; Fortran

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	5444 Models 1, 2, 3	2.45M	199K	5444 Mdls 1, 2, 3/A1, A2, A3; 5445	2.45M 2.45M 20.4M	199K 199K 312K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				3411/3410 Mdl 1	Reel (9)	1,600	20K
					3411/3410 Mdl 2	Reel (9)	1,600 (or 800)	40K (or 20K)
					3411/3410 Mdl 3	Reel (9)	1,600 (or 800)	80K (or 40K)

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	5496	On-line data recorder	22	1442 Models 6, 7	Reader/punch	300/60; 400/120
				5424-A1	Reader/punch	250/60
				5424-A2	Reader/punch	500/120

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	5213 Models 1, 2, 3	Serial	132	85 cps	1403 Models 2, N1	Line	132	600/1,100 lpm
	2222 Models 1, 2	Ledger card (serial)	220	85 cps	5203 Models 1, 2, 3	Line	96	100/200/300 lpm
					5471	Printer-keyboard	125	15.45 cps

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			None		

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS	CRT display station; MICR reader; off-line card sorter	Data entry keyboard; MICR reader; optical mark reader; off-line card sorter

SPEC CHART — SMALL BUSINESS COMPUTERS (I–N)

SYSTEM IDENTITY	IBM System/3 Model 15	IBM System/360 Model 20 Submodel 5
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	5415	2020 Submodel 5
Word Length (bits)	8	8
I/O Channels	Integrated attachments	Integrated channels
Type of Storage	MOSFET	Core
Capacity (words)	128K	8K-32K
Cycle Time (μ sec)	1.5	2.0
SOFTWARE		
Assembler	Yes	Yes
Operating System	Yes	No
Compilers	RPG II; Cobol; Fortran	RPG

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	5442-A2	4.9M	199K	2311	5.4M	81,000
	5445-1	20.48M	312K	2311 Model 11	2.4M	82,080
				2311 Model 12		

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	3410/3411 Mdls 1, 2, 3	7; 9 7; 9 7; 9	1,600/ 800/556/ 200 (all models)	20K 40K 80K	2401/1 2401/2 2401/4 2415 Series	9; 7 9; 7 9; 7 9; 7	800* 800* 1,600* 800/ 1,600*	30K 60K 60K 15K or 30K

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	5424-A1	Read/punch/print	250/60/60	1442/5	Punch	91-360
	-A2		500/120/120	2501/A1, A2	Readers	600/1,000
	1442-6	Read/punch	300/80	2520/A1	Reader/punch	500
	-7		400/160	2520/A2, A3	Punches	500/300
	2560 MFCU	Read/punch	500/91	2560 MFCM	Reader/punch	500/91

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	1403-2	Line	132	465 lpm	1403/2, 7	Line	132/120	600 lpm
	-5	Line	132	600 lpm	1403/N1	Line	132	1,100 lpm
	-N1	Line	132	1,100 lpm	2203/A1	Line	120/144	350 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			None		

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS	CRT display station; MCR; OCR	MICR reader; communications controller; Selectric typewriter. *All 7-track densities include 200 and 556; 2401 Mod 4 also has 800 on 7-track

SYSTEM IDENTITY	IBM System/360 Model 20 Submodel 6	IBM System/370 Model 115
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	2020 Submodel 6	3115
Word Length (bits)	8	32
I/O Channels	Integrated channels	Intgrtd chnls; adptrs; opt byte mltplxr
Type of Storage	Core	MOSFET
Capacity (words)	8K-16K	40K (160K bytes)
Cycle Time (μ sec)	3.6	0.48
SOFTWARE		
Assembler	Yes	Yes
Operating System	No	Yes
Compilers	RPG	RPG II; Cobol; Fortran; PL/1

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	2311 Model 11 2311 Model 12	5.4M 2.4M	81K 82,080	3348 Mdl 35 Mdl 70	 34.9M 69.8M	 864K 864K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	2415 Series	9; 7	800/ 1,600; 200/556	15K (or 30K)	3410/3411 Mdls 1, 2, 3	 7; 9 7; 9 7; 9	1,600/ 800/556/ 200 (all models)	 20K 40K 80K

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	1442/5 2501/A1,A2 2520/A1 2520/A2,A3 2560 MFCM	Punch Readers Reader/punch Punches Reader/punch	91-360 600/1,000 500 500/300 500/91	5425-A1 -A2 2560 MFCU	Read/punch/print Read/punch	250/60/60 500/120/ 120/500/91

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	1403/2, 7 1403/N1 2203/A1	Line Line Line	132/120 132 120/144	600 lpm 1,100 lpm 350 lpm	3203-1 -2 5203-3	Line Line Line	132 132 96; 120; 132	600 lpm 1,200 lpm 300 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			None		

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS	MICR reader; communications controller; Selectric typewriter	CRT display station; communications modems

SPEC CHART — SMALL BUSINESS COMPUTERS (I–N)

SYSTEM IDENTITY	Litton Automated Business Systems Models 1220/1221/1231/1241/1252	Litton Automated Business Systems Model 1281
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	NA	NA
Word Length (bits)	40	40
I/O Channels	16	16
Type of Storage	Drum	Drum
Capacity (words)	2K–4K	2K–4K
Cycle Time (μ sec)	0.5	0.5
SOFTWARE		
Assembler	Yes	Yes
Operating System	Yes	Yes
Compilers	No	No

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	None			None		

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				None			

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	None			64	Reader	120

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	20/30	Serial	192	35 cps	20/30 33	Serial Serial	192 192	35 cps 35 cps

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	NA	Reader/punch	50	NA	Reader/punch	50

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	Yes		Yes	

OTHER PERIPHERALS; COMMENTS	Drum auxiliary memory for Models 1241, 1252	

NA Not Available

SYSTEM IDENTITY	Lockheed System III	NCR Century 50
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	Lockheed Decimal Processor Core 62K	615-50 8 0 or 1 Rod (thin-film) 16K-32K 0.8
SOFTWARE Assembler Operating System Compilers	Yes, LAP-2 DOS RPG II	Yes Yes Basic; Cobol; Fortran IV; Neat/3

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
		5M (1 rem, 1 fx)		655-101	8.4M	108K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
		9 Cassette	800 360,000/ side	1,600-36,000; 60,000 6-24 ips	633 633-117 633-119	Reel (9) Reel (7) Reel (9)	800/ 1,600 200/556/ 800 800	40K/80K 10K/28K/ 40K 40K

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
		Reader (80 col) Punch (80 col) Reader/punch (96 col)	600 30 300 read/ 60 punch	682-100	Reader	300

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
		Line Line	132 132	100 cps 600 lpm	640-122 640-132 640-102	Line Line Line	132 132 132	200 lpm 300 lpm 450 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			662-100	Reader	1,000

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS	CRT display and console; data entry keyboard std	

SPEC CHART — SMALL BUSINESS COMPUTERS (I–N)

SYSTEM IDENTITY	NCR Century 100	NCR Century 101
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	615-100	615-101
Word Length (bits)	8	32
I/O Channels	2	2; 1 multiplexor
Type of Storage	Rod (thin-film)	Core
Capacity (words)	16K-32K	4K-16K
Cycle Time (μ sec)	0.8	1.2
SOFTWARE		
Assembler	Yes	
Operating System	Yes	Yes
Compilers	Basic; Cobol; Fortran IV; Neat/3	NEAT/3; Fortran; Cobol; Basic; RPG

DISC	Model	Capacity, char/pack	Peak Xfer, cps
	655-101	8.4M	108K
	655-201	4.2M	108K
	656-101	4.9M	312.5K
	656-102	4.9M	312.5K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps
	633	Reel (9)	800/ 1,600	40K/80K
	633-117/119	7; 9	200/556/ 800	10/28/40K
	633-111	9	1,600	80K
	633-211	9	1,600	144K
	633-311	9	1,600	144K

CARDS	Model	Type	Peak Speed, cpm
	682-100 686/687	Reader Punch	300 80-240/100
	682-100 686 680-201 687-301	Reader Reader; punch Reader Punch	300 560/750/800; 60-294 1,200 100

PRINTERS	Model	Type	Columns	Peak Speed
	640-102	Line	132	450 lpm
	640-102	Line	132	450/900 lpm
	640-300	Line	132	1,200 lpm
	649-150	Line	132	150 lpm

PAPER TAPE	Model	Type	Peak Speed, cps
	622-100 660-101 665-101	Reader Reader Punch	1,000 1,500 200
	622-100 660-101 665-101	Reader Reader Punch	1,000 1,500 200

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe
	None	
	None	

OTHER PERIPHERALS; COMMENTS	
	MICR; OCR

SYSTEM IDENTITY	NCR N-500						
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	 C-517-1 48 1 Core 200-400 1,080						
SOFTWARE Assembler Operating System Compilers	 Yes No No						
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	None							
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None							
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	C-582-1 C-577-1	Reader Punch		100 100				
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	C-541	Line	96	125 lpm				
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	C-562-1 C-563-1 C-571-1 C-572-1	Reader Reader Punch Punch		650 50 120 30				
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	N-500							
OTHER PERIPHERALS; COMMENTS								

SPECIFICATION CHART
Small Business Computers (O-Z)

SYSTEM IDENTITY	Qantel System			Singer System Ten		
CENTRAL PROCESSOR & WORKING STORAGE						
CPU Model No.	QA-2, QB-2, QC-1, QF-1, QD-1			20-101		
Word Length (bits)	8			60		
I/O Channels	12; 1 multiplexor			3		
Type of Storage	Core			Core		
Capacity (words)	32K			3K		
Cycle Time (μ sec)	1.5			3.3		
SOFTWARE						
Assembler	Yes			Yes		
Operating System				No		
Compilers	RPG			RPG		
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	MD-1 ME-1 MP-1	7.6M 30.7M 61.4M		42	4M	229K
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	MF-1 MJ-1 MK-1 ML-1 MM-1	9 9 9 9 9	800 800 800 1,600 1,600	10K 20K 20K 40K 40K	None			
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	AC-2	Reader		500	31 35	Reader Punch		1,000 100
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	PO-1 PB-2 PC-1 PE-1	Serial Line Line Line	132 132 24-132 132	100 lpm 200 lpm 1,120 lpm 1,800 lpm	53; 54 55; 56	Line Line	120 120	125; 200 300; 400
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	AD-1	Reader/punch		50	None			
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				None			
OTHER PERIPHERALS; COMMENTS	CRT display; control console; communications controller; key numeric input module				Workstation; CRT display; control adapters			

SYSTEM IDENTITY	Singer System Ten	Singer System Ten
CENTRAL PROCESSOR & WORKING STORAGE		
CPU Model No.	20-102	20-104/20-106
Word Length (bits)	6	6
I/O Channels	1-2	2-20/3-20
Type of Storage	Core	Core
Capacity (words)	10K-30K	20K-110K
Cycle Time (μ sec)	3.3	3.3
SOFTWARE		
Assembler	Yes	Yes
Operating System	No	No
Compilers	RPG	RPG

DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack	Peak Xfer, cps
	42	8M	229K	40 42	10M 8M	229K 229K

MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				45	Reel (7; 9)	800/556; 800	20K

CARDS	Model	Type	Peak Speed, cpm	Model	Type	Peak Speed, cpm
	None			30 35	Reader Punch	300 100

PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	52	Line	132	110 lpm	50 52	Line Line	132 132	450 lpm 110 lpm

PAPER TAPE	Model	Type	Peak Speed, cps	Model	Type	Peak Speed, cps
	None			60 65	Reader Punch	275 150

MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe	Model	Capacity, char/stripe
	None		None	

OTHER PERIPHERALS; COMMENTS	Workstation 70; CRT 80; FAC; disc controller; I/O channel	Workstation 70; CRT; FAC; JIS 100; attend. term. 105; data term. 900; communications term. 7102; SCA & ATA (20-106 only); digital clock

SYSTEM IDENTITY	Singer 6800 System				Ultimacc Systems CRT/Disc Systems			
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	 20 60 2 Core 30K 3.3				 Nova 1200 16 15 Core 8K-32K 1.2			
SOFTWARE Assembler Operating System Compilers	Yes No RPG				Yes Yes Basic; Fortran IV			
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	42	4M		229K	CRD1	5M		200K
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				None			
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	None				None			
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	52	Line	132	110 lpm	NA NA	Line Line	132 136	135 lpm 300 lpm
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	None				None			
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				None			
OTHER PERIPHERALS; COMMENTS	Model 70 workstation; Model 80 CRT				Teletypewriter; card and paper tape equipment also available			

NA Not Available

SYSTEM IDENTITY	Ultimacc Systems Disc Systems				Ultimacc Systems Tape System			
CENTRAL PROCESSOR & WORKING STORAGE CPU Model No. Word Length (bits) I/O Channels Type of Storage Capacity (words) Cycle Time (μ sec)	Nova 1200 16 15 Core 8K-32K 1.2				Nova 1200 16 1 Core 4K-32K 1.2			
SOFTWARE Assembler Operating System Compilers	Yes Yes Basic; Fortran IV				Yes Yes Basic; Fortran IV			
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	KBD1	5M		200K	None			
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				TRI-DATA 4196	Car-tridge	300 bpi	1.9K
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	None				None			
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	NA NA	Line Line	132 136	135 lpm 300 lpm	Litton Model 30	Serial	192	30 cps
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	None				None			
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				None			
OTHER PERIPHERALS; COMMENTS	Video (CRT) display station; teletypewriter; card and paper tape equipment also available							

NA Not Available

SYSTEM IDENTITY	Univac 9200			Univac 9200 II			
CENTRAL PROCESSOR & WORKING STORAGE							
CPU Model No.	9200			9200			
Word Length (bits)	8			8			
I/O Channels	Opt mux			Std mux; opt selector			
Type of Storage	Plated wire			Plated wire			
Capacity (words)	8K-16K			8K-32K			
Cycle Time (μ sec)	1.2			1.2			
SOFTWARE							
Assembler	Yes			Yes			
Operating System	Yes			Yes			
Compilers	RPG; Fortran; Cobol			RPG; Fortran; Cobol			
DISC	Model	Capacity, char/pack	Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	8410	3.2M	100K	8410 8411 8414	3.2M 7.25M 29M		100K 156K 312.5K
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	None				Uniservo VIC Uniservo 12	Reel (7; 9) Reel (7; 9)	200/556/ 800; 800 200/556/ 800; 800/ 1,600	34.2K 68K
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	0711-00 0603-04	Reader Punch		400 75-200	0711-00 0603-04 0711-02 0716-97 0604-00 0604-99	Reader Punch Reader Reader Punch Punch		400 75-200 600 1,000 200 250
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	0762-00	Line	96 (min)	250 lpm (min)	0762-00 0768-00 0768-99 0762-02	Line Line Line Line	96 (min) 132 132 132	250 lpm (min) 900/1,100 lpm 1,200/1,600 lpm 840-2,000lpm
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	0920-00	Reader/punch		300/110	0920-00	Reader/punch		300/110
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None				None			
OTHER PERIPHERALS; COMMENTS	Card controller; remote batch terminal; data communications controllers; optical document reader				Card controller; remote batch terminal; data communications controllers; optical document readers; selector channel			

– Not Applicable NA Not Available

SYSTEM IDENTITY	Wang 2200						
CENTRAL PROCESSOR & WORKING STORAGE							
CPU Model No.	2200						
Word Length (bits)	8						
I/O Channels	6 std; 5 more opt						
Type of Storage	MOS						
Capacity (words)	32K						
Cycle Time (μ sec)	1.6						
SOFTWARE							
Assembler	No						
Operating System	No						
Compilers	Basic (hardwired interpreter)						
DISC	Model	Capacity, char/pack		Peak Xfer, cps	Model	Capacity, char/pack		Peak Xfer, cps
	2230-1 2230-2 2230-3	1.2M 2.4M 4.9M		200K 200K 200K				
MAGNETIC TAPE	Model	Type (trks)	Char/In.	Peak Xfer, cps	Model	Type (trks)	Char/In.	Peak Xfer, cps
	Cassette 2217		6264	326				
CARDS	Model	Type		Peak Speed, cpm	Model	Type		Peak Speed, cpm
	2234	Reader		300				
PRINTERS	Model	Type	Columns	Peak Speed	Model	Type	Columns	Peak Speed
	2221 2231 2203	Impact Print/ plot Plotter	132 80	150 cps 100 cps 400 steps/ sec				
PAPER TAPE	Model	Type		Peak Speed, cps	Model	Type		Peak Speed, cps
	2203	Reader		300				
MAGNETIC STRIPE LEDGER CARDS	Model	Capacity, char/stripe			Model	Capacity, char/stripe		
	None							
OTHER PERIPHERALS; COMMENTS	CRT; mark sense card reader; combined cassette reader/recorder and CRT							

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	BASIC/FOUR			
	CENTRAL PROCESSOR AND WORKING STORAGE			
350	Central Processing Unit (8K; with video display terminal; 2100 disc system; 3100 printer)	895	32,400	183
400	Central Processing Unit (8K; with video display terminal and/or accounting machine terminal; 2100 disc system; 3100 printer)	954	34,900	186
500	Central Processing Unit (8K; with video display terminal and/or accounting machine terminal; 2100 disc system; 3100 printer)	1,023	37,900	189
	MASS STORAGE			
2200	Disc System (4.2 mc)	279	9,950	60
	INPUT/OUTPUT			
	Printers			
3100	Printer (60-150 lpm; 165-cps matrix)	197	6,450	55
3400	Printer (200-lpm)	285	9,950	66
	Punched Card			
4100	Card Reader (400-cpm; 80-col)	159	4,450	61
4200	Card Reader (400- or 800-cpm; 80/90 col)	170	4,950	61
	Paper Tape			
5110	Paper Tape Reader (300-cps; std)	124	4,450	26
5200	Paper Tape Punch (75-cps; std)	124	4,450	26
5210	Paper Tape Punch (75-cps; advanced)	124	4,450	26
	Magnetic Tape			
6100	Magnetic Tape System (9-track; 800-bpi; NRZI)	243	7,950	68
6200	Magnetic Tape System (7-track; 800/556-bpi; NRZI)	243	7,950	68
6201	Magnetic Tape System (7-track; 800/200-bpi; NRZI)	243	7,950	68
6202	Magnetic Tape System (7-track; 556/200-bpi; NRZI)	243	7,950	68
	DATA COMMUNICATIONS			
7200	Video Display Terminal (Models 400 and 500)	132	4,950	23
7400	Executive Display Terminal (inquiry only; Models 400 and 500 only)	74	2,450	20
7300	KSR 33 Teletype	76	2,500	21
7301	ASR 33 Teletype	90	3,000	24
	BURROUGHS L SERIES			
	CENTRAL PROCESSOR AND WORKING STORAGE			
L2000	Processors (with keyboard)			
L2000-008	(128 user words)	243	6,995(1)	NA
L2000-208	(256 user words)	276	7,995(1)	NA
L2101-008	(128 user words)	280	8,490	NA
L2101-208	(256 user words)	313	9,490	NA
L2101-408	(384 user words)	346	10,490	NA
L2101-608	(512 user words)(2)	379	11,490	NA
L2301-008	(128 user words)	290	8,790	NA
L2301-208	(256 user words)	323	9,790	NA
L2301-408	(384 user words)	356	10,790	NA
L2301-608	(512 user words)(2)	389	11,790	NA
L2302-908	(768 user words)(2)	455	13,790	NA
L3000	Processors (with keyboard)			
L3111-008	(128 user words)	326	9,890	NA
L3111-208	(256 user words)	359	10,890	NA
L3111-408	(384 user words)	392	11,890	NA
L3111-608	(512 user words)(2)	425	12,890	NA
L3311-008	(128 user words)	336	10,190	NA
L3311-208	(256 user words)	369	11,190	NA
L3311-408	(384 user words)	402	12,190	NA
L3311-608	(512 user words)(2)	435	13,190	NA
L3312-908	(768 user words)(2)	495	14,190	NA
L3231-307	(256 user words)	297	8,990	NA
L3231-608	(320 user words)	363	10,990	NA
L3331-608	(288 user words)	396	11,990	NA
L4000	Processors (with keyboard)			
L4111-009	(128 user words)	372	11,290	NA
L4111-209	(256 user words)	406	12,290	NA
L4111-409	(384 user words)	439	13,290	NA
L4111-609	(512 user words)(2)	472	14,290	NA
L4311-209	(256 user words)	415	12,590	NA
L4311-409	(384 user words)	448	13,590	NA
L4311-609	(512 user words)(2)	481	14,590	NA
L4312-909	(768 user words)(2)	514	15,590	NA
L5000	Processors (with keyboard)			
L5012-619	(608 user words)	660	19,990	NA
L5112-689	(608 user words)(2)	710	21,500	NA
L5112-619	(608 user words)(2)	759	22,900	NA
	INPUT/OUTPUT FOR L2000/3000/4000/5000			
	Punched Card			
A595	Card Reader	97	2,950	NA
A596	Card Reader	115	3,490	NA
A509	Card Punch Control Unit	33	1,000	NA
A149	Card Punch (GPV product)	120	5,990	NA
	Card/Tape			
A581	Paper Tape/Edge Punched Card Reader	46	1,390	NA
A562	Paper Tape/Edge Punched Card Perforator	52	1,590	NA
	Magnetic Tape			
A1495	MTU and Controller	365	11,500	NA
	Document Reader			
A4005	Magnetic Record Reader (L5000 only)	148	4,490	NA
	CENTRAL PROCESSOR AND WORKING STORAGE			
L7000	Processors (with console)(3)			
L7300-300	Processor	495	15,000	62
L7300-350	Processor	500	15,150	63
L7400-400	Processor	541	16,400	64
L7400-450	Processor	546	16,550	65
L7500-501	Processor	843	25,550	86
L7500-551	Processor	848	25,700	86
L7500-502	Processor	888	26,900	94
L7500-552	Processor	893	27,050	95
	Processor Options			
A2311	Extended Memory Controller	42	1,275	3
A5400	Scratchpad Memory Module (32 words)	15	45	1
A7311	Extended Memory Module Control	6	175	1
A7312	Cable for Third Extended Memory Module	7	200	1
A9371	Extended Memory Module (2,048 words)	83	2,500	5
	INPUT/OUTPUT FOR L7000			
	Punched Card			
A3111	Card Reader Control	10	310	1
A9114	Card Reader	70	2,120	20
A8111	Card Reader Code Conversion (BCL)	2	60	
A8112	Card Reader Code Conversion (EBCDIC)	2	60	
A3211	Card Punch Control	31	775	3
A 149	Card Punch	120	5,990	28
A8211	Card Punch Code Conversion (BCL)	2	60	
A8212	Card Punch Code Conversion (EBCDIC)	2	60	
	Card/Tape			
A3121	Paper Tape/Edge Punched Card Reader Control	14	425	2
A3222	Paper Tape/Edge Punched Card Punch Control	14	425	2
A9222	Paper Tape/Edge Punch Card Punch	38	1,165	12
A2321	Card/Tape Subsystem Controller		1,000	4
A6321	Card/Tape Subsystem Buffer No. 2 or No. 4		165	1
A6322	Card/Tape Subsystem Buffer No. 3		350	1
	Printers			
A9249	Line Printer		8,000	432
A3243	Line Printer Controller		500	30

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	BURROUGHS L SERIES (Contd.)			
	Document Reader			
A9161	Magnetic Record Reader (single-track)	148	4,490	25
A9162	Magnetic Record Reader (dual-track)	161	4,890	25

Notes:

(1) Prices given are for 3-month warranty. Same styles can be purchased with 1-year warranty for $7,350 and $8,350.

(2) User words may be fewer, depending on firmware requirements.

(3) Available user words on L7000 processors depend on interpreter requirement.

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	BURROUGHS L8000			
	CENTRAL PROCESSOR AND WORKING STORAGE			
L8000	Accounting Computers with			
L8200-100	15-1/2" Rear Feed Forms Handler (4 Kb)	394	12,990	
L8200-200	15-1/2" Rear Feed Forms Handler (4 Kb; 1 cassette tape station)	424	13,990	
L8300-100	15-1/2" Front Feed Forms Handler (4 Kb)	409	13,490	
L8300-200	15-1/2" Front Feed Forms Handler (4 Kb; 1 cassette tape station)	440	14,490	
L8400-100	26" Front Feed Forms Handler (4 Kb)	446	14,690	
L8400-200	26" Front Feed Forms Handler (4 Kb; 1 cassette tape station)	476	15,690	
L8500	Magnetic Record Computers with			
L8541-100	26" MMR Forms Handler (6 Kb; 352-digit data track)	667	21,990	
L8541-200	26" MMR Forms Handler (6 Kb; 352-digit data track; 1 cassette tape station)	697	22,990	
L8541-104	26" MMR Forms Handler (6 Kb; 352-digit data track; solid platen)	637	20,990	
L8541-204	26" MMR Forms Handler (6 Kb; 352-digit data track; 1 cassette tape station; solid platen)	667	21,990	
L8542-100	26" MMR Forms Handler (6 Kb; 704-digit data track)	697	22,990	
L8542-200	26" MMR Forms Handler (6 Kb; 704-digit data track; 1 cassette tape station)	727	23,990	
	Processor Options			
A4011	2-Kb Memory Module (up to 16-Kb total)	31	1,100	
A4011-1	2-Kb Memory Module (over 16 Kb)	21	810	
A2011	24-Kb Extended Memory Pot	21	750	
A2012	32-Kb Extended Memory Pot	22	800	
A7341	Upgrade Kit (to upgrade an L8000 MMR console, 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	
	Magnetic Tapes			
A9490-25	Cassette Tape Subsystem (1st station includes controller)	55	1,940	
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 Synch (15-1/2")	7	250	
PF 22	RF, Single Asynch (15-1/2")	7	250	
PF 23	RF, Dual (15-1/2")	14	500	
PF 24	FF, Single Synch (15-1/2")	7	250	
PF 25	FF, Single Asynch (15-1/2")	7	250	
PF 26	FF, Dual (15-1/2")	14	500	
PF 27	FF, Single Synch (26")	7	250	
PF 28	FF, Single Asynch (26")	7	250	
PF 29	FF, Dual (26")	14	500	

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	BURROUGHS B 700 SYSTEMS			
	CENTRAL PROCESSOR AND WORKING STORAGE			
B705	Processor (incl 16K bytes main memory; console control; wiring for 40 Kb)	420	15,425	70
B711	Processor (incl I/O base; 16K bytes main memory; console control, wiring for 40 Kb)	600	20,650	80
	Processor Options			
A1306	I/O Expansion Feature	25	1,000	4
	Upgrade B705 to B711 Processor	180	5,225	
B11-32	Total Memory (32K bytes)	122	5,300	16
B11-40	Total Memory (40K bytes)	180	9,000	24
B11-48	Total Memory (48K bytes; B711 only)	205	10,600	32
	B 700 Packaged Systems			
B 706	Audit Entry System (incl 0.5-Mhz processor with 32-Kb memory; 26" systems console printer; 4.6-mb dual disc cartridge drive; necessary I/O device controls)	1,061	43,350	177
B 716	Audit Entry System (incl 1-Mhz processor with 32-Kb memory; 26" systems console printer; 4.6-mb dual disc cartridge drive; necessary I/O device controls)	1,241	48,575	187
B 707	Audit Entry System (incl 0.5-Mhz processor with 32-Kb memory; 26" console printer; 4.6-mb dual disc cartridge drive; 90-lpm line printer; magnetic tape cassette subsystem; audit entry computer system; necessary I/O device controls)	1,820	66,065	309
B 717	Audit Entry System (incl 1 Mhz processor with 32-Kb memory; 26" systems console printer; 4.6-mb dual disc cartridge drive; 90-lpm printer; magnetic tape cassette subsystem; audit entry computer system; necessary I/O device controls)	2,000	71,090	319
B 708	Card System (incl 0.5-Mhz processor with 32-Kb memory; 26" systems console printer; 4.6-mb dual disc cartridge drive; 90-lpm line printer; 96-col card/read/punch/printer; 96-col card data recorder; necessary I/O device controls)	1,745	70,865	360

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	BURROUGHS B 700 SYSTEMS (Contd.)			
B718	Card System (incl 1-Mhz processor with 32-Kb memory; 26" systems console printer; 4.6-mb dual disc cartridge drive; 90-lpm line printer; 96-col card reader/punch/printer; 96-col card data recorder; necessary I/O device controls)	1,925	76,090	370
	MASS STORAGE			
	Discs			
A9480-12	Dual Cartridge Drive (4.6-mb)	365	15,450	53
A9481-12	Dual Cartridge Drive (9.2-mb)	480	21,600	72
B489	Control (for A9480-12)	19	675	14
B489-1	Control (for A9481-12)	38	1,200	14
A9985-2	Disc Cartridge (for A9480 drives)		170	
A9985-3	Disc Cartridge (for A9481 drives)		225	
	INPUT/OUTPUT			
	Punched Card			
A9114-1	Card Reader (80-col; 200-cpm)	78	2,790	21
B111	Control (for A9114-1)	22	750	5
A9119-1	Card Reader (96-col; 300-cpm)	85	3,500	25
B311	Control (for A9119-1)	25	850	2
A9419-2	Card Reader/Punch/Print (96-col; 300-cpm read; 60-cpm punch)	240	9,490	71
A9419-6	Card Reader/Punch/Print (96-col; 300-cpm read; 60-cpm punch; 6 pocket sorting)	285	11,390	85
B311	Control (for A9419-2, A9419-6)	25	850	2
	Consoles			
B9343-1	Front Feed Forms Handler (15-1/2")	143	5,500	21
B9343-2	Front Feed Forms Handler (26")	160	7,500	24
PF24	FF, Single Synch (15-1/2")	7	250	
PF25	FF, Single Asynch (15-1/2")	7	250	
PF26	FF, Dual (15-1/2")	14	500	
PF27	FF, Single Synch (26")	7	250	
PF28	FF, Single Asynch	7	250	
PF29	FF, Dual (26")	14	500	
	Paper Tape			
A9122-1	Reader (40-cps)	42	1,490	10
A9222-1	Punch (40-cps)	53	1,890	13
B121-1	Control (for A9122-1)	22	750	2
B221	Control (for A9222-1)	22	750	2
	Printers			
A9249-1	Printer (90 lpm; 132 PP)	240	8,500	60
A988	Printer (164 lpm; 120 PP)	370	11,200	117
A9249-2	Printer (180 lpm; 132 PP)	280	11,200	70
A9247-2	Printer (400 lpm; 120 PP)	460	19,500	100
A9247-12	Printer (400 lpm; 120 PP)	485	20,500	100
B243	Control (for A9249-1)	16	625	5
B245	Control (for A988)	12	450	5
B243-1	Control (for A9249-2)	36	1,600	5
B244	Control (for A9247-2, A9247-12)	45	2,000	5
A9949-2	12-Channel Format Tape Reader Option (for A9247-2, A9247-12)	61	3,050	15
A9942-2	Addt'l 12 PP (for A9247-2, A9247-12)	40	2,000	10
A9942-9	Addt'l Train Module (for A9247-2, A9247-12)	65	3,500	18
	Magnetic Tapes			
A9490-25	Magnetic Tape Cassette (10 ips)	55	1,940	6
A9491-2	Tape Unit (10-Kb; NRZ 9-chnl; 800-bpi)	215	8,600	21
B391	Control (for A9491-2)	30	1,250	30
B392	Control (for A9490-25)	24	800	3

Note:

Maintenance rates are higher outside metropolitan areas.

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Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	BURROUGHS B 1712/B 1714 SYSTEMS			
	CENTRAL PROCESSOR AND WORKING STORAGE			
B1712	Processor (includes I/O base; 16K bytes main memory; console; table; corner table)	560	27,225	90
B1714	Processor (includes I/O base; 16K bytes main memory; console; table; corner table)	780	34,225	95
	Processor Options			
A1305	I/O Expansion Feature	30	1,500	5
	For B 1712 Only			
B1012-24	Total Memory (24K)	150	5,000	10
B1012-32	Total Memory (32K)	400	12,000	16
B1012-40	Total Memory (40K)	550	17,000	27
	For B 1714 Only			
B1014-24	Total Memory (24K)	200	6,500	13
B1014-32	Total Memory (32K)	400	12,500	18
B1014-40	Total Memory (40K)	550	20,000	25
B1014-49	Total Memory (48K)	700	26,000	36
B1014-57	Total Memory (56K)	850	32,000	48
B1014-65	Total Memory (64K)	1,000	38,000	61
	MASS STORAGE			
	Discs			
	Disc Cartridge Drives (60-msec avg seek time; 20-msec avg latency; 80-msec avg data access time)			
A9480-1	Single-Cartridge Drive (2.3-mb)	250	10,000	31
A9480-2	Dual-Cartridge Drive (4.6-mb)	365	15,450	53
A9481-1	Single-Cartridge Drive (4.6-mb)	310	13,200	47
A9481-2	Dual-Cartridge Drive (9.3-mb)	480	21,600	72
A1480	Control (for A9480-1 and A9480-2 Drives)	90	2,700	14
A1481	Control (for A9481-1 and A9481-2 Drives)	100	3,500	15
A9985-2	Disk Cartridge (for A9480 Drives)	—	170	—
A9985-3	Disk Cartridge (for A9481 Drives)	—	225	—
	INPUT/OUTPUT			
	Punched Card			
A9115	Reader (80-col; 300-cpm)	110	4,500	25
A9116	Reader (80-col; 600-cpm)	195	6,500	35
A1115	Control (for A9115)	45	900	7
A1116	Control (for A9116)	55	1,200	8
A9119-1	Reader (96-col; 300-cpm)	85	3,500	25
A1119-1	Control for A9119-1	45	900	7
A9210-1	Punch (100-cpm; 80-col)	250	12,000	67
A1210-1	Control (for A9210-1)	90	4,320	14
A9319-2	Reader/Punch (reads 300 cpm; punches/prints 60 cpm; 96-col)	200	7,990	60
A9319-4	Reader/Punch (reads 500 cpm; punches/prints 120 cpm; 96-col)	310	11,190	91
A1319-2	Control (for A9319-2)	65	1,900	10
A1319-4	Control (for A9319-4)	70	2,300	11
	Recorders			
A9419-2	Reader/Punch Data Recorder (reads 300 cpm; punches/prints 60 cpm; 96-col)	240	9,490	71
A9419-6	Reader/Punch Data Recorder (reads 300 cpm; punches/prints 60 cpm; 6-pocket sorting at 300 cpm; 96-col)	285	11,390	85
A1419-2	Control for A9419-2	65	1,900	10
A1419-6	Control for A9419-6	70	2,100	11
	Printers			
A9240-1	Printer (475-lpm 132 PP)	475	19,500	174
A9240-2	Printer (700-lpm 132 PP)	625	31,000	179
A9245-16	Printer (300-lpm 132 PP)	475	20,000	149
A9245-19	Printer (400-lpm 132 PP)	575	23,000	154
A9247-3	Printer (750-lpm 132 PP)	710	35,000	138
A9249-1	Printer (90-lpm 132 PP)	240	8,500	60
A9249-2	Printer (180-lpm 132 PP)	280	11,200	70
A1240-1	Control (for A9240-1)	50	1,400	9
A1240-2	Control (for A9240-2)	70	1,500	11
A1245-16	Control (for A9245-16)	50	1,400	8
A1245-19	Control (for A9245-19)	70	1,500	11
A1247-3	Control (for A9247-3)	215	2,800	44
A1249-1	Control (for A9249-1)	35	1,000	5
A1249-2	Control (for A9249-2)	40	1,100	6
A9949-2	Format Tape Reader (for A9247-3; 12-chnl)	61	3,050	15
	Consoles			
A9340	Console Printer	55	2,640	15
A1340	Control (for A9340)	60	1,800	5
	Magnetic Tapes			
A9381-12	18-Kb Cluster (2-station; NRZ; 9-channel; 800-bpi)	525	25,200	179

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	BURROUGHS B 1712/B 1714 SYSTEMS (Contd.)			
A9381-13	18-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	570	26,960	200
A9381-14	18-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	680	32,160	241
A9381-22	36-Kb Cluster (2-station; NRZ; 9-channel; 800-bpi)	700	33,600	205
A9381-23	36-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	900	43,200	236
A9381-24	36-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	1,100	52,800	267
A9491-2	10-Kb Tape Unit (NRZ; 9-channel; 800-bpi)	215	8,600	21
A1381	Tape Cluster Control	250	6,000	38
A1491-2	Tape Control (10-Kb)	200	3,900	30
	Sorters			
A9135-2	8-Pocket (900 doc/min; E13-B; off-line sorting)	1,000	45,500	431
A9135-3	12-Pocket (900 doc/min; E13-B; off-line sorting)	1,300	55,900	467
A9136-5	8-Pocket (600 doc/min; E13-B; off-line sorting)	700	34,000	225
A9136-6	12-Pocket (600 doc/min; E13-B; off-line sorting)	850	39,000	270
A1135	Control (for A9135)	150	6,000	30
A1136	Control (for A9136)	150	6,000	30
	DATA COMMUNICATIONS			
A1351	Single-Line Control	50	2,000	8
	Line Adapters			
A1650-1	Asynch Data Set Connect (up to 1,200 bps)	50	1,500	8
A1650-2	Asynch Data Set Connect (up to 1,800 bps)	65	1,800	10
A1650-5	Asynch Direct Connect (up to 2,400 bps)	50	1,500	8
A1650-6	Asynch Direct Connect (up to 4,800 bps)	65	1,800	10
A1650-7	Asynch Direct Connect (up to 9,600 bps)	80	2,100	12
A1651-1	Synch Data Set Connect (up to 2,400 bps)	50	1,500	8
A1651-2	Synch Data Set Connect (up to 4,800 bps)	65	1,800	10
A1651-3	Synch Data Set Connect (up to 9,600 bps)	80	2,100	12
A1652-1	Asynch Data Set Connect (for TTY)	50	1,500	8
A1652-5	Asynch Direct Connect (for TTY)	50	1,500	8

Note:

Maintenance rates are higher outside metropolitan area.

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	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	140
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 disk)	3,825	181,688	498
	Processor Options			
B1097-3	Corner Table	15	720	NC
B1305	I/O Expansion Feature (2 allowed)	30	1,500	5
	Control Memory Options			
B1026-2	Additional 2,048 Bytes	400	9,600	30
	Main Memory Options for B1726			
B1026-32	32K Bytes	85	5,400	10
B1026-40	40K Bytes	205	10,800	16
B1026-49	48K Bytes	325	16,200	22
B1026-57	56K Bytes	460	21,600	28
B1026-65	64K Bytes	610	27,000	35
B1026-81	80K Bytes	935	42,190	47
B1026-98	96K Bytes	1,285.	57,380	60
	Main Memory Options for B1728			
B1028-81	80K bytes	250	11,000	12
-98	96K bytes	450	19,800	25
-114	112K bytes	650	28,600	37
-131	128K bytes	850	37,400	49
-147	144K bytes	1,050	46,200	61
-163	160K bytes	1,250	55,000	73
-180	176K bytes	1,450	63,800	85
-196	192K bytes	1,650	72,600	97
-212	208K bytes	1,850	81,400	109
-229	224K bytes	2,050	90,200	121
-245	240K bytes	2,250	99,000	133
-262	256K bytes	2,450	107,800	145
	MASS STORAGE			
	Discs			
	Disc Cartridge Drives (70-msec avg seek time; 20-msec avg latency; 90-msec avg data access time)			
B9480-1	Single-Cartridge Drive (2.3-mb)	250	10,000	31
B9480-2	Dual-Cartridge Drive (4.6-mb)	365	15,450	53
B9481-1	Single-Cartridge Drive (4.6-mb)	310	13,200	47
B9481-2	Dual-Cartridge Drive (9.2-mb)	480	21,600	72
B1480	Control (for B9480)	97	4,665	15
B1481	Control (for B9481)	97	4,665	15
B9985-2	Disk Cartridge (for B9480) (purchase only)	8	170	NA
B9985-3	Disk Cartridge (for B9481) (purchase only)	8	225	NA
	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	129
B1486	Control (for B9486-2)	950	45,600	108
B9974-1	Disk Pack (for B9486-2)	25	575	NC
B9974-4	Disk Pack, certified at 200 tpi for B9484-4, 9485-4, and 9486-4	30	690	NA
B1484-4	Disk 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
	Head-per-Track Memory Banks (incl 1 EU)			
B9371-7	Storage (7-mb, 20-msec)	600	28,800	215
B9371-14	Storage (14-mb, 40-msec)	750	36,000	210
	Head-per-Track Memory Bank Add-On Units			
B9374-10	Storage (14-mb, 40-msec)	550	26,400	94
B9374-17	Storage (7-mb, 20-msec)	400	19,200	115
B1374	Control (for Head-per-Track Memory Banks)	200	9,600	12
B1674-1	1x2 Disk File Adapter	45	1,980	7
B1764-2	2x2 Disk File Exchange	40	1,760	5
	INPUT/OUTPUT			
	Punched Cards			
	Card Readers (80-col)			
B9111	800-cpm	350	17,550	90
B9112	1,400-cpm	450	23,600	126
B9115	300-cpm	110	4,500	25
B9116	600-cpm	195	6,500	35
	800-cpm	250	9,000	43
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	5
B9919	40-Column Read Switch (for B9111 and B9112)	—	—	—
B9119-1	Card Readers (96-col; 300-cpm)	85	3,500	25
B1119	Control (for B9119-1)	48	2,332	7
B9210-1	Card Punch (80-col; 100-cpm)	250	12,000	70
B1210	Control (for B9210-1)	90	4,320	14
B9213	Card Punch (300-cpm, 80-col)	530	25,440	145
B1213	Control (for B9213)	90	4,320	90
B9319-2	Card Reader/Punches (96-col) (Reads 300 cpm; punches/prints 60 cpm)	200	7,990	60

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	BURROUGHS B 1726 and B 1728 SYSTEMS (Contd.)			
B9319-4	(Reads 500 cpm; punches/prints 120 cpm)	310	11,190	91
B1319	Control (for B9319)	75	3,628	11
B9419-2	Card Reader/Punch/Data Recorder (reads 300 cpm; prints/punches 60 cpm; keyboard; 96-col)	240	9,490	71
B9419-6	Multipurpose Card Unit (reads 300 cpm; prints/punches 60 cpm; keyboard; 96-col)	285	11,390	85
B1419	Control (for B9419)	75	2,332	11
	Printers			
B9240-1	475-lpm (132 PP)	475	19,500	189
B9240-2	700-lpm (132 PP)	625	31,000	195
B9240-3	1,040-lpm (132 PP)	900	43,500	211
B9247-2	400-lpm (120 PP)	460	19,500	100
B9247-3	750-lpm (132 PP)	750	35,000	148
B1240	Control (for B9240-1, 2, or 3)	60	2,880	9
B1247	Control (for B9247 Printers)	90	4,320	14
B9942-2	Additional 12 Print Positions for B9247-2/3	40	2,000	11
B9942-9	Additional Train Module for B9247-2/3	65	3,500	18
B9949-2	12-Channel Format Tape Reader (for B9247 series printers)	61	3,050	15
	Magnetic Tapes			
B9381-12	18-Kb Cluster (2-station; NRZ; 9-channel; 800-bpi)	525	25,200	179
B9381-13	18-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	570	26,960	200
B9381-14	18-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	680	32,160	241
B9381-22	36-Kb Cluster (2-station; NRZ; 9-channel; 800-bpi)	700	33,600	205
B9381-23	36-Kb Cluster (3-station; NRZ; 9-channel; 800-bpi)	900	43,200	236
B9381-24	36-Kb Cluster (4-station; NRZ; 9-channel; 800-bpi)	1,100	52,800	267
B9390	18/50-Kc Mag Tape Unit (7-channel; 200/556-bpi)	330	15,860	149
B9391	18-50-72-Kc Mag Tape Unit (7-channel; 200/556/800 bpi)	375	18,000	169
B9394-2	96-Kb Mag Tape Unit (9-channel; 800-bpi)	425	20,400	174
B9496-2	40-Kb Mag Tape Unit (9-channel; 1,600 bpi)	270	12,800	65
B9496-4	80-Kb Mag Tape Unit (9-channel; 1,600-bpi)	320	15,300	69
B9495-2	120-Kb Mag Tape Unit (9-channel; 1,600-bpi)	400	16,650	74
B9491-2	10-Kb 9-Channel Tape Unit	215	8,600	21
B1381	Tape Cluster Control	250	6,960	38
B1390	18/50-Kc 7-Channel Tape Control	250	6,960	38
B1491	10-Kb Tape Control	216	10,368	30
B1394-2	9-Channel Tape Control	300	12,300	40
B1496-4	Single Control for B9496 Series	325	15,740	53
B1495-2	Single Control for B9495 Series	460	19,130	53
B9499-30	1x4 Master Electronics Exchange (for B9496 Series only)	125	5,500	20
B9499-32	2x8 Master Electronics Exchange (for B9496 Series only)	300	13,200	43
B9499-31	1x8 Master Electronics Exchange (for B9496 Series only)	200	8,800	20
B9499-10	1x4 Master Electronics Exchange (for B9495 Series only)	125	5,500	20
B9499-11	1x8 Master Electronics Exchange (for B9495 Series only)	200	8,800	20
	Sorters			
	Reader Sorters			
B9131-1	13-Pocket (1,000 doc/min)	1,200	57,600	486
B9134-1	4-Pocket (1,625 doc/min; requires B9938-1)	1,025	49,200	351
B9135-2	8-Pocket (900 doc/min, E13B; off-line sorting)	1,000	45,500	431
B9135-3	12-Pocket (900 doc/min, E13B; off-line sorting)	1,300	55,900	467
B9136-5	8-Pocket (600 doc/min; E13-B; off-line sorting)	700	34,000	225
B9136-6	12-Pocket (600 doc/min; E13-B; off-line sorting)	850	39,000	270
	For 9131-1			
B1131	Control	150	6,480	23
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	54
B9934	Start/Stop Bar (B9131)	7	275	NC
B9935	Special Field Ending	10	450	NC
B9935-4	Canadian Check Feature (B9131)	NA	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	30
B9930-3	Mobile Carrier	NA	150	NC
B9930-4	One-Tray Document Rack	NA	60	NC
B9932-1	Endorser	200	9,000	54
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	5
B9933-2	Two-Field 8-Pocket Off-Line Sort	30	1,440	5
B9933-3	One-Field Expanded Off-Line Sort (max 8)	5	240	NC
B9933-4	Extended Sort Control	50	2,400	16
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	38
B9936-1	Stacker Overflow	10	480	1
B9937-1	Valid Character Check	5	240	1
B9938-1	Multitrack E13-B Read	375	18,000	59
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	200	6,480	30
	For B9136-5/6			
B1136	Control	150	6,480	23
B9931-3	Extended Sort Control	NA	NA	NA
B9931-4	51-Column Card Read	NA	NA	NA
B9931-5	Valid Character Check Option	NA	NA	NA
	DATA COMMUNICATIONS			
B1351	Single Line Control	50	2,000	8
B1352	Multiline Controller (8 lines)	200	13,000	28
B1353	Multiline Controller Extension (8 lines; B1728-1 only)	150	6,750	21
	Line Adapters			
B1650-1	Asynch Data Set Connect (up to 1,200 bps)	50	1,500	8
B1650-2	Asynch Data Set Connect (up to 1,800 bps)	65	1,800	10
B1650-5	Asynch Direct Connect (up to 2,400 bps)	50	1,500	8
B1650-6	Asynch Direct Connect (up to 4,800 bps)	65	1,800	10
B1650-7	Asynch Direct Connect (up to 9,600 bps)	80	2,100	12
B1651-1	Synch Data Set Connect (up to 2,400)	50	1,500	8
B1651-2	Synch Data Set Connect (up to 4,800)	65	1,800	10
B1651-3	Synch Data Set Connect (up to 9,600)	80	2,100	12
B1652-1	TTY Asynch Data Set Connect	50	1,500	8
B1652-5	TTY Asynch Direct Connect	50	1,500	8
B1653-1	Binary Synch Data Set Connect (up to 2,400 bps)	200	8,800	32
B1653-2	Binary Synch Data Set Connect (up to 4,800 bps)	225	9,900	34
B1653-3	Binary Synch Data Set Connect (up to 9,600 bps)	250	11,000	36
	CASCADE DATA CONCEPT II SERIES			
	BASIC CONFIGURATIONS			
	Tape Systems			
3010	Computer System (16K)	—	27,500	188
3011	Computer System (16K with matrix printer)	—	33,500	258
	Disc Systems			
4010	Computer System (16K; 5M disc)	—	38,500	220
4011	Computer System (16K; 5M disc)	—	39,900	286

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	CASCADE DATA CONCEPT II SERIES (Contd.)			
4020-C	Computer System (24K; 1 1,280-char CRT)	—	48,500	280
4021-C	Computer System (same as 4020-C but with larger console printer)	—	49,900	345
4030-M	Multi-Programming System (32K; 1 1,290-char CRT)	—	53,000	301

Note:

Rental arrangements are not available. Maintenance prices are based on the average use of 175 hours per month.

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	CODON CB100			
	CENTRAL PROCESSOR AND WORKING STORAGE			
CB100	Basic System (with 10-cps console printer; 1 video data terminal; 24K-char core; 1 dual disc drive — 6.4 MM char, and standard software)	1,010	47,360	243
	MASS STORAGE			
	Discs			
DSK 2	Addt'l Disc Drives (6.4-mm char ea)	NA	NA	NA
	INPUT/OUTPUT			
	Magnetic Tape			
CM800	Magnetic Tape (800-bpi; 7/9-trk)	NA	NA	NA
	Printers			
CB101	Printer (350-lpm; 80-col)	NA	NA	NA
CB102	Printer (250-lpm; 132-col)	NA	NA	NA
CB105	Printer (165-cps; 132-col)	NA	NA	NA
	DATA COMMUNICATIONS			
CB302	Video Data Terminal (with 64 x 20 screen; audio error alert and 10-key pad)	NA	NA	NA
CB302R	CB302 (with telephone interface for remote operation)	NA	NA	NA
CM2035	Bi-Sync Communication Adapter	NA	NA	NA

Note:

Sold in tailored basic configurations only. Monthly rental is based on 5-year lease.

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NA Not Available

— Not Applicable

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	DIGITAL EQUIPMENT, DEC DATA-SYSTEMS			
	CENTRAL PROCESSOR & WORKING STORAGE			
Series 300, Model 320	PDP-8 Processor; 4 DECtape Drives; 1 CRT keyboard; one 60-lpm line printer; and COS 300 Operating System	942 (5-yr lease)	29,035	333
Series 300, Model 330	PDP-8 Processor; 1 RK05 Disc Cartridge; 2 DECtape Drives; 1 CRT keyboard; one 60-lpm line printer; and COS 300 Operating System	1,060 (5-yr lease)	32,585	375
Series 300, Model 340	PDP-8 Processor; 2 RK05 Disc Cartridges; 1 CRT keyboard; one 60-lpm line printer; and COS 300 Operating System	1,090 (5-yr lease)	32,685	403
Series 500	In this series, the model number is based on the model of the PDP-11 computer used; for example, Model 520 priced here uses PDP-11/20, and another model such as Model 540 would use the PDP-11/40 processor			
Model 520	PDP-11/20 Processor; 1 CRT keyboard; 1 card reader; one 60-lpm line printer; 2 RK05 Disc Cartridges; and COS 500 Operating System.	1,530 (5-yr lease)	52,528	430
	MASS STORAGE			
	Discs			
RK05-AA	DECpack Disc Cartridge		5,100	
RP03-AS	Fixed-Head (time-sharing) Disc Drive		20,000	
	INPUT/OUTPUT			
	Punched Cards			
CRF-8	Punched Card Reader		4,500	
CR11	Punched Card Reader		4,500	50
	Paper Tapes			
PC8-E	Paper Tape Reader/Punch		3,900	30
PC11	Paper Tape Reader/Punch		3,900	30
	Printers			
LS8-EA	Line Printer with Control		5,200	
LE8-JA	Line Printer with Control		17,500	75
LS11-A	Line Printer with Control		5,200	
LP11-JA	Line Printer with Control		17,500	
	Magnetic Tapes			
TD8-EM	Dual DECtape Drive (including controller)		5,000	
TU56/TC11	Dual DECtape Drive (including controller)		8,700	
TU10-EE	DEC MAGtape Drive (9-track industry-compatible drive; 800 bpi)		6,950	70
TU10-FE	DEC MAGtape Drive (7-track industry-compatible drive; 800/556/200 bpi)		6,950	70
	Terminals			
VT05-B	CRT Keyboard Terminal		2,795	35
LA80	DECwriter Data Terminal (teletype)		2,795	30
	DATA COMMUNICATIONS			
LT33-DC	ASR33 Synch Terminal (Teletype) (hard copy terminal with paper-tape reader/punch)		1,620	

Notes:

Prices are given for the Model 520 configuration with the COS 500 Operating System, which is intended for batch processing. Prices will vary according to the processor, the peripherals, and the operating system selected. CTS 500 is a time-sharing operating system, and CDMS is a commercial data management system.

Services provided with purchase include installation of hardware and software, and training courses, but do not include maintenance.

Lease prices include maintenance.

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	ELDORADO ELECTRODATA MODEL 140			
	CENTRAL PROCESSOR & WORKING STORAGE			
140	Basic Processor (8K memory; 3 read/write cassette drives; selectric typewriter with forms tractor)	–	18,750	109
	Memory (4-61K)	–	2,000	12
	MASS STORAGE			
	Discs			
	Disc Controller (up to 4 disc drives)	–	1,450	80
	Moving Head Disc (5 mb)	–	12,000	70
	INPUT/OUTPUT			
	Magnetic Tapes			
	IBM-Compatible Magnetic Tape Controller (7- or 9-track)	–	2,000	12
	IBM-Compatible Magnetic Tape Transport (7- or 9-track; 7-in. reels)	–	4,600	27
	IBM-Compatible Magnetic Tape Transport (7- or 9-track; 10-1/2-in. reels)	–	6,100	36
	Punched Card			
	Card Reader and Controller (300 cpm)	–	3,300	19
	Printers			
	Line Printer and Controller (132 cols; 60 lpm)	–	4,300	25
	Line Printer and Controller (132 cols; 135 lpm)	–	6,750	39
	Line Printer and Controller (132 cols; 600 lpm)	–	14,200	83
	10-Key Auxiliary Keyboard and Interface	–	800	5

Note:

Leases available through leasing firms, but not from manufacturer.

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Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	HONEYWELL SERIES 50, MODEL 58			
	CENTRAL PROCESSOR & WORKING STORAGE			
58MOD1	Central System (5,000-byte processor; keyboard; 100-cpm card reader; 100-lpm, 96-column printer; 10-position visual display)	842	31,620	181
58MOD2	Central System (5,000-byte central processor, keyboard, 100-cpm card reader, 10-position visual display)	600	23,210	135
	Processor Options			
AMK050	Additional 5,000 bytes of memory	207	7,900	45
CRK051	300-cpm Option for Card Reader (CRS050 prereq.)	82	3,265	18
CRS050	200-cpm Option (for card reader)	164	6,530	43
OMR050	Optical Mark Reading Option (for card reader)	63	2,370	14
PMK051	128-Column Option (for printer)	42	1,585	10
PMK053	200-lpm Option (for printer)	114	4,350	26
PSC100	Manual Switch Console (includes 1 PSU100)	165	6,480	29
PSU100	Manual Switch (for switching 2 peripheral controls to same central processor)	42	1,632	6
PSC101	Manual Switch Console (includes 1 PSU101)	165	6,480	29
PSU101	Manual Switch (for switching 1 peripheral control between 2 central processors)	42	1,632	6
	MASS STORAGE			
	Discs			
DSS058	Disc Storage Subsystem (3.46 mb)	494	26,440	188
ADS158	Additional Disc Storage (2.3 mb)	133	3,430	22
ADS258	Additional Disc Storage (5.76 mb)	239	6,120	32
ADS358	Additional Disc Storage (5.76 mb)	415	17,510	94
ADS458	Additional Disc Storage (5.76 mb)	415	17,510	94

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Discs (Cont.)			
EMS050	Extended Memory Store (initial 8,000 bytes; AMK050 prereq)	225	8,980	40
EMS051	Extended Memory Store (additional 8,000 bytes; AMK050 and EMS050 prereqs. Up to 7 EMS051s may be installed)	143	5,720	30
	INPUT/OUTPUT			
	Punched Cards			
CPA050	Card Punch (40 cps)	104	3,950	26
PCP050	Print Option (for CPA050)	31	1,185	6
SLC055	Single-Line Communications Controller	227	8,700	49
PLF055	Polling/Selection Mode (for SLC055)	62	2,450	14
CS100	Off-Line Card Sorter	83	3,960	26
P112	Off-Line Keypunch	114	4,235	46
	Printers			
PRT065	Printer (100 lpm; 96 col)	234	9,050	46
PRT112	Printer (300 lpm; 132 col)	645	25,710	200
PMK054	450-lpm Option for PRT112	153	6,120	38
PMK055	650-lpm Option for PRT112 (prereq PMK054)	210	8,370	48
	DATA COMMUNICATIONS			
SLC058	Single-Line Communications Controller (2000/2400/4800 baud)	225	8,980	40
MLC050	Multiline Communications Controller	306	12,240	60
SCU050	Supplemental Channel Unit for second, third, and fourth terminals	33	1,310	6
RCA050	Direct Connect Adapter for Loop-back Current Interface (1 required per terminal)	20	820	7
RCA052	Direct or Remote Connections Adapter for EIA RS232C Interface (1 required per modem and/or interface)	41	1,635	13

Note:

All rental prices quoted are based upon a 3-year base. One- and 5-year leases are available.
All monthly rental prices include maintenance.

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HONEYWELL SERIES 100, MODEL 15

CENTRAL PROCESSOR & WORKING STORAGE

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
1M156D	16K Processor (minimum configuration also requires DSS164 Disc Subsystem, and Series 100 printer)	1,995	79,590	287
1M156F	24K Processor	2,260	92,190	325
1M156H	32K Processor	2,570	104,790	362
1M156L	48K Processor (MSOP15 required)	3,600	146,790	443
1M156P	64K Processor (MSOP15 required)	4,220	171,990	524
	Processor Options			
MSOP115	CPU Upgrade (required for 1M156L and 1M156P)	217	8,820	34
	MASS STORAGE			
	Discs			
DSS164	Disc Storage Subsystem (5.7 mb) (2 disc pack drives)	630	29,280	221
ADS164	Capacity Upgrade (for DSS164) (5.7 mb)	239	6,000	34
ADU164	Additional Disc Pack Drives for DSS164 (11.4 mb)	670	28,600	167
DSC130	Disc Control (up to 5 drives)	309	13,055	32
DSU130	Disc Drives (2.98 mc)	284	10,705	59
DSS161	Disc Storage Subsystem (15.36 mc)	1,680	48,360	208
DSU160	Additional Disc Pack (for DSS160) (7.68 mc; up to 6 can be added to DSS161)	640	15,780	84

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	INPUT/OUTPUT			
	Magnetic Tapes			
MTS163	Magnetic Tape Subsystem (control and 1 tape unit; add up to 7 units; 9 tracks, 30 kc/sec)	825	34,416	94
OPT183	200/556/800 bpi Recording Densities	207	8,832	18
MTS166	Magnetic Tape Subsystem (control and 1 tape unit; add up to 7 units; 9-track, 60 kc/sec)	1,240	51,744	138
OPT186	200/556/800 bpi Recording Densities	207	8,832	18
	Punched Cards			
CRZ100	Card Reader and Control (300 cpm)	156	5,760	34
CRZ111	Card Reader and Control (400 cpm; includes 2 stackers)	237	8,880	51
CRZ120	Card Reader and Control (600 cpm; includes 2 stackers)	284	10,320	69
CPZ101	Card Punch and Control (200 cpm)	324	11,670	81
CPZ103	Card Punch and Control (300 cpm)	625	22,420	156
CRP100	Card Reader/Punch and Control (300/300 cpm; includes 3 stackers)	605	21,510	161
OPT024	51-Column Adapter (for CRZ111)	54	2,016	9
OPT025	51-Column Adapter (for CRZ120)	37	1,300	9
CSO600	Card Reader Upgrade (to 600 cpm)	48	1,440	17
	Paper Tapes			
PTR100	Paper Tape Reader (500 cps)	124	4,520	30
PTP110	Paper Tape Punch (60 cps)	114	4,080	29
CTW101	Console Typewriter with Paper Tape Reader/Punch	255	10,500	48
	Printers			
PRT100	Printer and Control (300 lpm; 104 pp)	430	15,120	114
OPT075	Extension of Print Positions to 120	37	1,300	9
OPT076	Extension of Print Positions to 136	73	2,545	19
OPT080	Fast Skip (63 ips)	73	2,545	19
PRT110	Printer and Control (600 lpm; 104 pp)	625	22,080	177
OPT077	Extension of Print Positions to 120	47	1,635	13
OPT078	Extension of Print Positions to 136	92	3,270	26
OPT079	Fast Skip (63 ips)	73	2,545	19
PRT120	Printer and Control (780 lpm; 120 pp)	930	32,835	244
OPT085	Extension of Print Positions to 136	104	3,650	28
OPT086	Fast Skip	73	2,545	19
PRT130	Printer and Control (1,100 lpm; 120 pp; fast skip)	1,135	40,175	296
OPT087	Extension of Print Positions to 136	104	3,650	28
MRS101	MICR Reader-Sorter	1,240	43,800	297
	DATA COMMUNICATIONS			
SLC100	Datanet 10 Single-Line Communications Controller (half-duplex; synch; up to 2,400 bps; ASCII code)	217	9,320	18
SLC102	Datanet 12 Single-Line Communications Controller (half-duplex; synch; up to 50,000 bps; ASCII code)	309	12,100	55
SLC111	Single-Line Communications Controller (half-duplex; asynch; up to 1,200 bps; ASCII code)	217	8,592	35
SLC112	Single-Line Communications Controller (half-duplex; synch; up to 150,000 bps; ASCII code)	309	12,288	50
SLC113	Single-Line Communications Controller (half-duplex; synch; up to 2,400 bps; ASCII code)	217	8,592	35
SLC114	Single-Line Communications Controller (half-duplex; synch; up to 150,000 bps; ASCII code)	217	8,592	35
SLC115	Single-Line Communications Controller (half-duplex; synch; up to 2,400 bps; excess 3 code)	217	8,592	35
	Manual Peripheral Switches			
PSC100	Manual Switch Console (includes one PSU100)	165	6,480	29
PSC101	Manual Switch Console (includes one PSU101)	165	6,480	29

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Manual Peripheral Switches (Cont.)			
PSU100	Manual Switch (for switching 2 peripheral controls to same CPU)	42	1,632	6
PSU101	Manual Switch (for switching 1 peripheral control between 2 CPUs)	42	1,632	6

Note:

All monthly rental prices include maintenance and are based upon a 3-year lease. One- and 5-year leases are available.

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HONEYWELL SERIES 200 MODELS 105 AND 115

CENTRAL PROCESSOR & WORKING STORAGE

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
105	Central Processing Unit			
106-1	(16K; power supply; control panel)	550	27,170	83
106-2	(24K; power supply; control panel)	1,025	46,560	154
106-3	(32K; power supply; control panel)	1,440	60,060	216
1014	8-Bit Code Handling Instruction	28	1,250	3
1019-1	Simultaneous Use of Third R/W Channel	70	3,025	11
115	Central Processing Unit			
116-1	(16K; power supply; control panel)	1,110	50,020	168
116-2	(24K; power supply; control panel)	1,415	63,985	215
116-3	(32K; power supply; control panel)	1,725	77,905	262
1014	8-Bit Code Handling Instruction	28	1,250	3
1019	Simultaneity for Third R/W Channel	129	5,810	13
1044	Direct Transcription	65	2,250	6
	Processor Options			
212-1	Central Processor Adapter (for connection of any 2 Series 200 processors)	444	18,000	48
212-2	Central Processor Memory-to-Memory Transfer Unit	444	18,000	48
213-3	Interval Timer	97	3,600	11
017	Interval Selector	60	2,250	6
213-4	Time-of-Day Clock	220	9,000	26
220-1	(with printer)	220	9,000	26
220-3	(replaces control panel on 105/115)	337	13,500	38
008	Pin-Feed Drive	28	1,125	6

MASS STORAGE

Discs

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Disc Storage for Model 105			
170-2	Disc Storage Subsystem	494	20,460	151
173-2	Disc Storage Subsystem (18.4M char)	705	29,165	188
070	Direct Access Time Speedup	43	1,760	5
173	Disc Pack Drive (for 173-2; 9.2M char)	352	14,585	94
	Disc Storage for Model 115			
157C	Disc Control (for 155 Disc Pack Drive)	276	11,700	32
257C	Disc Control (for 155 Disc Pack Drive)	319	13,500	38
155	Disc Pack Drive (3.6M char)	381	14,910	69
171	Disc Pack Drive (4.6M char)	329	12,875	75
172	Disc Pack Drive (9.2M char)	470	21,220	81
276-2	Disc Storage Subsystem (74.8M char)	1,490	67,200	271
074	Write Protect	21	900	4
076	Dynamic Disc Addressing	27	1,050	3
079	Central Processing Finished (for 172 and 276-2)	33	1,350	6
276	Disc Pack Drive (for 276-2; 37.4M char)	510	23,040	98

INPUT/OUTPUT

Magnetic Tapes

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Magnetic Tape for Model 115 Only			
103A	Tape Control (includes one 204B-13)	540	21,490	87
103F	Tape Control (includes one 204B-21; controls up to four 204B-21 and 22 units)	790	31,080	118

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Magnetic Tapes (Cont.)			
203B-1	Tape Control (up to eight 204B-1, -2, -3, -4 units)	471	18,360	51
203B-2	Tape Control (up to eight 204B-5 units; no interrupt)	471	18,360	51
203B-2A	Tape Control (up to eight 204B-5 units)	471	18,360	51
293B-4	Tape Control (up to eight 204B-7, -8 units)	471	18,360	51
203B-6 and 203B-6A	Tape Control (up to eight 204B-9 units)	471	18,360	51
203D-1	Tape Control (up to eight 204D-1 units)	750	29,400	84
203D-3	Tape Control (up to eight 204D-3 units)	855	33,600	96
050	IBM Format Feature (for type 203B)	60	2,250	6
051	IBM Code Compatibility Feature (for type 203B)	60	2,250	6
052	IBM 7-Channel Tape (for type 203D)	160	5,500	16
056	Dynamic Tape Addressing	27	1,050	2
059	Density Switch (for 203D, 103F)	21	670	2
1052	EBCDIC Code Translator (for type 203D)	107	4,100	11
1055	IBM Magnetic Tape Compatibility (for type 103F)	60	2,160	6
204B-1	Magnetic Tape Unit (200/556 bpi)	394	15,120	89
204B-2	Magnetic Tape Unit (200/556 bpi)	340	12,960	75
204B-3	Magnetic Tape Unit (200/556 bpi)	555	21,600	126
204B-4	Magnetic Tape Unit (200/556 bpi)	505	19,440	114
204B-5	Magnetic Tape Unit (200/556 bpi)	785	30,240	176
204B-7*	Magnetic Tape Unit (556/800/1,200 bpi)	447	17,280	100
055	Recording Density (1,200 bpi)	55	2,100	6
204B-8*	Magnetic Tape Unit (556/800 bpi)	670	25,920	151
204B-9*	Magnetic Tape Unit (556/800/1,200 bpi)	890	34,560	200
054	Recording Density (1,200 bpi)	27	1,300	2
204B-14	Magnetic Tape Unit (556/800 bpi)	296	12,175	69
204B-22	Magnetic Tape Unit (220/556 bpi)	340	12,800	86
204D-1	Magnetic Tape Unit (800/1,600 bpi)	410	15,960	91
204D-3	Magnetic Tape Unit (800/1,600 bpi)	595	23,100	131
	Punched Cards			
123	Card Reader (400 cpm)	217	9,000	62
1043	Adapter (51 col)	33	1,125	8
214-1	Card Punch (100-400 cpm)	378	14,700	108
214-2	Card Reader/Punch (400 cpm reading; 100-400 cpm punching)	432	16,800	125
	Punched Card for Model 115 Only			
123-2	Card Reader (600 cpm)	276	11,475	82
123-4	Card Reader (1,050 cpm)	373	14,490	108
223	Card Reader and Control (800 cpm)	341	13,500	92
223-2	Card Reader and Control (1,050 cpm)	390	15,120	113
043	Adapter (51 col)	49	1,800	6
044	Direct Transcription	33	1,125	5
045	90-Column Card Reading Capability (for 223)	134	5,025	18
	Paper Tapes			
209-2	Paper Tape Reader and Control (600 frames/sec)	365	14,625	43
210	Paper Tape Punch and Control (120 frames/sec)	251	10,125	34
1021	NCR-Type Reel Hubs	NC	NC	NC
1022	NAB-Type Reel Hubs	NC	NC	NC
	Printers			
	Printer for Model 105			
112	Printer (300 lpm)	487	20,250	149
1032	Extension of Print Positions from 120 to 132	60	2,250	15
112-3	Printer (650 lpm; 1019-1 req'd)	905	35,070	244
1037	Extension of Print Positions from 120 to 132	60	2,250	15
	Printers for Model 115			
122-3	Printer (650 lpm; 120 print positions)	905	35,070	244
122-4	Printer (950 lpm; 120 print positions)	1,190	46,200	286
122-6	Printer (1,100 lpm; 120 print positions)	1,325	51,660	299
1034	Extension of print positions from 120 to 132	60	2,250	15
222-3	Printer and Control (650 lpm; 120 print positions)	1,005	40,500	271

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Printers (Cont.)			
222-4	Printer and Control (950 lpm; 120 print positions)	1,420	57,375	384
222-6	Printer and Control (1,100 lpm; 120 print positions)	1,505	60,975	393
222-7	Printer and Control (300 lpm; 120 print positions)	645	25,410	185
032	Extension of Print Positions from 120 to 132 (for 222-3, -4, and -6)	109	4,500	30
034	Numeric Print (for 222-3)	139	5,625	15
035	Numeric Print (for 222-4)	33	1,125	4
036	Print Buffer (for 222-3, -4, -6 and -7)	236	9,100	34
1032	Extension of Print Positions from 120 to 132 (for 222-7)	60	2,250	15
1033	8-Channel Format Tape (for 222-7)	33	1,125	4
	Optical Document Readers			
243	Optical Document Reader and Control	1,700	67,200	464
042	Optical Mark Read	319	12,600	87
	MICR			
	MICR for Model 115			
232	MICR Reader-Sorter and Control	1,350	56,250	324
236-1	MICR Control (for 236)	345	14,950	32
236	MICR Reader-Sorter (16 pockets; 1,625 doc/min)	2,230	96,600	564
236-2	Multilevel E13B Recognition	446	19,320	72
236-3	Endorser	234	10,120	65
236-4	Expansion Unit (16 additional pockets)	117	5,060	13
236-5	Expansion Module (4 additional pockets)	350	15,180	47
236-6	Mobile Carrier	NC	175	NC
236-7	Short Document Read Capability	16	690	2
236-8	Short Document Module Expansion	10	460	2
236-9	Batch Ticket Detector	16	690	2
236-10	Resettable Item Counter	10	460	2
236-11	Basic Off-Line Sort	37	1,610	6
236-12	Expanded Off-Line Field Sort	10	460	2
236-13	Digit Override	16	690	2
236-14	Digit Edit	16	690	2
236-15	Zero Kill	16	690	2
236-16	Field Override	16	690	2
236-17	Field Edit	16	690	2
236-18	No Field/No Digit Outsort	16	690	2
236-19	Stacket Overflow	16	690	2
236-20	Valid Character Check	10	460	2
236-21	Extended Sort Control	64	2,760	20
	DATA COMMUNICATIONS			
	Single Channel Communication Controls			
281-1A	W.U. Telex	167	6,750	28
281-1B	TWX CE (8-level teletypewriter)	167	6,750	28
281-1C	5-Level Teletypewriter	167	6,750	28
281-1D	8-Level Teletypewriter	167	6,750	28
281-1E	TWX CE (IBM 1050)	167	6,750	28
281-1H	Voice Lines (for DATA SPEED 2)	167	6,750	28
1061	Interface (for VIP 765)	NC	NC	NC
1062	Interface (for VIP 775 and 785)	NC	NC	NC
281-1K	W.U. 180 Baud (IBM 1050)	167	6,750	28
281-1KTP	KEYTAPE/Communicator (private; 115 only)	167	6,750	28
281-1KTS	KEYTAPE/Communicator (network; 115 only)	167	6,750	28
281-1R	VIP Series Displays, Asynch	220	8,930	38
281-1TC	Burroughs TC-500	220	8,930	38
281-2B	Voice Lines	204	8,100	33
281-2BSC	IBM Binary Synch Communications Device	253	10,125	43
1060	Extended Speed (281-2B)	53	2,055	14
1061	Interface (for VIP 765, 281-2B)	NC	NC	NC
1062	Interface (for VIP 775 and 785, 281-2B)	NC	NC	NC
1070	2,000 bps (281-2B, -2BSC)	NC	NC	NC
1071	2,400 bps (281-2B, -2BSC)	NC	NC	NC
1072	3,600 bps (281-2B, -2BSC)	21	840	9
1073	4,800 bps (281-2B, -2BSC)	21	840	9

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	DATA COMMUNICATIONS (Cont.)			
1074	5,400 bps (281-2B, -2BSC)	21	840	9
1075	7,200 bps (281-2B, -2BSC)	21	840	9
1076	9,600 bps (281-2B, -2BSC)	21	840	9
281-2D	Voice Lines (IBM 7702, 1013)	253	10,125	43
281-2F	Telpak A	253	10,125	43
281-2R	VIP Series Displays, Synch	269	10,765	45
281-137P	150 Baud (8-level Teletypewriter)	167	6,750	28
281-137S	Voice Lines (8-level Teletypewriter)	167	6,750	28
	Multi-Channel Communications Controls for Model 115			
286-1	MCCC (for 2 to 3 lines)	237	9,450	41
286-2	MCCC (for 4 to 15 lines)	354	14,400	60
286-3	MCCC (for 16 to 63 lines)	446	18,000	75
086	Parity Check and Generation	60	2,250	10
087	Long Check	60	2,250	10
286-4	Message-Mode MCCC (for 2 to 32 half-duplex lines)	885	34,000	149
286-5	Message-Mode MCCC (for 33 to 63 half-duplex lines)	1,275	51,750	224
285-1A	W.U. Telex	38	1,350	8
285-1B	TWX CE (8-level Teletypewriter)	49	1,800	9
285-1C	5-Level Teletypewriter	38	1,350	8
285-1D	8-Level Teletypewriter	49	1,800	9
285-1E	TWX CE (IBM 1050)	49	1,800	9
285-1H	Voice Lines (for DATA SPEED 2, VIP 765)	49	1,800	9
285-1K	W.U. 180 Baud (IBM 1050)	49	1,800	9
285-1KTP	KEYTAPE/Communicator (private lines)	49	1,800	9
285-1KTS	KEYTAPE/Communicator (switched network)	49	1,800	9
285-1M	Data Station (288-1 central control station)	49	1,800	9
285-1N	100 wpm ASCII TWX Service	49	1,800	9
285-1PD	Teller Terminal (Direct)	102	3,930	16
285-1PM	Teller Terminal (Remote)	86	3,130	14
285-1R	VIP Series Displays, Asynchronous	102	3,895	16
285-1TC	Burroughs TC-500	102	3,895	16
285-2B	Voice Lines	76	2,700	12
285-2BSC	IBM Binary Synchronous Communications Device	124	4,500	18
1060	Extended Speed (285-2B only)	53	2,055	14
1061	Interface (for VIP 765; 285-2B only)	NC	NC	NC
1062	Interface (for VIP 775 and 785; 285-2B only)	NC	NC	NC
1070	2,000 bps (285-2B, -2BSC)	NC	NC	NC
1071	2,400 bps (285-2B, -2BSC)	NC	NC	NC
1072	3,600 bps (285-2B, -2BSC)	21	840	9
1073	4,800 bps (285-2B, -2BSC)	21	840	9
1074	5,400 bps (285-2B, -2BSC)	21	840	9
1075	7,200 bps (285-2B, -2BSC)	21	840	9
1076	9,600 bps (285-2B, -2BSC)	21	840	9
285-2D	Voice Lines (IBM 7702, 1013)	124	4,500	18
285-2R	VIP Series Displays, Synch	140	5,270	24
285-3A	Voice Lines DATA SPEED 5	97	3,600	15
285-4A	Voice Lines DATA SPEED 5	97	3,600	15
285-5A	Switched Circuits Auto Dialing	49	1,800	9
285-137P	150 Baud (8-level teletypewriter)	49	1,800	9
285-137S	Voice Lines (8-level teletypewriter)	49	1,800	9
285-8	Audio Response System for Model 115 Audio Response Adapter (6 lines)	439	16,875	49
082-1	Tone Answer Back Option (2 lines)	21	675	2
082-2	Voice Answer Back Option (2 lines)	21	675	2
083-1	Voice Cylinders (31 elements; phrases only)	(1)	2,050	–
083-2	Voice Cylinders (31 elements; words and phrases, or words only)	–	2,550	–
083-3	Voice Cylinders (63 elements; phrases only)	–	3,200	–
083-4	Voice Cylinders (63 elements; words and phrases, or words only)	–	3,600	–
083-5	Voice Cylinders (189 elements; words only)	–	3,600	–
285-8A	Audio Response Expansion (2 lines)	102	3,825	11
285-8C	Audio Unit (31 elements; 6 lines)	645	24,750	71
285-8D	2-Line Expansion (31 elements)	38	1,350	5
285-8F	Audio Unit (63 elements; 6 lines)	845	32,625	91
285-8G	2-Line Expansion (63 elements)	49	1,800	5

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	DATA COMMUNICATIONS (Cont.)			
285-8J	Audio Unit (189 elements; 6 lines)	1,340	51,750	146
285-8K	2-Line Expansion (189 elements)	55	2,050	5

Notes:

If specified at time of order, 204B-7, -8, -9 can record at 200/800 bpi.
(1) Voice Cylinders are not available on rental basis.
All monthly rental prices include maintenance, and are based upon a 3-year lease.
One and 5-year leases are available.

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HONEYWELL 2020/2030

CENTRAL PROCESSOR & WORKING STORAGE

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
2021	Central Processor (includes control panel and power supply)			
-1	24K	625	30,450	200
-2	28K	870	40,800	220
-3	32K	1,045	46,920	240
-4	40K	1,490	64,240	295
-5	48K	1,885	81,180	337
-6	56K	2,230	96,140	354
-7	64K	2,575	110,880	372
2032	Central Processor (includes control panel and power supply)			
-1	40K	2,450	100,800	325
-2	48K	2,680	110,250	360
-3	56K	2,935	120,750	395
-4	64K	3,165	130,200	435
-5	80K	3,600	141,000	455
-6	96K	4,030	158,000	475
2032A	Central Processor (for purchase only)			
-1	40K		101,300	325
-2	48K		110,750	360
-3	56K		121,250	395
-4	64K		132,000	435
-5	80K		145,500	455
-6	96K		158,500	475
-7	128K		182,500	510
-8	192K		230,480	570
	Processor Options			
001	Fourth Read/Write Channel (available only at 40K memory and above; for 2020 only)	60	2,160	5
002	Type 275-0S/2000 Pkg. (for 2030 only)	153	6,000	18
003	Type 277-0S/2000 Pkg. (for 2030 only)	665	26,000	91
004	Cycle Speed-up (2.75 us to 2.5 us; for 2020 only)	255	10,000	30
018	Expansion of Disc Control (for 2030 only)	60	2,160	5
1044	Direct Transcription (for 2032)	65	2,250	6
1100A	Scientific Unit (for 2032)	605	24,750	48
	For purchase only:			
PM1A30	Second I/O sector with 6 additional RWCs – for purchase only		16,800	55
PM2A30	1.6 microsecond cycle time – for purchase only		10,000	38
PM3A30	OS/2000 Package (includes 213-3 interval timer with 071 option, load mode and expansion of disc controller; for purchase only)		6,000	30
PM3B30	Buffered Adapter for 277 Disc (requires PM3A30; for purchase only)		20,000	75
PM4A30	Scientific Unit – for purchase only		24,750	48
	INPUT/OUTPUT			
	Magnetic Tapes			
	Magnetic Tape Unit (half-inch tape; 500 bpi)			
204B201	10 kc	204	8,800	44
204B301	20 kc	255	11,000	55

Model Number	Description	Monthly Rental $	Purchase $	Monthly Maint. $
	Magnetic Tapes (Cont.)			
204B401	30 kc	281	12,100	61
	Magnetic Tape Subsystem (includes tape control unit and tape drives)			
204B200	Three 204B201 Tape Drives	665	28,600	150
204B300	Three 204B301 Tape Drives	820	35,200	176
204B400	Three 204B301 Tape Drives	945	40,700	203
	Printers			
112-2A	Printer (450 lpm; 132 print positions)	692	26,820	190
222-2NA	Printer and Control (450 lpm; 132 print positions)	867	33,120	238

Notes:

All monthly rental prices include maintenance and are based upon a 3-year lease. One and 5-year leases are available.

* *

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	IBM SYSTEM/3 MODEL 6			
	Central Processor & Working Storage			
5406	Processing Units with Keyboard (disc systems)			
5406-B2	8K	601	29,300	127
5406-B3	12K	719	35,200	132
5406-B4	16K	836	35,900	132
	Processor Options			
1550	Command Keys 9-16	20	990	1
5732	Processing Unit Expansion	35	1,750	6
7081	Serial I/O Channel	153	7,490	5
	Mass Storage			
	Discs			
5444-001	Disk Storage Drive	167	8,720	48
5444-002	Disk Storage Drive	275	10,400	48
5444-003	Disk Storage Drive	167	8,720	48
6378	Second Disk Attachment	45	2,420	5
	Input/Output			
	Punched Card			
129-001	Card Data Recorder (reading 80-column cards at 50 cpm, and punching at 12-50 cpm; applies to all 129 models)	127	6,240	39
129-002	Card Data Recorder	142	6,990	43
129-003	Card Data Recorder	153	7,490	44
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	–
5486-001	Card Sorter	91	4,780	39
5486-002	Card Sorter	123	5,470	59
1225	Alphabetic Sorting	7	226	1
2370	Auxiliary Card Counter	10	525	3
7245	Sort Suppress/Digit Select	10	525	1
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	Self-Checking Number Mod 10	30	918	1
7062	Self-Checking Number Mod 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
	Printers			
5213-001	Printer (pin-feed platen)	163	6,320	49
5213-002	Printer (vertical forms control)	204	8,160	66
5213-003	Printer (vertical forms control)	255	8,360	76
3901	Printer Attachment (for 001)	71	3,490	19
3902	Printer Attachment (for 002)	71	3,490	19
3903	Printer Attachment (for 003)	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)	357	16,800	107
2222-002	Printer (bidirectional)	392	17,000	117
7951	Printer Attachment (for 001)	71	3,490	19
7952	Printer Attachment (for 002)	71	3,490	19
	Magnetic Character Readers			
1255-001	Magnetic Character Reader (500 doc/min; 6 stackers)	821	39,400	214
1255-002	Magnetic Character Reader (750 doc/min; 6 stackers)	999	45,100	341
1255-003	Magnetic Character Reader (750 doc/min; 12 stackers)	1,320	61,400	448
1470	Balance List	69	3,320	6
3215	Dash Symbol Transmission	50 S	35	NC
4380	Card Sorting (51 col)	15	734	NC
4520	High-Order Zero and Blank Selection	30	1,460	5
6303	System/3 Adapter	123	5,930	4
7060	Self-Checking Number	49	2,370	3

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
7850	2772 Adapter	44	2,130	3
	Displays			
2265-001	Display Station	173	5,530	41
2265-002	Display Station	173	5,530	41
4766	Alphanumeric Keyboard (for -001)	29	918	5
7960	2265 Attachment for (-002)	76	3,740	2
	Data Communications			
2074	Binary Synchronous Communications Adapter	270	13,200	66
4765	Local Communications Adapter	153	6,630	28
1315	Auto Call	40	1,990	1
4703	Internal Clock	25	1,240	1
7477	Station Selection	20	999	1
7850	Text Transparency	20	999	1
3872-001	Modem (2,400 bps)	86	3,030	24
3875-001	Modem (7,200 bps)	244	8,560	71
4872-001	Modem (4,800 bps; point-to-point)	–	4,549	20
4872-003	Modem (4,800 bps; multipoint tributary)	–	4,947	23
	IBM SYSTEM/3 MODEL 10			
	Central Processor & Working Storage			
5410	Processing Units (card systems)			
5410-A2	8K	334	16,400	39
5410-A3	12K	442	21,700	43
5410-A4	16K	566	22,400	43
5410-A5	24K	816	40,000	57
5410-A6	32K	1,060	40,700	57
5410-A7	49K	1,380	59,000	79
5410	Processing Units (disc systems)			
5410-A12	8K	470	23,000	85
5410-A13	12K	576	28,300	89
5410-A14	16K	698	29,100	89
5410-A15	24K	948	46,600	104
5410-A16	32K	1,190	47,300	104
5410-A17	49K	1,510	65,600	126
	Processor Options			
3500	Dual Program	118	5,830	1
5501	Power Supply Expansion	51	2,290	1
5732	Processing Unit Expansion A	37	1,850	3
5733	Processing Unit Expansion B	20	816	1
5734	Processing Unit Expansion C	56	2,240	1
5735	Processing Unit Expansion D	20	816	1
7081	Serial I/O Channel	162	7,940	5
	Mass Storage			
	Discs			
5444-001	Disk Storage Drive	167	8,720	48
5444-002	Disk Storage Drive	275	10,400	48
5444-003	Disk Storage Drive	167	8,720	48
6378	Second Disk Attachment	47	2,560	5
5444-A1	Disk Storage Drive	204	8,610	66
5444-A2	Disk Storage Drive	306	10,200	66
5444-A3	Disk Storage Drive	204	8,610	66
4501	Higher Performance (1st disc attachment)	20	999	1
4502	Higher Performance (2nd disc attachment)	20	999	1
5422-001	Disk Enclosure	102	4,990	12
5440	Disk Cartridge (for all 5444 drives)	–	175	TM
5445-001	Disk Storage Drive	357	16,000	86
5445-002	Disk Storage Drive	341	15,300	81
3901	First 5445 Disk Attachment	510	20,400	34
3902	Second 5445 Disk Attachment	15	612	1
2316-001	Disk Pack	20	525	TM
	Input/Output			
	Punched Cards			
1442-006	Card Read Punch (300 cpm reading; 80 cpm punching)	270	14,400	56
1442-007	Card Read Punch (400 cpm reading; 160 cpm punching)	392	15,500	66
3950	5410 Coupling	30	1,475	1
4130	1442-006/-007 Attachment	193	8,870	15
129-001	Card Data Recorder (reading 80-col cards at 50 cpm and punching at 12-50 cpm; applies to all 129 models)	127	6,240	39
129-002	Card Data Recorder	142	6,990	43
129-003	Card Data Recorder	153	7,490	44

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
5486-001	Card Sorter	91	4,780	39
5486-002	Card Sorter	123	5,470	59
1225	Alphabetic Sorting	7	226	1
2370	Auxiliary Card Counter	10	525	3
7245	Sort Suppress/Digit Select	10	525	1
5424-A1	Multi-Function Card Unit (250 cpm)	291	10,200	142
5424-A2	Multi-Function Card Unit (500 cpm)	437	13,500	204
4100	MFCU Attachment 250/60/60	85	4,530	14
4101	MFCU Attachment 500/120/120	102	5,750	14
	Magnetic Tapes			
3410-001	Magnetic Tape Unit	188	7,850	46
3410-002	Magnetic Tape Unit	249	10,500	51
3410-003	Magnetic Tape Unit	311	13,000	56
3411-001	Magnetic Tape Unit	412	17,300	71
3411-002	Magnetic Tape Unit	525	21,900	76
3411-003	Magnetic Tape Unit	637	26,700	81
3211	Single Density (1,600 bpi; phase encoded)	55	2,550	8
3221	Dual Density (800 or 1,600 bpi; NRZI; only for 002 and 003 models of 3410 and 3411)	81	3,670	28
6550	Seven Track	81	3,670	13
7003	Attachment to System/3 (for 3411)	76	3,210	3
7951	3411 Magnetic Tape Attachment	163	4,890	10
	Printers			
5203-001	Printer (100 lpm; 96 positions)	247	11,400	68
5203-002	Printer (200 lpm; 96 positions)	301	12,700	77
5203-003	Printer (300 lpm; 96 positions)	443	17,700	129
3475	Dual Feed Carriage	80	3,960	20
3480	Dual Feed Carriage Control	26	1,310	1
3970	Printer Attachment (for 001)	59	3,160	10
3971	Printer Attachment (for 002)	59	3,160	10
3972	Printer Attachment (for 003)	96	4,610	13
4730	Additional Interchangeable Chain Cartridge	80	3,960	1
4740	Additional Interchangeable Chain Cartridge	112	2,960	34
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
8642	Universal Character Set Control	15	487	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	265	12,900	27
1403-002	Printer (60 lpm)	764	28,500	174
1403-NI	Printer (1,100 lpm)	892	34,600	200
1376	Auxiliary Ribbon Feeding	74	2,590	16
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	74	2,630	NC
5110	Multiple Character Set Feature (for 002)	10	387	2
5111	Multiple Character Set Feature (for NI)	10	387	2
5381	Numerical Print	222	7,600	9
5523	Preferred Character Set Feature	39	1,260	2
5532	Additional Print Chain	975	975	NC
6410	Selective Tape Listing (for NI)	187	6,810	10
6411	Selective Tape Listing (for 002)	187	6,810	10
6413	Selective Tape Listing Stacker	–		TM
6420	Selective Tape Listing (for NI only)	276	10,000	24
8371	Type Subs (first slug; chain)	15 S		–
8372	Type Subs (each additional slug; chain)	7 S		–
8640	Universal Character Set (for NI)	10		2
8641	Universal Character Set (for 002)	10		2
9950	Special Chain Artwork	–		–

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
9951	Matrix (per slug)	–		–
9952	Set Up (2-char slug)	–		–
	Magnetic Character Reader			
1255-001	Magnetic Character Reader (500 doc/min; 6 stackers)	821	39,400	214
1255-002	Magnetic Character Reader (750 doc/min; 6 stackers)	999	45,100	341
1255-003	Magnetic Character Reader (750 doc/min; 12 stackers)	1,320	61,400	448
1470	Balance List	69	3,320	6
3215	Dash Symbol Transmission	50 S	35	NC
4380	51-Column Card Sorting	15	734	NC
4520	High-Order Zero and Blank Selection	30	1,460	5
6303	System/3 Adapter	123	5,930	4
7060	Self-Checking Number	49	2,370	3
7850	2772 Adapter	44	1,050	1
	Optical Mark Readers			
3881-001	Optical Mark Reader	1,368	57,100	142
1471	BCD Read	56	2,390	2
3450	Document Counters	22	948	2
3801	Expanded Storage	56	2,390	1
6451	Serial Numbering	167	7,030	26
	Keyboards			
5471-001	Printer-Keyboard	108	5,070	33
4110	5471 Printer-Keyboard Attachment	54	3,020	5
5475-001	Data Entry Keyboard	42	2,420	7
4120	5475 Data Entry Keyboard Attachment	47	2,720	1
	Data Communications			
2074	Binary Synchronous Communications Adapter	285	12,500	66
4765	Local Communications Adapter	153	6,630	29
1315	Auto Call	42	2,110	1
3601	SIA Local Attachment	25	1,020	1
4703	Internal Clock	26	1,320	1
7477	Station Selection	21	1,050	1
7850	Text Transparency	21	1,050	1
2084	Binary Synchronous Communications Adapter (2nd)	285	12,500	66
1325	Auto Call	42	2,110	1
3602	EIA Local Attachment	25	1,020	1
4723	Internal Clock	26	1,320	1
7487	Station Selection	21	1,050	1
7851	Text Transparency	21	1,050	1
3872-001	Modem (2,400 bps)	86	3,030	24
3875-001	Modem (7,200 bps)	244	8,560	71
4872-001	Modem (4,800 bps; point-to-point)	–	4,549	20
4872-002	Modem (4,800 bps; multipoint tributary)	–	4,947	23
	IBM SYSTEM/3 MODEL 15			
	Central Processor & Working Storage			
5415	Processing Units			
-A17	48K	1,510	63,000	210
-A18	64K	1,610	67,000	215
-A19	96K	1,860	78,000	220
-A20	128K	2,060	86,000	230
	Processor Options			
5501	Power Supply Expansion	50	2,250	1
5733	Processing Unit Expansion 1	20	800	1
5734	Processing Unit Expansion 2	55	2,200	1
5735	Processing Unit Expansion 3	20	800	1
7081	Serial I/O Channel	159	7,790	6
	Mass Storage			
	Discs			
5444-A2	Disc Storage Drive	300	10,075	65
5444-A3	Disc Storage Drive	200	8,450	65
6378	Second 5444 Attachment	67	3,495	6
5445-001	Disc Storage Drive	350	15,750	85
3901	First 5445 Attachment	500	20,000	33
3903	Second 5445 Attachment	75	3,000	1
5440	Disc Cartridge (for 5444-A2)		175	TM
5422	Disc Enclosure	100	4,900	12
	Input/Output			
	Punched Cards			
1442-006	Card Read Punch (300 cpm read; 80 cpm punch)	265	14,140	55
1442-007	Card Read Punch (400 cpm read; 160 cpm punch)	385	15,255	65

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
3950	5410 Coupling	30	1,475	1
4130	1442-006, -007 Attachment	190	9,310	15
2501-A1	Card Reader (600 cpm)	195	11,010	35
-A2	Card Reader (1,000 cpm)	255	11,240	49
3630	2501 Coupling	5	150	NC
8090	2501 Attachment	150	6,700	7
5424-A1	Multi-Function Card Unit (250/60/60 cpm)	286	10,010	140
5424-A2	Multi-Function Card Unit (500/120/120 cpm)	429	13,320	200
4100	MFCU Attachment (for 5424-A1)	84	4,450	14
4101	MFCU Attachment (for 5424-A2)	16	900	2
2560-A1	Multi-Function Card Machine	615	27,055	97
1575	Card Print (first 2 lines)	135	5,880	14
1576	Card Print (second 2 lines)	135	5,880	14
1577	Card Print (third 2 lines)	135	5,880	14
1580	Card Print Control	25	1,250	3
8100	2560 MFCM	150	6,300	16
	Magnetic Tapes			
3411-001	Magnetic Tape Unit & Control	405	17,000	70
3411-002	Magnetic Tape Unit & Control	515	21,600	75
3411-003	Magnetic Tape Unit & Control	625	26,300	80
7951	3411 Magnetic Tape Attachment	160	4,800	10
	Printers			
1403-002	Printer (600 lpm)	750	28,030	171
1403-005	Printer (465 lpm)	580	26,800	123
1403-N1	Printer (1,100 lpm)	875	33,970	197
4140	Printer Attachment (1403-002)	120	5,150	21
4135	Printer Attachment (1403-005)	110	4,700	21
4150	Printer Attachment (1403-N1)	175	5,650	21
5421	Printer Control Unit (for 1403)	260	12,740	26
	Data Communications			
2074	Binary Synchronous Communications Adapter (1st)	280	12,300	65
1315	Auto Call	42	2,075	1
3601	SIA Local Attachment	25	1,000	1
4703	Internal Clock	26	1,295	1
7477	Station Selection	21	1,035	1
7850	Text Transparency	21	1,035	1
2084	Binary Synchronous Communications Adapter (2nd)	280	12,300	65
1325	Auto Call	42	2,075	1
3602	EIA Local Attachment	25	1,000	1
4723	Internal Clock	26	1,295	1
7487	Station Selection	21	1,035	1
7851	Text Transparency	21	1,035	1
4765	Local Communications Adapter	150	6,500	28
3741-002	Data Station	194	7,250	50
3271-002	Control Unit	180	7,200	12
3275-002	Display Station	145	6,500	13
	IBM 360/20			
	Central Processor & Working Storage			
2020				
Submdl 1	Processing Unit Submodel 1			
-B1	CPU (4K)	500	16,005	37
-C1	CPU (8K)	700	22,130	42
-BC1	CPU (12K)	950	30,035	48
-D1	CPU (16K)	1,200	37,410	52
2020				
Submdl 2	Processing Unit Submodel 2			
-B2	CPU (4K)	575	18,375	40
-C2	CPU (8K)	775	24,500	45
-BC2	CPU (12K)	1,030	32,400	51
-D2	CPU (16K)	1,275	39,780	55
2020				
Submdl 3	Processing Unit Submodel 3			
-B3	CPU (4K)	355	11,270	37
-C3	CPU (8K)	450	14,190	42
-BC3	CPU (12K)	605	19,080	48
-D3	CPU (16K)	760	23,700	52
2020				
Submdl 4	Processing Unit Submodel 4			
-B4	CPU (4K)	395	12,560	40
-C4	CPU (8K)	490	15,415	45

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Central Processor & Working Storage (Contd.)			
-BC4	CPU (12K)	645	20,235	51
-D4	CPU (16K)	800	24,920	55
2020				
Submdl 5	Processing Unit Submodel 5			
-C5	CPU (8K)	875	44,230	90
-BC5	CPU (12K)	1,125	56,260	100
-D5	CPU (16K)	1,375	70,615	105
-DC5	CPU (24K)	1,710	88,950	115
-E5	CPU (32K)	2,050	104,565	130
2020				
Submdl 6	Processing Unit Submodel 6			
-C6	CPU (8K)	575	19,550	100
-BC6	CPU (12K)	800	29,600	110
-D6	CPU (16K)	1,000	40,000	115
3901	1401/1440 Compatibility (submodel 5 only)	275	13,750	29
	Mass Storage			
	Discs			
2311-011	Disk Storage Drive	570	21,030	55
2311-012	Disk Storage Drive	350	18,390	35
1316	Disk Pack	15	360	TM
7495	Storage Control (Submodel 2 or 4)	225	7,410	5
7496	Storage Control (Submodel 4)	172	5,540	5
7497	Storage Control (Submodel 5)	225	7,410	5
7498	Storage Control (Submodel 6)	225	7,410	5
	Input/Output			
	Punched Card			
1442-005	Card Punch	255	12,365	52
3630	1130/1442 Coupling	5	225	NC
4460	1442-005 Attachment	30	985	3
2501-A1	Card Reader	195	11,010	35
2501-A2	Card Reader	255	11,240	49
3630	1130/2501 Coupling	5	150	NC
8090	2501 Attachment	20	670	2
2520-A1	Card Read Punch	730	31,515	98
2520-A2	Card Punch	650	28,225	93
2520-A3	Card Punch	470	27,945	72
8092	2520-A1 Attachment	50	1,640	6
8095	2520-A2 or -A3 Attachment	25	850	3
2560-A1	Multi-Function Card Machine	615	27,055	97
2560-A2	Multi-Function Card Machine	480	19,885	97
1575	Card Print (first 2 lines)	135	5,880	14
1576	Card Print (second 2 lines)	135	5,880	14
1577	Card Print (third 2 lines)	135	5,880	14
1580	Card Print Control	25	815	2
8099	2560 Attachment	75	2,470	5
8100	2560 Attachment	75	2,470	5
	Printers			
1403-002	Printer (600 lpm)	750	28,030	159
1403-007	Printer (600 lpm)	630	26,960	124
1403-N1	Printer (1,100 lpm)	875	33,970	183
4442	1403-002 Attachment	225	7,410	23
4447	1403-007 Attachment	200	7,245	23
4448	1403-N1 Attachment	275	7,740	23
1376	Auxiliary Ribbon Feeding	73	2,540	16
4740	Interchangeable Chain Cartridge Adapter	73	2,580	NC
5110	Multiple Character Set Feature (for 002)	10	380	2
5111	Multiple Character Set Feature (for N1)	10	380	2
5381	Numerical Print	218	7,460	9
1416	Interchangeable Train Cartridge (for N1)	97	2,910	TM
5523	Preferred Character Set Feature	39	1,240	2
5532	Print Chain (additional)	975 S	975	NC
5575	Printer Features Control	55	1,740	2
6410	Select Tape List (for N1)	184	6,680	10
6411	Select Tape List (for 002)	184	6,680	10
6413	Selective Tape Listing Stacker	–	250	TM
6420	Select Tape List (for N1)	272	9,890	23
8371	Type Subs, First Slug, Chain	15 S	5	–
8372	Type Subs, Each Additional Slug, Chain	7 S	5	–
8637	Universal Character Set Adapter	15	505	4
8640	Universal Character Set (for N1)	10	380	2

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
8641	Universal Character Set (for 002)	10	380	2
9951	Service Charge – Matrix (per slug)	–	150	–
9952	Service Charge – Set Up (2-chain slug)	–	50	–
2203-A1	Printer (submodel 1, 2, 5, or 6)	510	18,390	72
2203-A2	Printer (submodel 3 or 4)	390	14,020	72
1901	Additional Character Set (13 char)	400 S	400	NC
1902	Additional Character Set (39 char)	450 S	450	NC
1903	Additional Character Set (52 char)	475 S	475	NC
1904	Additional Character Set (63 char)	500 S	500	NC
8082	2203 Attachment	55	1,815	5
8083	2203 Attachment	55	1,815	5
8084	2203 Attachment	55	1,815	5
8085	2203 Attachment	55	1,815	5
3475	Dual Feed Carriage	100	4,000	9
3480	Dual Feed Carriage Control	10	350	2
5558	Print Positions (24 addt'l)	45	1,980	4
7815	Tape Channels (6 addt'l)	10	340	1
2152-001	Printer-Keyboard	131	5,430	61
4450	Forms Stand Stacker	–	60	NC
8070	2152 Attachment	87	3,055	5
	Magnetic Tape			
2401-001	Magnetic Tape Unit	335	12,880	66
2401-002	Magnetic Tape Unit	485	18,720	75
2401-004	Magnetic Tape Unit	385	14,800	92
3471	Dual Density (800 to 1,600 bpi)	25	990	2
5121	Mode Compatibility	10	380	NC
5301	Native Tape Attachment (for 001 and 002)	440	22,000	170
5302	Native Tape Attachment (for 004)	535	26,750	310
5519	Power Window	275	275	NC
7125	7-Track Compatibility (for feature 5301)	50	2,500	22
7126	7-Track Compatibility (for feature 5302)	110	5,500	33
7160	Simultaneous Read While Write	10	380	NC
2415-001	Magnetic Tape Unit and Control	750	29,390	108
2415-002	Magnetic Tape Unit and Control	1,205	47,030	194
2415-003	Magnetic Tape Unit and Control	1,655	64,660	280
2415-004	Magnetic Tape Unit and Control	905	35,590	124
2415-005	Magnetic Tape Unit and Control	1,455	57,180	221
2415-006	Magnetic Tape Unit and Control	2,005	78,770	318
3228	Data Conversion	45	1,730	1
4701	Isolation Control Unit (for 001, 002, 003)	NC	NC	NC
4703	Isolation Control Unit (for 004, 005, 006)	NC	NC	NC
5320	9-Track Compatibility	135	5,190	10
7125	7-Track Compatibility (for 001, 002, 003)	50	1,920	1
7127	7-Track Compatibility (for 004, 005, 006)	95	3,640	4
7135	7- and 9-Track Compatibility	155	5,950	13
	Magnetic Character Readers			
1255-001	Magnetic Character Reader (500 dpm; 6 stackers)	805	38,645	210
1255-002	Magnetic Character Reader (750 dpm; 6 stackers)	980	44,260	335
1255-003	Magnetic Character Reader (750 dpm; 12 stackers)	1,300	60,240	440
6320	S/360 Mod 20 Adapter (reqrd)	150	7,200	18
4520	High-Order Zero and Blank Selection (model 3 only)	30	1,440	5
7060	Self-checking Number/Improved Recognition	49	2,330	2
3215	Dash Symbol Transmission	50 S	35	NC
4380	Card Sorter (51-col)	15	720	NC
1259-001	Magnetic Character Reader	1,065	48,015	250
7081	Serial I/O Channel	100	3,490	7
1419-001	Magnetic Character Reader	2,380	107,185	241
1445	Batch Numbering	130	6,060	10
3215	Dash Symbol Transmission	50 S	35	NC
3610	Electronic Accumulation and Sequence Check	251	9,455	19
3791	Endorser	394	17,800	32
3792	Endorser Plate (no artwork)	–	55	–
3795	Endorser Only	261	11,735	21
3800	Expanded Capability	162	7,285	1
4380	Card Sorter (51 col)	15	720	NC
4700	Isolation Control Unit	NC	NC	NC
5201	Multiple Column Control	52	2,180	2
5739	5739 Program Control (for pocket lights 1-6)	27	960	1
5741	5741 Program Control (for pocket lights 7-12)	10	380	1
7061	Self-Checking Number Mod 10	42	1,890	2

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
7062	Self-Checking Number Mod 11	68	2,910	3
7440	Split Field	21	1,190	1
7720	S/360 Adapter – Single Address	104	5,140	7
7730	S/360 Adapter – Dual Address	282	12,705	9
	Data Communications			
1315	Automatic Calling	34	835	1
2074	Binary Synchronous Communication Adapter	410	11,545	17
4500	High Speed (19.2K bps)	49	1,190	1
4501	High Speed (40.8K or 50K bps)	49	1,190	1
4100	Full Transparent Text Mode	20	490	1
4703	Internal Clock	25	615	1
7477	Station Selection	29	715	1
3872-001	Modem (2,400 bps)	85	2,975	24
3875-001	Modem (7,200 bps)	240	8,400	70
4875-001	Modem (4,800 bps; point-to-point)	–	4,460	20
4875-003	Modem (4,800 bps; multipoint tributary)	–	4,850	23
	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	142,900	250
-FE	98,304 bytes	3,145	152,600	255
-G	131,304 bytes	3,345	162,300	160
-GE	163,840 bytes	3,545	172,200	265
	Processor Options			
3898	External Signals	100	4,850	1
3900	Floating Point	NC	NC	NC
4640	Integrated Communications Adapter	205	9,950	21
4641	Integrated Communications Adapter Extension	75	3,650	1
4650	Integrated 3203 Attachment (4653 req'd)	75	3,700	6
4653	Integrated 3203/5203 Prerequisite	80	3,800	7
4670	Integrated 2560 Attachment	140	6,800	10
4690	Integrated 5203 Mdl 3 Attachment (4653 req'd)	75	3,700	6
4692	Integrated 5213 Model 1 Attachment	100	4,850	3
4695	Integrated 5425 Attachment	140	6,800	16
5248	Byte Multiplexer Channel	190	9,250	17
7520	S/360 Model 20 Compatibility	NC	NC	NC
	Mass Storage			
	Discs			
3340-A2	2 Drives	999	40,000	74
-B1	1 Drive	558	22,000	40
-B2	2 Drives	705	28,000	64
	Input/Output			
	I/O Attachments			
3540	Diskette I/O Unit			
-B1	One drive	535	22,000	25
-B2	Two 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	38,000	185
-2	1,200 lpm; 4650 req'd)	1,234	49,000	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

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
2596	Card Read/Punch	845	29,575	330
2560-A1	Multi-functional Card Machine (500 cpm)	615	27,055	97
-A2	Multi-functional Card Machine (310 cpm)	480	19,885	97
5425-A1	Multi-functional Card Unit (250/60/60 cpm)	570	18,000	150
-A2	Multi-functional Card Unit (500/120/120 cpm)	740	22,000	295
	Paper Tape			
1017-1	Paper Tape Reader (120 cps; reads strips of tape)	49	2,330	14
-2	Paper Tape Reader (120 cps; reads strips or rolls)	73 †	3,565 †	17
1018	Paper Tape Punch (120 cps)	121 †	5,395 †	40
2671	Paper Tape Reader (1,000 cps)	140 †	6,305 †	21
2822	Paper Tape Control (controls one 2671)	210 †	9,410 †	8
2826	Paper Tape Control (for up to 2 1017s and/or 2 1018s)	275 †	14,380 †	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	7,700	45
-2	40K bps at 1,600 bpi	245	10,300	50
-3	80K bps at 1,600 bpi	305	12,800	55
3411	Magnetic Tape Unit and Control (single-channel control unit with 1 drive)			
-1	20K bps at 1,600 bpi	405	17,000	70
-2	40K bps at 1,600 bpi	515	21,600	75
-3	80K bps at 1,600 bpi	625	26,300	80
3211	Single-Density Tape Unit	55	2,500	7
3221	Dual-Density Tape Unit	80	3,600	27
6550	7-Track Tape Unit	80	3,600	13
	Magnetic Character Readers			
1255	Magnetic Character Reader			
-1	500 Documents/minute – 6 stackers	805	38,645	210
-2	750 Documents/minute – 6 stackers	980	44,260	335
-3	750 Documents/minute – 12 stackers	1,300	60,240	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; document reading only)	3,400	136,000	1,160
3881	Optical Mark Reader (max 8/system)	1,351	56,000	140
3886	Optical Character Reader (max 8/system)	2,315	91,000	475
	Audio Response			
7770	Audio Response Unit (up to 4 lines)	1,165	55,870	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
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	1,940	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

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Input/Output (Contd.)			
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	7,500	11
-2	1,920 Char	205	8,200	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	3,400	7
-2	Display Station (1,920 char; for 3272 Model 2 only)	110	4,400	15
3284-1	Printer (40 cps; 480 char; for 3272 Model 1 or 2)	150	5,850	28
-2	Printer (40 cps; 1,920 char; for 3272 Model 2 only)	160	6,560	28
3286-1	Printer (480 char; for 3272 Model 1 or 2)	180	7,380	28
-2	Printer (1,920 char; for 3272 Model 2 only)	190	8,170	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	9,130	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	77,600	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
	LITTON ABS 1200 SERIES			
	Central Processor and Working Storage			
1241	Basic System (1801 16-32K processor; keyboard; paper tape storage; paper tape reader and punch; and printer)	NA	22,760	NA
1251	Basic System (same as 1241 except has 16K words of usable memory)	NA	26,900	NA
1281-1	Basic System (includes 1 magnetic ledger card chute)	NA	22,960	NA
1281-2	Basic System (includes 2 magnetic ledger card chutes)	NA	24,960	NA

Model Number	Description	Monthly Rental $ *	Purchase $	Monthly Maint. $
	Mass Storage			
	Disc			
52	Drum Storage System (16K words)	NA	10,750	NA

Notes:
†Manufactured in France. Freight charges from point of shipment in USA.
**Rental prices quoted are based upon a one-year lease.*
+Model A1 prices are quoted. All other models are also compatible.

NC No Charge — Not Applicable TM Time and Material Basis
S Single Use Charge NA Not Available

Disc drives, mag tape units, printers, and many features that connect to these devices may also be leased on either a 12- to 23-month plan, which decreases 1-year lease prices approximately 8%, or a 24-month plan, which decreases 1-year lease prices approximately 16%.

Two- to five-year leases available. Free installation; unlimited usage. Parts, labor, and 90-day preventive maintenance included in maintenance charges. Request price quotation for rental and maintenance prices.

PRICE DATA

Small Business Computers N-Z

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $
	NCR CENTURY 50			
	CENTRAL PROCESSOR & WORKING STORAGE			
	Basic System			
615-50/616-200	Processor (with 16K memory)	1,575	71,500	275
682-100	Card Reader (300 cpm)			
640-122	Printer (200 lpm)			
655-151	Disc Unit (8.4 mb; low speed)			
	Alternate Devices (for basic system)			
615-50/616-300	Processor (with 32K memory)	300	12,500	10
662-100	Paper Tape Reader (1,000 cps)	—	—	-15
640-132	Printer (300 lpm)	150	6,000	15
640-102	Printer (450 lpm)	350	12,000	30
655-101	Disc Unit (8.4 mb; high speed)	150	5,000	35
	Processor Options			
5621	Communications Package (6101 reqd)	425	19,500	75
5622	BASIC-1 Hardware Pkg (6101 reqd)	400	18,500	60
6051	One Common Truck	50	3,000	5
6101	Input/Output Writer	100	4,000	15
6106	Software Initiated Alarm	10	400	2
6107	Remote Audible Alarm	20	800	1
6108	Extra Loud Alarm	20	800	1
	MASS STORAGE			
	Discs			
655-102	High-Speed Disc (108 kb; 8.4M bytes)	625	28,750	110
655-152	Low-Speed Disc (108 kb; 8.4M bytes)	550	26,500	75
	INPUT/OUTPUT			
	Punched Card			
686-111	Card Read/Punch (560/60-180 cpm; 6051 reqd)	400	20,500	115
686-201	Card Reader (750 cpm; 6051 reqd)	300	14,750	75
686-311	Card Punch (60-180 cpm; 6051 reqd)	300	14,750	75
	Paper Tape			
660-101	Paper Tape Reader (1,500 cps; 6051 reqd)	300	14,750	35
665-101	Paper Tape Punch (200 cps; 6051 reqd)	375	18,000	55
	Magnetic Tape			
624-119	9-Channel Control Unit (40 kc)	300	14,000	20
624-179	7-/9-Channel Control Unit (10/28/40 kc; 200/556/800 bpi)	350	16,500	20
633-117	7-Channel Control Unit (10/28/40 kc; 200/556/800 bpi)	350	17,000	65
633-119	9-Channel Unit (40 kc)	350	17,000	65
	Sorter			
670-101	MICR Sorter (600 dpm; 6051 reqd)	990	45,000	150
	DATA COMMUNICATIONS			
622-201	735/736 Encoder Adapter	175	8,250	10

Notes:

Basic systems listed are minimum configurations that can be purchased. Device prices under the headings of Alternate Devices are amounts to be added to, or subtracted from, price of basic system.

*Rental prices quoted are based on a one-year lease.

* *

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $
	NCR CENTURY 100 and 101			
	CENTRAL PROCESSOR & WORKING STORAGE			
	Century 100 Basic System			
615-100/616-200	Processor (with 16K memory)	2,500	89,500	385
682-100	Card Reader (300 cpm)			
640-102	Printer (450 — 900 lpm)			
655-101	Disc Unit (8.4 mb; high speed)			
	Alternate Devices (for Century 100 Basic System)			
615-100/616-300	Processor (with 32K memory)	400	12,500	10
662-100	Paper Tape Reader (1,000 cps)	—	—	-15
626-101	Printer Control Unit (price included with printers)	—	—	—
640-200	Printer (1,500 lpm; 132 col), or	925	35,500	75
640-210	Printer (1,500 lpm; 160 col), or	1,025	39,750	75
640-300	Printer (600 lpm; 132 col)	675	25,450	50
640-205	OCR Printer (750/1,500 lpm; 132 col)	1,025	38,300	85
640-215	OCR Printer (750/1,500 lpm; 160 col)	1,125	42,550	85
	Processor Options			
	For Century 100 Basic System			
6101	Input/Output Writer (for 615-100)	100	4,000	15
6105	I/O Writer Selector Switch Assembly	5	200	1
6106	Software Initiated Alarm	10	400	2
6107	Remote Audible Alarm	20	800	1
6108	Extra Loud Alarm	20	800	1
	Century 101 Basic System	2,025	89,520	325
615-101 w/ 7001	Processor (w/16K byte memory)			
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 (for Century 101 Basic System)			
615-101/ 7002	Processor (w/24K byte memory)	175	7,875	10
615-101/ 7003	Processor (w/32K byte memory)	300	13,500	15
615-101/ 7004	Processor (w/48K byte memory)	600	27,000	25
615-101/ 7005	Processor (w/64K byte memory)	900	40,500	35
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 w/Controller (450-900 lpm)	300	17,350	5
640-300	Integrated Printer (1,200 lpm)	575	23,800	30
640-300/ 626-101	Printer w/Controller (1,200 lpm)	675	28,800	30
655-201/ 625-101	Disc Unit & Controller (8.2 mb; 108 kb)	345	16,455	30
656-102's	Additional 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			
	For Century 101 Basic System			
6001	Multiply/Divide	100	4,500	10
6002	Integrated Communications Multiplexor	175	7,875	40
6003	I/O Common Trunks 1 & 6	100	4,500	10
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	—
6101	Teletype I/O Writer w/Interface	100	4,000	15
6102	Thermal I/O Writer w/Interface	150	6,250	15
6106	Software Initiated Alarm	10	400	2
6107	Remote Audible Alarm	20	800	1
6108	Extra Loud Alarm	20	800	1
615-951	Auxiliary Cabinet	25	800	—
9511	640 Integrated Printer Attachment	75	3,375	15
	MASS STORAGE			
	Discs			
	For Century 101 Basic System			
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
	Additional Equipment (for Century 100 and 101)			
	MASS STORAGE			
	Discs			
625-101	Disc Control Unit	300	14,000	15
655-102	Disc Unit (as a sec unit on 615-100 processor)	625	28,750	110

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $
	MASS STORAGE (Contd.)			
655-201	Common Trunk Unit (625-101 reqd)	600	26,500	115
955-1	Disc Pack (for 655 Disc Units)	12	350	NA
625-201	Single Density Disc Controller (for 657 disc units)	875	40,250	40
625-202	Dual Density Disc Controller (for 657 disc units)	1,075	49,450	70
657-101	Single Spindle Disc Unit (30/48 mb)	575	26,450	90
657-102	Dual Spindle disc unit (60/96 mb)			
	1st Unit	900	41,400	100
	2nd Unit	700	32,200	100
	3rd or more Units	600	27,600	100
6571	Add-On Drawer	325	14,950	10
956-1	Disc Pack (for 656 disc units)	NA	175	NA
957-1	Disc Pack (for 657 disc units)	12	425	NA
	CRAM Units			
623-201	CRAM Control Unit	300	14,000	20
653-101	CRAM Unit (145 mb)	1,250	60,000	140
	CRAM Deck	—	450	—
	INPUT/OUTPUT			
	Punched Card			
680-201	Card Reader (1,200 cpm)	650	32,500	120
686-102	Card Read/Punch (800/83-294 cpm)	500	24,000	115
686-111	Card Read/Punch (560-60/180 cpm)	400	20,500	115
686-201	Card Read (750 cpm)	300	14,750	75
686-302	Card Punch (82-240 cpm)	300	14,750	115
687-301/ 622-701	Card Punch and Controller (100 cpm)	325	15,500	95
	Paper Tape			
660-101	Paper Tape Read (1,500 cps)	300	14,750	35
665-101	Paper Tape Punch (200 cps)	375	18,000	55
	Magnetic Tapes			
624-111	80 kb Control Unit	450	21,000	20
633-111	80 kb Single Unit (phase modulated, 9-channel)	400	19,500	60
633-121	80 kb Dual Unit (phase modulated; 9-channel)	750	36,000	90
624-211	144 kb Control Unit	500	24,000	20
633-211	144 kb Single Unit (phase modulated; 9-channel)	500	24,000	60
624-311	240 kb Control Unit	550	25,500	20
633-311	240 kb Single Unit (phase modulated; 9-channel)	550	25,500	60
624-119	9-Channel, 40 kc Control Unit	300	14,000	20
633-119	9-Channel, 40 kc Unit (800 bpi)	350	17,000	65
624-179	7-/9-channel, 10/28/40 kc Control Unit (200/556/800 bpi)	350	16,500	20
633-117	7-channel, 10/28/40 kc Control Unit (200/556/800 bpi, respectively)	350	17,000	65
	Optical Character Readers			
622-401	MICR Sorter Control Unit	200	15,100	10
670-101	MICR Sorter (600 doc/min)	990	45,000	150
622-301	OCR Control Unit	150	7,000	10
420-1	Optical Character Reader	1,200	48,000	184
420-2	Optical Character Reader	1,700	68,000	265
671-101	MICR Sorter (1,200 dpm, 18 pockets)	2,350	117,500	530
6711	Endorser Feature	300	12,000	45
	Displays			
795-100	Display Controller	190	6,650	18
795-151	Memory (1,024 char)	65	2,275	7
795-152	Memory (2 x 512 char)	65	2,275	7
795-153	Memory (4 x 256 char)	65	2,275	7
795-201	Cabinet (1 controller)	35	1,225	2
795-202	Cabinet (up to 2 controllers)	35	1,225	2
795-300	Display Screen	70	2,450	14
795-400	Keyboard (standard)	15	525	4
795-401	Keyboard (hard copy)	22	770	4
795-402	Keyboard (A/M style)	30	1,050	4
795-500	Split Screen	20	700	3
795-521	Hard Copy Output	175	6,125	12
795-640	Teleprinter	50	1,750	21
	Printers			
626-101	Printer Control Unit	300	14,000	25
640-102	Printer (450 lpm, 132 col)	575	27,500	60
640-122/-132	Printer (200 or 300 lpm, 132 col)	NA	NA	NA
6401	Selector (6/8 lines per inch)	25	1,000	-0-
640-200	Printer (1,500 lpm, 132 col)	1,200	49,000	110
6402	640-200 Continuous Form Tab Set Handling Feature	10	300	2
640-205	OCR Printer (750/1,500 lpm, 132 col)	1,300	51,800	120
640-210	Printer (1,500 lpm, 160 col)	1,300	53,250	110
640-215	OCR Printer (750/1,500 lpm, 160 col)	1,400	56,050	120
640-300	Printer (600 lpm, 132 col)	950	38,950	85
6401	6/8 Lines Per Inch Selector	25	1,000	-0-
649-300	Printer (300 lpm, 64 char set)	575	24,150	80
6491	6/8 Lines Per Inch Selector	15	675	1
1001	Single Numeric, 64 Char Set (450/450 lpm)	—	1,500	—
1011	Double Numeric, 52 Char Set (450/900 lpm)	—	1,500	—
1081	Block Typeline for 1" Char	—	3,000	—
1190	Shelf-Labeling Typeline	85	1,800	—
2001	Single Numeric, 64 Char Set (1,500/1,500 lpm)	—	1,500	—
2011	Double Numeric, 52 Char Set (1,500/3,000 lpm)	—	1,500	—
2081	Financial Typeline	85	1,800	—
2181	Financial Typeline	85	1,800	—
2101	Single Numeric, 64 Char Set (1,500/1,500 lpm)	—	1,500	—
2111	Double Numeric, 52 Char Set (1,500/3,000 lpm)	—	1,500	—
2161	OCR-A, Double Numeric, 64 Char Set (750/1,500 lpm)	—	1,500	—
2190	Shelf-Labeling Typeline	85	1,800	—
2195	OCR-B, Double Numeric, 64 Char Set (750/1,500 lpm)	—	1,500	—
3011	Double Numeric, 64 Char Set (1,200/1,200 lpm)	—	1,500	—
3031	Upper/Lowercase, 52 Char Set (600/1,200 lpm)	—	1,500	—
	DATA COMMUNICATIONS			
621/101	Communications Multiplexor (15 lines)	300	15,000	40
690-101	621-101 Auxiliary Cabinet	50	2,500	-0-
621-102	Communications Multiplexor (250 lines)	475	22,750	45
6901	Transparency Feature	15	675	-0-
6902	Wide Band Feature	10	450	-0-
6921	End of Message Feature (621-102 only)	20	950	-0-
690-201	621-102 Auxiliary Cabinet	250	12,500	5
692-100	Asynchronous Character Adapter	65	3,250	10
692-401	Asynchronous Polling Adapter (1 line/cage)	100	5,000	10
692-402	Asynchronous Polling Adapter (2 lines/cage)	140	7,000	15
692-403	Asynchronous Polling Adapter (3 lines/cage)	165	8,250	20
692-405	Terminal Adapter (1 line/cage)	100	4,800	15
692-406	Terminal Adapter (2 lines/cage)	140	6,700	20
693-200	735/736 Encoder Adapter	175	8,250	15
693-300	General-Purpose Synchronous Adapter	160	7,750	25
	MISCELLANEOUS			
	Control Units			
620-301	Common Trunk Switching Unit	175	8,750	5
620-302	Central Switching Controller (complete freestanding unit)	300	15,000	10
6903	1 x 2 Switch Module (for -301 and -302)	35	1,750	5
6904	2 x 1 Switch Module (for -301 and -302)	45	2,250	5
6905	2 x 2 Switch Module (for -301 and -302)	65	3,250	5
622-201	For 736 Mag Tape Encoders	175	8,250	10
622-601	Processor Intercoupler	300	14,750	30
627-201	Emulator w/315 Feature	250	11,750	32
627-202	Emulator w/1401 Feature	175	8,000	26
627-203	Emulator w/both 315 and 1401 Feature	400	18,500	57

Notes:

*Rental prices quoted are based on a one-year base.

The Century 100 can also be leased for 3 years, at $2,115/mo, and 5 years, at $1,995/mo. Installation charges included in lease prices.

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $*
	MISCELLANEOUS (Contd.)			
	Notes: (Contd.)			
	Basic systems listed are minimum configurations that can be purchased. Device prices under the headings of Alternate Devices are amounts to be added to, or subtracted from, price of basic system.			
	*Conversion-to-purchase option allows 50% of rental to be applied toward purchase for up to 24 months. For rental in nonmetropolitan areas, increase the lease price by adding 20% of maintenance price; for purchased equipment, increase the maintenance cost by 20%.			
	* *			
	PHILIPS 350 SERIES			
	CENTRAL PROCESSOR & WORKING STORAGE			
P-351	Central Processor (400 words)	200	NA	NA
P-352	Central Processor (1,200 words)	265-460	NA	NA
P-354	Central Processor (1,200 words)	360-550	NA	NA
P-356	Central Processor (1,200 words)	330-490	NA	NA
P-358	Central Processor (1,200 words)	480-600	NA	NA
P-359	Central Processor (1,200 words)	550-650	NA	NA
	INPUT/OUTPUT			
	Punched Cards			
P-115	Card Reader (280 cpm; for P-352, P-354, P-356, P-358, P-359)	105	NA	NA
P-110	Card Punch (37.5 cpm)	115	NA	NA
P-130	Auto Reader	125	NA	NA
	Printer			
P-150	Line Printer	160	NA	NA
	Paper Tape			
P-120	Paper Tape Punch (50 cps)	90	NA	NA
P-125	Paper Tape Reader (50 cps; for P-352, P-353, P-358, P-359)	90	NA	NA
	Magnetic Stripe Ledger Card (included in price of P-358, P-359)		NA	NA
P-351	Keyboard Input	176	NA	NA
	Notes:			
	*Rental prices quoted are based upon a one-year lease.			
	Leases average 2.3% of purchase price. Maintenance fee under 12-month warranty. After first year, 7% of purchase price. Purchase prices range from $8,395 to $27,000. Average price of system is $21,000. Request price quotations from manufacturer.			
	* *			
	QANTEL SYSTEM			
	CENTRAL PROCESSOR & WORKING STORAGE			
QA-2	4K System (includes I/O typewriter and power supply mounted in desk, operates with up to 12 I/O controllers; each controller has either single device, multidevice, or direct access to main memory capabilities)	300	12,315	65
QB-2	8K System (basic system with expanded memory; can be field or factory installed)	353	14,465	75
QC-1	16K System (basic system with expanded memory; can be field or factory installed; includes programmer's control console)	483	19,805	105
QF-1	24K System (basic system with expanded memory; can be field or factory installed; includes programmer's control console)	580	23,755	125
QD-1	32K System (basic system with expanded memory; can be field or factory installed; includes programmer's control console)	666	27,305	145
	MASS STORAGE			
	Discs			
MD-1	Disc Drive (7.6M bytes; sectored disc; 20,000 sectors; 380 bytes/sector; full sector buffer; auto detection and marking of defective sectors; CRC check/sector; decimal addressing; includes controller)	351	14,400	80
ME-1	Disc Drive (30.7M bytes; sectored disc; 40,000 sectors; 760 bytes/sector; full sector buffer; auto detection and marking of defective sectors; CRC check/sector; decimal addressing; includes controller)	482	19,750	121
MP-1	Disc Drive (60M bytes; sectored disc; 2314 type; 80,000 sectors; 768 bytes/sector; full sector buffer; auto detection and marking of defective sectors; CRC check/sector; decimal addressing; includes controller)	674	27,500	175
	INPUT/OUTPUT			
	Console			
AA-2	Programmer's Control Console	35	1,440	10
	Typewriter			
PA-1	Extra I/O Typewriter (heavy duty IBM Selectric 735; 15 cps; buffered)	96	3,950	30
AB-1	10-Key Numeric Input Module (adding machine style keyboard; read-out tube; 32-char buffer; two indicator flags; termination interrupt provided at end of message)	15	1,440	10
	Paper Tape			
AD-1	Reader/Punch (50 cps; 5-, 6-, 7-, or 8-channel tape; 100-foot capacity)	57	2,350	20
	Punched Card			
AC-2	Reader (500 cpm; 80 col; photoelectric reader; translates extended Hollerith code to ASCII; reads col binary direct from card; controlled by Qantel Read and Set-Read instructions)	101	4,150	35
	Printers			
PD-1	Serial Printer (60-100 lpm; 132 pp; 132-char buffer; 63-char ASCII set; 1 original and four copies)	170	6,950	50
PB-2	Line Printer (200 lpm; 132 pp; 132-char buffer; 64-char ASCII set; chain type printer)	305	12,500	275
PC-1	Line Printer (245 lpm-132 pp; 1,120 lpm-24 pp; 132-char buffer; 64-char ASCII set; prints up to 6-part multicopy)	512	21,000	140
PE-1	Line Printer (700 lpm-132 pp; 1,800 lpm-68 pp; 132-char buffer; 64-char ASCII set; prints up to 6-part multicopy)	817	33,500	185
	Magnetic Tape			
CJ-1	Magnetic Tape Drive Controller (20,000 bytes/sec; 800 bpi; handles up to 4 MJ-1 or MK-1 drives; all drives connected to CJ-1 controller must have same data densities and read/write speeds; controller board mounts in processor housing)	37	1,500	10
CL-1	Magnetic Tape Drive Controller (40,000 bytes/sec; 1600 bpi; handles up to 4 ML-1 or MM-1 drives; all drives connected to CL-1 controller must have same densities and read/write speed; controller board mounts in processor housing)	49	2,000	12
MF-1	600' Magnetic Tape Drive (9-channel, NRZI-IBM format; 800 bpi; read/write speed is 10,000 bytes/second; single desktop cabinet or multiple units in freestanding cabinet; 1 drive per controller with controller included in unit price)	121	4,950	30
MJ-1	600' Magnetic Tape Drive (9-channel, NRZI-IBM format; 800 bpi; read/write speed is 20,000 bytes/second; read-after-write capability)	121	4,950	32

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $**
	MASS STORAGE (Contd.)			
MK-1	2400' Magnetic Tape Drive (9 channel, NRZI-IBM format; 800 bpi; read/write speed is 20,000 bytes/second; read-after-write capability; connects to CJ-1 controller)	194	7,950	50
ML-1	600' Magnetic Tape Drive (9 channel; PE compatible format; 1,600 bpi, read/write speed is 40,000 bytes/second; read-after-write capability; connects to CL-1 controller)	140	5,750	34
MM-1	2400' Magnetic Tape Drive (9 channel; PE compatible format; 1,600 bpi; read/write speed is 40,000 bytes/second; read-after-write capability; connects to CL-1 controller)	218	8,950	60
MFA-1	3-Tape Drive Cabinet (freestanding; mounts 3 MF-1, MJ-1, and ML-1 Drives)	—	250	—
	Displays			
AF-1	Video Display Unit (12" CRT; 2048 x 8-bit mag core memory; 1,998-char screen capacity; 74 char/line; 27 lines/display; programmable cursor; 64-char ASCII set; keyboard plus numeric keypack; configured with up to 6/system; includes controller)	121	4,950	30
	DATA COMMUNICATIONS			
	Model CC Series Communications Micro-Processor is a stored program micro-computer with a 2K by 8-bit IC memory. Direct access (cycle steal) channels provide programmed simultaneity and data exchange to processor main memory from the controller memory. No more than 3 of these controllers should be configured on any one processor.			
CCA-1	Buffered Synch/Asynch Controller (9,600 baud synch; 1,800 asynch; handles auto call unit; can interrupt system during unattended operation to auto answer; operates with any Bell serial-by-bit data set or sets with EIA interface; can communicate with systems using IBM bi-sync mode)	98	4,000	30
CCB-1	Communications Line Multiplexor (I/O extender including remote control unit, controller housing, and power supply mounted in desk or cabinet; handles up to 12 Qantel I/O controllers, other than model CC series controllers)	176	7,200	50
CCC-1	Display Concentrator (handles from 1 to 8 CRTs; includes display multiplexor)	96	3,950	30
CA-2	CA Series Unbuffered Synch/Asynch Communications Controller (operates half-duplex with any serial-by bit data set with EIA I/O characteristics; transmission rates: synch, 4,800 baud; asynch, 75 — 2400 baud; modes are switch selectable at time of installation; handles auto call unit and can interrupt system during unattended operation to auto answer)	49	2,000	20
CB-2	CB Series Buffered Asynch Communications Controller (half-duplex speed of 1,800 baud; simultaneity is provided by 156-byte buffer; data speeds are switch selectable at time of installation; operates with 103 or 202 serial data sets, or 402D parallel data set using 7-/or 8-bit code, with 1 start bit and 1 or 2 stop bits, and byte-only transfer; can handle auto call unit; can interrupt system during unattended operation to auto answer)	49	2,000	20

Notes:

* Based on 36-month lease; 60-month full payout lease is available, may require up to a 10% security deposit.

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $**
	Notes: (Contd.)			
	** Maintenance prices are slightly higher outside regular service area; maintenance contract is mandatory with all leases.			
	* *			
	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	495	22,335	NA
	Max increase 10K core			
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
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	Magnetic Tape Controller	95	2,970	NA
45	Magnetic 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
—	Synch 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	
	Asynch Terminal Adapter (ATA)			
—	Direct Connect	60	1,700	NA
—	Communicator	100	2,835	NA

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $
	DATA COMMUNICATIONS (Contd.)			
—	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:

*Rental prices quoted are based upon a one-year lease.

For nondisc communications systems, delete price of FAC and disc controller. Lease rates include maintenance; Singer does not publish separate maintenance prices.

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ULTIMACC COMPUTER SYSTEMS

	Disc System Basic Configuration			
	NOVA 1200 Processor (8-32K)	1,150	56,900	
	IOMEC 2000 Disc Storage System (5M char; max 4)	137	6,500	86
	Printer (135 lpm)	145	6,900	55
	Printer (300 lpm)	NA	14,000	NA
	Other Peripherals for Disc System			
	Video Display Terminal	82	3,900	27
	IBM-Compatible Magnetic Tape Drives (max 4)	232	1,100	60
	Telephone Coupler or Asynch Modem	NA	NA	NA
	Tape System Basic Configuration			
	NOVA 1200 Processor (4-32K)			
	TRI-DATA 4169 Tape Cartridge Serial Printer (30 cps)	975	42,500	175

Notes:

*Rental prices quoted are based upon a one-year lease.

Installation and unlimited usage included in lease price. Lease is 5-year full payout. Conversion-to-purchase option available.

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UNIVAC 9200 AND 9200II

	CENTRAL PROCESSOR & WORKING STORAGE			
3030-00	9200 Processor (with printer)	310	13,485	92
3030-94	9200II Processor (with printer and multiplexor channel)	364	15,834	100
F0822-00	1001 Control	42	1,690	6
F0822-02	1001 Control (9200II only)	90	3,870	12
F0869-98	Multiplexor I/O Channel (9200 only)	53	2,175	6
F0943-99	Channel Adapter 1004/1005	95	4,080	17
F1104-99	Selector Channel (9200II only)	68	3,330	12
7007-85	Storage (32K; 9200II only)	1,593	69,295	154
7007-87	Storage (24K; 9200II only)	1,207	52,505	116
7007-91	Storage (16K)	799	34,755	77
7007-92	Storage (12K)	673	29,275	58
7007-93	Storage (8K)	402	17,485	39
F0890-93	Storage Expansion (8K; 9200II only)	386	16,790	38
F0890-94	Storage Expansion (16K; 9200II only)	794	34,540	77
F0890-95	Storage Expansion (8K; 9200II only)	408	17,750	39
F0890-96	Storage Expansion (4K)	126	5,480	19
F0890-97	Storage Expansion (4K)	126	5,480	19
F0890-98	Storage Expansion (4K)	271	11,790	19
F0882-00	Multiply, Divide, Edit	79	3,380	6
	MASS STORAGE			
	Discs			
F1023-00	Disc File Control (for 8410)	210	9,356	41
F1023-01	Disc File Control (for 8410) (if 1001 control or selector channel used)	210	9,356	41
8410-00	Dual Disc File Master	317	14,149	176
8410-92	Dual Disc File Slave	317	14,149	147
8410-02	Single Disc File Slave	193	8,631	94
F1015-00	Buffer/FASTBAND Search	167	7,434	34
F1016-00	Disc Drive	124	5,518	53
F1102-00	Cartridge	12	252	—
5024-00	Disc File Control (for 8411) Subsystem (for 9200II only)	470	21,011	90
8411-00	Disc Drive	424	20,916	84
F1043-00	Dual Channel	87	3,885	16
F1098-00	Record Overflow	10	457	—
F1099-00	File Scan	37	1,602	—
F1211-00	Disc Pack	16	315	—
5024-02	8414 Control (subsystem for 9200II only)	561	27,720	95
8414-92	Disc Storage (2 disc drives)	838	34,650	138
8414-94	Disc Storage (4 disc drives)	1,676	69,300	276
8414-96	Disc Storage (6 disc drives)	2,514	103,950	414
8414-98	Disc Storage (8 disc drives)	3,352	138,600	552
8414-85	Disc Drive (for expansion)	419	17,325	69
F1043-00	Dual Channel	87	3,885	16
F1214-00	Disc Pack	21	347	—
	INPUT/OUTPUT			
	Magnetic Tapes			
	UNISERVO Tape Subsystems (for 9200II only)			
0858-99	UNISERVO VIC Subsystem (9-track)	787	33,800	242
0858-10	UNISERVO VIC Master (9-track)	429	18,218	130
0858-14	UNISERVO VIC Slave (9-track)	257	10,994	78
0858-98	UNISERVO VIC Subsystem (7-track)	787	33,800	242
0858-00	UNISERVO VIC Master (7-track)	429	18,218	130
0858-01	UNISERVO VIC Slave (7-track)	257	10,994	78
F0827-00	Data Conversion	57	2,237	5
F0828-00	7-Track Feature (for 0858-99)	57	2,237	5
F1021-00	7- to 9-Track Conversion (to 0858-00 and 0858-01)	NC	NC	NC
F1021-99	7- to 9-Track Conversion (to 0858-98)	NC	NC	NC
5017-99	UNISERVO 12 Control (9-track)	561	23,967	105
0861-00	UNISERVO 12 Master (9-track)	360	15,383	113
0861-01	UNISERVO 12 Slave (9-track)	289	12,333	78
0861-04	UNISERVO 12 Master (7-track)	313	13,334	113
0861-05	UNISERVO 12 Slave (7-track)	257	10,963	78
F0823-99	7-Track NRZI (allows 5017-99 to control 7-track units)	113	5,025	16
F0826-00	9-Track NRZI	113	5,025	16
F0935-00	Dual Density	53	2,284	10
F1028-95	7-Track Addition (to F0826-00)	82	3,654	10
F1028-96	9-Track Addition (to F0823-99)	82	3,654	10
F1041-00	7- to 9-Track Conversion (for 0861-04)	48	2,049	NC
F1042-00	7- to 9-Track Conversion (for 0861-05)	32	1,371	NC
	Punched Cards			
F1487-00	Short Card — 51 Columns	39	1,497	10
F1487-01	Short Card — 66 Columns	39	1,497	10
F1488-00	Validity Check	16	756	—
F1498-00	Alternate Stacker Fill	10	504	—
F1530-00	Dual Translate	22	1,008	5
F1486-00 and-02	ASCII Conversion	—	105	—
F1106-00	Mark Read — EBCDIC	177	8,316	39
F1106-01	Mark Read — ASCII	177	8,316	39
F1108-00	600 DPM Speed Upgrade	236	11,088	34
F1149-00	Punch Card Read	59	2,772	10
F1154-00	Validity Check	10	504	—
F1155-00	Univac H-14 Conversion	—	762	—
F1156-00	USASCSOCR Conversion	—	762	—
F1163-00	Modulus 10 Check Digit	22	1,008	5
F1239-00	EBCDIC OCR Conversion	—	—	—
F1239-01	ASCII OCR Conversion	—	—	—
F1249-00	EBCDIC Mark Read Convert	—	63	—
F1249-01	ASCII Mark Read Convert	—	300	—
F1557-00	Optical Card Reader -B	—	762	—
2703-00	Optical Document Reader	937	44,100	197
	Printers			
0768-00	Printer and Control (1,100 lpm; 9200II only)	1,001	42,709	354
0768-02	Printer and Control (2,000 lpm; 9200II only)	1,146	48,873	398
0768-99	Printer and Control (1,600 lpm; 9200II only)	1,242	52,989	438
F1071-00	1,600/1,200-lpm Rate (converts 0768-00 to 0768-99)	241	10,280	84
F0865-00	Variable Speed Printing	68	2,900	17
F0866-00	120 Print Positions	116	5,070	16
F0868-01	132 Print Positions	179	7,730	24
F0868-00	Print Position Expansion	64	2,787	5
F0963-00	300-lpm Print Speed	54	2,284	—
F0969-00	8-lpi Print Spacing	5	231	—
F1130-00	Form Alignment	10	431	—
F1522-00	Print Code Expansion	5	252	—
8541-95	Console/Inquiry (with printer)	145	6,960	34
	DATA COMMUNICATIONS			
8575-00	Line Terminal Control-4	259	11,025	47
F1000-00	Line Terminal Control-1	113	4,799	17
F1002-00	CI Telegraph	8	368	2
F1002-03	CI Private Line	13	594	2
F1002-04	CI Data Phone	13	594	2
F1002-05	CI Wideband	23	961	5
F1002-08	CI 205B	13	594	2

Model Number	Description	Monthly Rental $*	Purchase $	Monthly Maint. $
	DATA COMMUNICATIONS (Contd.)			
F1003-96	LT TWX	69	2,268	11
F1003-97	LT Telex	63	2,688	11
F1003-98	LT Telegraph Checking	47	2,016	8
F1003-99	LT Telegraph Non-Check	43	1,827	7
F1004-98	LT Medium Speed Checking	61	2,594	10
F1004-99	LT Medium Speed Non-Check	51	2,205	8
F1005-96	LT Synch Checking Odd LRC	72	3,040	13
F1005-97	LT Remote Computer	63	2,683	10
F1005-98	LT Synch Checking Even LRC	59	2,494	10
F1005-99	LT Synch Non-Check	51	2,205	8
F1006-99	LT Parallel	39	1,680	6
F1007-99	Dialing Adapter	50	2,163	8
F1008-00	LRC (longitudinal redundancy check; for 8575-00)	43	1,822	7
F1008-99	LRC (for F1000-00)	18	777	3
F1010-99	ATA (Asynch Timing Assembly; 16 available speeds)	10	457	2
F1011-00	STA 1200 (Synch Timing Assembly)	39	1,680	6
F1011-04	STA 600	39	1,680	6
F1011-05	STA 1800	39	1,680	6
F1357-00	Line Terminal Control-IC Integral (adds to 8577-00)	134	6,300	28
F1358-00	LT Non-Transparent	108	5,040	17
F1358-01	LT Transparent	134	6,300	28
F1359-00	High-Speed Buffer	27	1,260	5
F1360-00	Polling (not software supported)	37	1,764	5
F1361-00	Station Select	27	1,260	5
F1363-00	Dialing Adapter	37	1,764	5
F1395-00	Communication Interface	16	756	5
F1395-01	Communication Interface	43	2,016	5

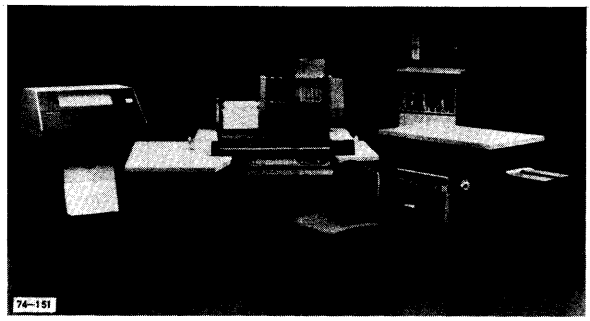
Note:

*Rental prices quoted are based upon a one-year lease.

— Not Applicable
NA Not Available
NC No Charge

BURROUGHS

L Series Business Minicomputers



OVERVIEW

The Burroughs L Series comprises a family of microprogrammed, "visible record" computers intended for small accounting applications. Individual members of the series differ in capabilities depending on the type of processor, memory, and peripherals in the system. Higher performance members can be used for data analysis and report generation. All models support a Cobol compiler, a powerful tool for programming business applications. 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.

The smaller members of the family are distinguishable from most other small business computers by the use of magnetic discs rather than core or semiconductor memory for both firmware control storage and working storage. The L2000, L3000, and L4000 Series models have no provisions for auxiliary magnetic storage; the L5000 allows auxiliary storage of sorts, in the form of magnetic stripe ledger cards, called Magnetic Memory Records (MMR) by Burroughs. The L7000 upgrades the line still further by using the higher speeds of MOS ROM for control firmware, while both working storage and auxiliary storage are master files on disc.

The most recent addition to the line, the L8000 Series, is not simply further extensions at the top end of the line, but the L8000 also provides alternative models at each L Series level with greater working storage capacity, higher processing speeds, and a new cassette-based, software-controlled "dynamic memory overlay" technique. None of the 8000 Series use discs. Instead, MOS LSI RAM stores the control firmware and operates as user 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. The addition of the cassette drive and supporting software expands on-line and working storage at considerably less cost than upgrading from an L2000 to an L7000, for example.

Most L-Series models can be easily converted to a corresponding TC terminal computer model; the data communications memory and logic are housed in a separate unit. The TC 500, 1500, 2500, and 3500 Series roughly correspond to the L2000, L3000, L4000, and L8000 Series, respectively. Like the L8000, the TC 3500 straddles the entire series; certain TC 3500 models are direct upgrades for TC 500/1500/2500 models. The basic differences among L8000 Series models and the correspondence of L8000 models L-Series and TC-Series models are presented in Table 1.

PERFORMANCE AND COMPETITIVE ANALYSIS

The addition of the L8000 Series has enabled Burroughs to keep its popular L Series competitive in a market generally experiencing price drops as a result of the lower costs of large-scale MOS circuitry. Because the L Series design was originally innovative for its time, using 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.

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

IBM does not compete in the steadily growing accounting computer market; its accounting machines are still of the old electromechanical variety. Litton Industries, Singer-Friden, and the European-based Philips and Nixdorf companies have made substantial inroads into the U.S. market for small accounting computers. All provide for production of ledger cards; the Litton ABS and Singer Series use edge-punched cards while Philips and Victor also provide for the magnetic stripe ledger cards more popular in Europe.

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 will have to be further developed before competing directly with the European accounting computers currently available with the range and price/performance of the Burroughs L Series.

User Reactions

We interviewed several small users for this report and discovered that all had recently upgraded from an old L-Series system to an L8000 model. A small manufacturer of replacement parts for appliances exchanged an L5000

Table 1. Burroughs L8000 Models Compared With Other L Series and TC Models

L8000 Models	Forms Feed	Platen Type	Platen Width (in.)	Cassette Drive*	Corresponding Models: L Series	Corresponding Models: TC 3500	Corresponding Models: Other TC
L8200-100	Rear	Split	15.5	No	L2000	TC 3520	500
L8200-200	Rear	Split	15.5	Yes	L2000	TC 3520	500
L8300-100	Front	Split	15.5	No	L3000	TC 3530	1500
L8300-200	Front	Split	15.5	Yes	L3000	TC 3530	1500
L8400-100	Front	Split	26.0	No	L4000	TC 3540	2500
L8400-200	Front	Split	26.0	Yes	L4000	TC 3540	2500
L8541-100	MMR**	Split	26.0	No	L5000	TC 3570	—
L8541-200	MMR**	Split	26.0	Yes	L5000	TC 3570	—
L8541-104	MMR**	Solid	26.0	No	L5000	TC 3570	—
L8541-204	MMR**	Solid	26.0	Yes	L5000	TC 3570	—
L8542-100	MMR** (dual track)	Split	26.0	No	L7000	TC 3580	—
L8542-200	MMR* (dual track)	Split	26.0	Yes	L7000	TC 3580	—

Notes:
* Refers to L8000 and TC 3500 Series only.
** Magnetic Memory Reader; i.e., magnetic stripe ledger card reader. Unless otherwise stated, refers to single track holding 352 bytes.

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 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, rarely was overtime required on the first shift 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 the L8000 is easier to convert to its corresponding TC 3500 communications version than earlier models had been 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.

Table 2 outlines the configuration differences among the models or lines. Table 1, as mentioned previously, shows the characteristics of each L8000 Series processor

Table 2. Configuration Differences in the L Series

MODEL	L2000/L3000 L4000	L5000	L7000	L8000
MEMORY				
Cycle Time (μ sec)	0.5	0.5	0.5	0.3
Firmware Location	Disc	Disc	MOS ROM	MOS ROM
RAM (user memory)				
Type	Disc	Disc	Disc	MOS
Size (bytes)	512-6,144	512-6,144	512-6,144	4K to 44K
Data Structure				
Bits/Word	64	64	64;16	64
Bytes/Word	8	8	8;2	8
Auxiliary Memory	—	—	Disc	Cassette
PERIPHERALS, I/O				
Punch Cards				
80-Col Reader	A595; A596	A595; A596	9114	A9114-1
80-Col Punch	A149	A149	A149	A9119-1
96-Col Reader	—	—	—	A9119-2
96-Col Multifunction	—	—	—	A9119-6
P. Tape/EP Card				
Reader	A581	A581	A9122	A9122-1
Punch	A562	A562	A9222	A9222-1
Computer Tape	A1495	A1495	A1495	A1495
Transport Magnetic				
Stripe				
1-trk	—	A4005	A9161	A9161-1
2-trk	—	—	A9162	A9162-1
Console Forms Handler	—	—	—	A9361/A9362
Auxiliary Printers	—	—	A9249	A9249-1, -2
Magnetic Tape				
Cassette Transport	—	—	—	A9490-25

model and its related processor of the L2000, L3000, L4000, L5000, or L7000 Series and its corresponding TC 3500 model.

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, as shown in Table 2. 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 that provided by 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 is equivalent to more than 10 times the capacity of the 416-word maximum for the previous models; each word is eight bytes long.

Common Characteristics

All L-Series accounting computers use the same basic keyboards, platens, and printers. 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 similar to 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 Magnetic Memory Record available for the L5000, L7000, and L8500 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 the controlling program. Single tracks hold 352 digits, dual tracks 704. The MMR forms handler can also handle normal (nonmagnetic) forms and continuous forms.

L2000/L3000/L4000/L5000 Peripherals

The following optional input and output peripherals are available for the older models: edge-punched-card perforator (A562) punches 40 characters per second; paper-tape, edge-punched-card reader (A581) reads 40 characters per second; an 80-column-card reader (A595) reads 100 BCL- or EBCDIC-punched cards per minute; a card keypunch (A149) 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 speeds; 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. Five-, 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.

L7000/L8000 Peripherals

The L7000 and L8000 can attach the same types of peripherals as 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 cards per minute; it has two feed hoppers and can be furnished with six stacking hoppers to permit off-line sorting and merging, then 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 an L8400 and up, but it can not run on an L2000, L3000, L8200, or L8300 because of the longer print line. An L8400 program, on the other hand, can not run on the L4000 because of the L4000's small memory size. Programs written for a system with tape cassettes and dynamic memory overlay feature implemented will not run on an L4000.

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

SOFTWARE

The L Series is unusual in terms of programming flexibility, because it still remains 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. The company provides, at no extra cost, preprogrammed routines to assist in program debugging, as well as several utility routines.

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 is not as oriented toward customized programming as is, 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 mortgage 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 dynamic memory overlay mode, programs are automatically loaded from cassette tape stations and are 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.

HEADQUARTERS

Burroughs Corporation
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Detroit MI 48202

BURROUGHS
B 700 Series

SUMMARY

It's not certain that a "gap" really existed between the Burroughs Series L 8000 and the Burroughs B 1700 Series, but Burroughs has conveniently filled it by the introduction of the B 700 Series, the smallest of the Burroughs "700" family of computers. The B 700 Series is truly a small business machine. It offers hardware, an operating system, a license to programming products, training, and selected maintenance. Programs to be run are called by very simple commands. Data conversion, from card to disc, or from tape cartridge to disc, is simple and fast.

The B 700 system is aimed at first-installation users and is totally designed to be run with the Burroughs Business Management System (BMS). BMS is a comprehensive set of business programs developed for and being used with the Series L 8000 and the B 1700 Series computer systems, and now the 700 series. BMS is priced separately from the hardware and operating system software. According to users, it is sufficiently flexible to contain the needs of any business operation, world-wide.

It is the BMS, in fact, that separates the B 700 from a high-powered programmable accounting machine. Business reports of almost every usable genre can be produced easily, if not quickly.

Clearly, the Series L 8000, B 700, and B 1700 overlap. All use the Business Management System and all have Cobol. The larger two have RPG. The B 1700 and L 8000 can handle communications, the B 700 currently cannot (hints are being made about the B 700, however). The L 8000 cannot handle disc or full-sized magnetic tape reels. The B 700 and B 1700 both have operating systems. The B 1700 currently can handle IBM System/3 RPG, the B 700 cannot (more hints). Prices and core capacity overlap between the L 8000 and the B 700, and between the B 700 and the B 1700.

It appears that the deciding factor in which system to purchase should be the amount of data and the degree of general purpose flexibility desired. The B 1700 is technologically and operationally superior; at the low end it completely encompasses the B 700 for a slightly higher price. At the high end it overlaps the medium general purpose B 2700.

However, for a pure and simple business system, flexible within the constraints of small business requirements, and little else, the B 700 is a good system if not too much data needs to be readily accessible at any one time.

One of the better features of data entry is the Audit Entry capability. The operator/data-enterer is informed by a beep whenever illogical or invalid data is entered in a specific field. The console used for entering data is the same pleasantly pastel color-coded terminal used for the L 8000. The Audit Entry Terminal (AE 300) is available whenever input needs go beyond a single data enterer, or whenever data is to be encoded at a different location and transferred for entry to the machine. The AE 300 enters data onto a magnetic tape cassette, compatible with the L 8000. Information from the tape cassette is read by the B 700 processor and placed on disc.

Data and programs to be executed are stored on disc. This is different from the L 8000, for which programs are stored as object programs on tape cassettes, and require previous compilation on a B 3500, and data is stored on magnetic records. Disc-resident programs are the norm for the B 1700 Series, and the data can be stored on disc or tape. And of course, the B 700 offers the ever-present 80- or 96-column punched card.

Security procedures were not mentioned at the B 700's announcement, although the organization of data stored on disc for the B 700 series is key-oriented. Apparently, access to the machine and knowledge of report programs' names yield access to the data.

Another similarity with the B 1700 Series is that the B 700 series has an operating system, albeit a naive one. The operating system can assign resources, handle the checkpoint/restarting of the program running (Burroughs calls this facility "interrupt/resume"), and handle the invocation of general programs, sort, utilities, and the Cobol and RPG compilers.

Physically, the B 700 system is small, both in occupied floor space and number of units, and is quiet. It is also low to the ground; access to the disc cartridges, the printer, the terminal, and the tape storage area is best performed by continual and uncomfortable stooping.

COMPETITIVE POSITION

In addition to competing with other Burroughs products, the B 700 competes with the HIS 2020, the Univac 9200, the IBM System/3 Model 10, the Singer System Ten, and the NCR Century 50.

The HIS 2020 has a wider range of peripherals and available languages, and already offers communications capabilities. It also has a slightly more sophisticated operating system which, although not offering a checkpoint/restart, can handle two programs at one time by alternating I/O and CPU time. Both the B 700 and the HIS 2020 are disc-oriented. Both offer a wide range of applications programs for businesses, banks, wholesalers, etc.

The B 700 however is technologically more innovative than is the HIS 2020 and as a result operates at significantly faster speeds. The operating system on the B 700 is microprogrammed, as are all I/O instructions and the instructions for the Cobol interpreter, the sort program, and the utilities, that is, the B 700 is a mini-computer disguised as a small business machine. The HIS 2020 is a conventional smaller version of a larger general-purpose machine.

Both the HIS 2020 and the B 700 are upward compatible with their respective general-purpose machines at the source code level.

Users who want a larger choice of business and scientific applications software than is offered by the B 700, IBM System 360/370 compatibility, but not IBM prices, can opt for the Univac 9200. The Univac 9200 is completely upward compatible with the rest of the Univac 9000 series.

The nearest IBM competitor to the B 700 is the System/3 Model 10. The system is more flexible, offers a wider variety of programming support and of peripherals, and has a more sophisticated operating system. It is also more expensive. And it is completely incompatible with the larger general purpose computers in the IBM product line.

In the discussion of relatively isolated performers, i.e., machines that are not upward compatible with anything in particular, the Singer System Ten is a noteworthy competitor. Its strongest distinguishing factor when compared with the B 700 is its wide range of special purpose peripherals, including employee badge readers and cash-register-type terminals with merchandise tag readers. It also supports a CRT display.

The System Ten doesn't have an operating system, but it does have a sophisticated memory segmentation and I/O channel sharing that allows multiprogramming of up to 20 programs at one time.

The NCR Century 50 could be called the "plain vanilla" competitor of the B 700. It offers about the same functions, to approximately the same user base, for about the same price. However, its total core capacity is less. And it is not intended for any kind of conversational user-machine interaction. Its typewriter keyboard is an optional feature that serves primarily for communication with the CPU.

CONFIGURATION GUIDE

Two central processors are available for the B 700 series; the B 705 and B 711. Both have 1 microsecond cycle times, although processor speed for the B 705 is half as fast as processor speed for the B 711. The B 705 has a 32K byte basic memory which is field expandable to 40K. The B 711 has a 32K byte basic memory, field expandable in two 8K byte increments to 48K bytes. There is no technological reason why either of the processors could not be further expanded.

The processor logic, memory, peripheral controls, and power supplies are all included in one unit. Two buffered I/O controls, the minimum per processor, may be expanded to eight I/O controls.

Regardless of functional orientation, every basic configuration includes 32K bytes of memory, a 26-inch console, and a disc cartridge drive with 4.6 megabytes of storage. Every basic configuration can accommodate either of the two available processor speeds.

Tailoring of the basic configuration for audit entry includes addition of a 90-line-per-minute printer, a magnetic tape cassette drive, and an AE 300 audit entry terminal equipped with a magnetic tape cassette.

Tailoring of the basic configuration for a card system includes addition of a 90-line-per-minute printer, a 96-column card reader/punch/printer/data recorder, and an off-line 96-column card data recorder for data preparation.

Equipment announced as available, and a general comparison with the L 8000 and the B 1712/1714, appears in Table 1.

COMPATIBILITY

At the source code level, the B 700 Cobol and RPG programs are compatible with the B 1700 and therefore with the rest of Burroughs' medium systems (the B 2700, B 3700, B 4700, etc.).

Object code is in no way compatible. Data should be compatible. Cobol programs written for tape cassettes and with minimal I/O from the L 8000 will run on the B 700 with little or no modification.

The Cobol and RPG are not compatible with other manufacturer's versions of the same languages.

Peripheral compatibility appears in Table 1.

SOFTWARE

The most noteworthy feature of the software is the Burroughs Management System, which is indeed the set of applications programs of the same name that exists for the L 8000 and the B 1700.

The BMS is actually a collection of over 350 modules, each of which performs a single, common business function. The modules are collected into different groups to perform the required functions of the user. The same modules are used in whatever functional group requires them.

For example, a hospital accounting routine payroll subsystem may require deductions of various natures. Even though the function and performance results of the entire package may differ from the results of a wholesaler's payroll subsystem, the chances are that exactly the same BMS module is being used in both packages to perform the desired payroll deductions. To the user, this modularity means desirable flexibility, comprehensiveness, and ease of use.

The BMS is heavily report oriented. Its data base is key-oriented, which makes production of reports much simpler. Key-oriented data bases lend themselves to cross-referencing.

Table 1. Available B 700 Peripheral Devices

B 700 Characteristic or Device	Compatible with L 800	Compatible with 1712/1714
B 9343 Console	No	No
AE 300 Audit Entry Computer	No	No
Disc Cartridge		
A 9480 (4.6 megabyte)	No	Yes
A 9481 (9.2 megabytes)	No	Yes
Magnetic Tape Cassette		
A 9490-25 (240,000 char, 800 bpi, 10 inches per second)	Yes	No
A 9491-2 (9-channel, 800 bpi, NRZI, 10 kb)	No	Yes
Line Printers		
A 9249-1 (90 lpm, 132 char. print line)	Yes	Yes
A 9249-2 (180 lpm, 132 char. print line)	No	Yes
A 988 (164 lpm, 120 char. print line)	No	No
A 9247-2 (400 lpm, 120 char. print line)	No	No
Card Reader		
A 9114-1 (80-col, 200 cpm)	Yes	No
A 9119-1 (96-col, 300 cpm)	No	Yes
Card Reader/Punch/Data Recorder		
A 9419-2 or -6 (96-col, 300/60 cpm)	No	Yes
Paper Tape Reader		
A 9122	No	No
Paper Tape Perforator		
A 9222-1	No	No

Registers, reports, journals, statements, and inventories of many descriptions are available.

Other software functions available are a sort program, and various data conversion utilities.

The B 700 operates under the control of the System Control Program (SCP) which is primarily a serial batch processor. 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 then be resumed, without omission or duplication of any function.

The SCP is disc-oriented. Programs are read to disc before being executed. This allows for much faster processing than in the L 8000, for example.

TECHNOLOGY

Burroughs has a marketing habit — annoying to people who prefer technical accuracy — of stressing design features that are sometimes inaccurately named. For the MCP it was "virtual memory", for the B 1700 it was "bit addressability". For the B 700 the design feature inaccurately named is "Dynamic Interpreter Configuration".

Classically, an interpreter is a fixed set of routines designed to provide immediate execution of a series of programming language instructions, as each instruction is encountered.

Burroughs when it refers to an interpreter, means an organized group of micro-instructions used to control the processor functions. Immediate execution of sequential instructions does not enter into the picture at all. Also, Burroughs' interpreter refers not just to the programming language "compilers", but also to the various sort and utilities routines.

What Burroughs means by "dynamic interpreter configuration" is the following. Memory on the B 700 is divided into a shared memory (magnetic core) and nanomemory (bipolar ROM). The shared memory is used for all applications programs, utilities, sort, and the microcoded operating system. The nanomemory holds the microcode for every basic function that the machine is capable of performing. The functions in the nanomemory are language-independent. They are a group of 256 carefully chosen instruction primitives designed to represent a composite of the basic desirable functions of Cobol, RPG, sort, various utilities, and the operating system, including I/O.

When each application program is compiled, a list is made of the micro-instructions it will use, and the proper execution sequence for the instructions. These lists are read onto disc. When the program is called into memory, micro-memory collapses to include only those micro-instructions needed for execution; the remainder of memory is therefore expanded and can be used for the processing of the application.

There is overhead in I/O transfer from memory to disc; but generally this overhead should be offset by the increased available core.

Again, as it did with the B 1700's variable word length, Burroughs has chosen not to promote what seems to be the most exciting technological aspect of the B 700 — that is, the modular treatment of the language-independent primitive instructions of the machine.

The difference between this concept and, say, the way IBM operates, is that IBM designs its basic machines around the functions represented by the Assembler language.

Burroughs in the B 700 has designed basic functions irrespective of any one particular language.

What this means for the B 700 is that any application program can have access to whatever micro-instructions are best suited to the tasks it is performing. It does not have to suffer through a series of micro-instructions that are makeshift substitutes for its preferred functions. This means that processing time and core resources are being much more effectively used.

Burroughs engineers probably learned this from their application program designers. The Business Management System, for example, is composed exactly the same way: it is a clearly defined group of basic, company-independent functions, able to be combined in a wide variety of ways to perform almost every conceivable business function (hospitals, wholesalers, banks, etc.).

The use of microprocessors will very likely give the B 700 a processing edge with respect to its competitors.

MAINTENANCE AND TRAINING

Maintenance test routines exist that will convert the system to a diagnostic tester. Microcoded diagnostics routines use test cards and a dictionary to isolate memory failures.

Maintenance of hardware, operating system software, and program products is provided if the user buys the entire package of hardware, operating system, licensing of program products, and the training of personnel. No mention was made of maintenance agreements available if the entire package is not purchased.

BURROUGHS
B 1700 Report Update

OVERVIEW

In July, 1973, Burroughs Corporation announced the latest and largest processor in its 1700 line of business-oriented general purpose computers. Target areas for its use are industries such as banking, wholesaling, distributing, manufacturing, hospitals, government, and education.

The announcement of the B 1728 is significant because it extends what was originally a line of small business machines into the small-to-medium area. In fact, the 1728 overlaps the capabilities of Burroughs current entry into the Medium Systems area, specifically, the "700" series B 2700/3700 computers.

The B 1728 has all of the characteristics and capabilities of the formerly announced members of the 1700 line: the B 1712 and 1714 (the so-called "1710" systems) and the 1726. (The 1726 and 1728 together are called the "1720" systems.) These features include compatibility with Burroughs' B 300/B 500 (achieved through emulation or straight compatibility, depending on model), and emulation capabilities for IBM's 1401/1440/1460. Other characteristics shared by the new arrival with the series are its orientation towards communications (a multiline controller was announced), and its ability to use the peripherals and subsystems available on the 1712, 1714, and 1726. It also shares a market thrust towards small or new businesses as well as large firms that require satellite data processing computers.

COMPARISON WITH OTHER BURROUGHS PRODUCTS

The B 1728 is similar to the 1726 in that both have the same control memory/main memory stratifications and speeds, although the 1728 control memory can be expanded from 6,144 bytes to 8,192 bytes, double that of the 4K maximum available on the 1726.

They have similar I/O channel schemes, and all of the peripherals that can be attached to the 1726 can also be attached to the 1728.

Both use the MCP-II multiprogramming operating system, and the same programming languages: Cobol, Fortran, RPG, Basic, NDL (Network Definition Language), and UPL (User Programming Language). Also, both can use the same applications software, including the Burroughs-authored business management system software.

Both the 1726 and the 1728 can use the multiline controller announced simultaneously with the 1728. Use of this controller provides a maximum of 8 lines on the 1726 and 16 lines on the 1728. The controller uses direct memory access and transmits data at 9,600 bits per second. It is very similar to the Data Communications Processor in use with the Burroughs Medium Systems.

The B 1728 differs from the B 1726 in that the main memory capacity of the B 1728 is larger: 64K bytes expandable in 16K increments to 262K bytes.

Another difference between the B 1728 and B 1726 is that a head-per-track systems disc memory with integrated controller is included in the basic price of the 1728; it is available at separate cost on the 1726. The disc is a modified version of the head-per-track discs available with the Medium Systems processors: it has the same access time (20 milliseconds); its capacity is slightly lower (8.1 million bytes) because of modifications necessary to adapt the disc to the 1728. Disc expansion is the same as that available for the Medium Systems — up to 5 units can be attached for a total of 40.5 million bytes for the 1728. The disc is used to store systems programs and, additionally, user programs and data.

Also announced were phase-encoded, 1,600 bpi tape drives for use on the 1726 and the 1728. Transfer speeds for the 3 drives announced are 40, 80, and 120 kilobytes per second, respectively.

Other devices that have been announced for the 1728 seem to be modified versions of devices available on the Medium Systems; these include an 80-column card reader with a reading speed of 800 cards per minute, and an 80-column card punch with a punching speed of 300 cards per minute; paper tape equipment with respective read/punch speeds of 1,000 and 100 characters per second; and a chain printer with a 48-character set and a speed of 400 lines per minute. High-speed devices that also seem to be modified Medium Systems devices are the 9-channel magnetic tape unit with a 96-kilobyte transfer rate and a 7-channel tape unit with a 72-kilobyte transfer speed.

Because a pattern of adapting Medium Systems peripherals to the "1700" line is developing, a relevant question is, what does the emergent "1700" line have over the existent "700" line?

For one thing, the "1700" series uses the more modern stratified approach to memory technology. Control memory is bipolar semiconductor and operates at 167 nanoseconds (2 bytes). Main memory, also integrated circuit memory, cycles at 667 nanoseconds (3 bytes). This layered approach yields faster execution times than the core technology of the "700" series.

Secondly, the "1700" series can be configured at lower monthly rentals than their "700" series counterparts.

Thirdly, the operating system of the "1700" series computers is more sophisticated than that of the "700" series Medium Systems. The MCP-II uses a pure paging scheme (similar to that used on the multiprocessing 6700/7700 machines) and dynamically reconfigures microcode instructions. These features give it a performance edge over the "700" series MCP-V, which uses a segmentation form of virtual addressing and a fixed microcode instruction set.

Competitive Position

The first obvious target for comparison is Burroughs' own Medium Systems processors, the B 2700/3700. The B 1728 has several distinct advantages. Analysis of monthly rental costs for comparable configurations of the B 1728 and B 2700/3700 indicate that the B 1728 is less expensive. The maximum memory capacity of the B 1728 outstrips that of the smaller B 2700 configurations, and maximum memory of the B 3700 is only 38 kilobytes greater than that of the B 1728.

Other factors in favor of the B 1728 are its more modern technology already discussed, and the somewhat more sophisticated MCP-II.

The major advantage of the B 2700/3700 series over the B 1728 is the significantly greater on-line storage capacity, but future announcements may alter this.

Other more modern competition includes the IBM System/370 Model 125. The B 1728 was scheduled for first delivery September, 1973. Comparisons therefore can only be speculative, pending actual throughput analyses.

The B 1728 is good for applications that need large amounts of on-line storage; it has in excess of a half-billion bytes of on-line storage. However, the S/370 Model 125 dual-density 3330 Model 11 drives give it an 800 million-byte capacity. Model 1 packs give a 400-million byte capacity, which is less than that offered on the 1728.

The 1728 is also good for applications that are oriented toward communications; the single line controller of the earlier 1700 systems is available, plus the multiline controller, as announced (an independent processor), can connect up to 16 lines. The IBM System/370 Model 125 can support 6 synchronous lines or 16 start-stop lines with one optional adapter or double that with a second optional adapter. IBM offers a Network Control Program that eases the user's network definitions, but Burroughs Network Definition Language offers more flexibility and it is easier to use.

As far as operating systems go, the MCP as defined in the main 1700 report is better than any of the competing operating systems for increased throughput without unnecessary overhead.

Both operating systems require some user sophistication. IBM's DOS/VS is not for the novice, since throughput on a virtual memory machine as implemented by DOS/VS, where core is a strict limitation, requires considerable planning to avoid "thrashing". Job mix and balancing functions must be performed by the user with DOS/VS. MCP-II, on the other hand, performs these functions and allocates system resources. The 1728 is a good system. The only truly negative feature that we have found lies not in the 1728 hardware, but in the business management system software available for applications. Users of this system, which is available on other Burroughs machines, have complained that its extreme modularity makes it slow and unnecessarily redundant.

CONFIGURATION GUIDE

The B 1728-1 Basic System includes a central processor; 6,111 bytes of control memory (167 nanoseconds for 2 bytes); 65,536 bytes of main memory (667 nanoseconds for 3 bytes); an I/O subsystem with 14 I/O positions; a console printer and control; a head-per-track disc file control (partly integrated); and a head-per-track systems disc. The latter comprises one disc file electronics unit and one disc file storage unit (capacity: 8.1 million bytes, average access time: 20 milliseconds).

The basic system is modular and can be expanded as follows:

- Main memory (LSI) from 65,536 bytes to a maximum of 262,144 bytes, in 16K-byte increments.
- IC control memory from the standard 6,144 bytes to 8,192 bytes.
- Head-per-track disc from the standard 8.1 million bytes to 40.5 million bytes in 8.1 million-byte increments.
- Removeable disc subsystems up to a maximum of 525 million bytes.

Addition of a second electronics unit as available on the "700" series disc system, but not yet announced for the 1728, would allow a 1 x 2 exchange and the addition of another 40.5 million bytes of on-line storage. Additionally, a disc pack memory controller connects the modular disc pack memory subsystem. Transfer rate is 625,000 bytes per second. The maximum disc capacity is 525 million bytes.

The I/O subsystems offer buffered controls for the following devices: 96- and 80-column card equipment, line printers, the head-per-track memory, disc cartridge memory, magnetic tape, paper tape, MICR reader/sorters, and the data communications single line control. Buffered controls speed up I/O transfer considerably, which is important in systems with I/O bound applications, such as business systems invariably use.

BURROUGHS

B 1700 Systems

OVERVIEW

Burroughs B 1700 computers are small-scale general business systems aimed at both small and/or new businesses as well as large firms that need satellite data processing installations. They provide efficient competition for the IBM System/3, Honeywell Models 2020 and 2030, NCR 50, and Univac 9200.

The 3 models currently in the B 1700 series — B 1712, B 1714, and B 1726 — vary essentially in processor cycle rate, size range of main memory, and available peripherals. The B 1726 also has a control memory that operates at 4 times its main memory operating rate of 666 nanoseconds per 24 bits.

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 new series of MICR document reader-sorters, which are of special interest for banking applications. All devices are buffered; up to 8 individual I/O controls are available on any of the 3 systems.

Two versions of the Master Control Program (MCP) operating system have been announced for the 1700 series: MCP I and MCP II. MCP I is a serial programming system which is not released to date. MCP II provides a multiprogramming environment. Both MCPs are responsible for dynamic control of memory and resource assignment, I/O operations, operator communications, library management, logging, and other functions. The commands for the MCP, entered via the console or via control cards, are simple to use and understand.

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.

A design feature, strongly emphasized by Burroughs, is "bit addressability." Burroughs claims that this is the ability of the B 1700 processors to address an individual bit in memory. It is true that the 1700 microinstructions are capable of direct bit manipulation and that memory fetch addresses are at the bit level. However, the B 1700 memory is physically divided into 8-bit words. The CPU addresses main memory physically on byte boundaries so that parity bits can be checked and created. What the microinstructions can do that is noteworthy is access memory in either positive or negative increments respective to a referenced bit, for a specified number of words of variable length.

The variable instruction, operand, and word lengths are the design features that Burroughs should really be emphasizing. At the s-code level, the Burroughs word (or "unit") can be defined as 1 to 65,535 bits (8,191 characters). This flexibility allows improved utilization of available space and faster execution. In regard to space savings, Burroughs is making a claim of a 20 to 40% reduction in the amount of memory needed to execute programs. Users of variable word length machines from other manufacturers have reported space savings of as much as 70%. Burroughs' 40% is probably a conservative estimate.

Configuration Guide

Tables 1 and 2 show the variations in processor speed, memory size, and supported peripherals of the three B 1700 series models. It also contains 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 card per minute), an A 9245-16 32-column line printer, and an A

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

Characteristic or Device	B 1712	B 1714	B 1726	Comments
Processor Speed (msec)	0.5	0.25	0.125	
Memory Size (bytes)	16-40K	16-65K	24-98K	
Increment Sizes	8K	8K	8K to 65K; 16K to 98K	On the 1726, main memory increments replace the basic configuration memory. MOS/LSI semiconductor.
Control Memory	—	—	x	2K or 4K available for 1726.
9340 Console Printer & Control	x	x	x	Required.
I/O Channels (max without I/O expansion feature)	5	5	8	On the 1726, there are 5 types of I/O subsystem connections. 1 each std.
I/O Channels (max with I/O expansion feature)	8	8	8	Max 2 expansion features on 1726; adds 1 each of 3 types of subsystem connections.
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	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	
9486-2 Dual Disc Pack Drive (95.5 mb; 42.5 msec)	—	—	x	Max 1/control.
9371 Head-per-Track Memory Bank (7 or 14 mb; up to 5 units; 20 and 40 msec, respectively.)	—	—	x	Max 1/control.
Magnetic Tape				Max 1 control/processor.
9491-2 9-Channel Magnetic Tape Unit (10 kb; NRZ; 800 bpi)	x	x	x	Max 4/control.
9381-12/13/14 9-Channel Magnetic Tape Cluster (18 kb; 2/3/4 stations)	—	x	x	
9381-22/23/24 9-Channel Magnetic Tape Cluster (36 kb; 2/3/4 stations)	—	x	x	
9390-3 7-Channel Magnetic Tape Unit (18/50 kb; NRZ; 200 or 556 bpi)	—	—	x	

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, except for the 1726, is eased by add-on memory modules and compatibility of peripherals. On the 1726, the basic configuration memory is replaced during upgrading. Also, the 1726 will not handle the slow-speed printers of the 1712 and 1714.

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

Table 2. Burroughs B 1700: Configuration Information

Characteristic or Device	B 1712	B 1714	B 1726	Comments
Card Equipment				Max 2 controls/processor. Max 3 readers on 1726.
9115 80-Col Card Reader (300 cpm)	x	x	x	
9116 80-Col Card Reader (600 cpm)	—	x	x	
9111/2 80-Col Card Readers (800, 1,400 cpm)	—	—	x	
9210 80-Col Card Punch (100 cpm)	x	x	x	
9119-1 96-Col Card Reader (300 cpm)	x	x	x	Max four 96-col readers, or if MICR used, probably 3.
9319-2 96-Col Card Reader-Punch (300/60 cpm)	x	x	x	
9319-4 96-Col Reader-Punch (500/120 cpm)	—	x	x	
9419-2 96-Col Reader-Punch Data Recorder	x	x	x	
9419-6 96-Col Multifunction Card Unit (includes sorter)	x	x	x	
Line Printers				Max 1 control/processor.
132-Col Line Printers (90-300 lpm)	x	x	—	
132-Col Line Printer (400 lpm)	—	x	—	
132-Col Line Printers (475-750 lpm)	—	x	x	
132-Col Line Printer (1,040 lpm)	—	—	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	
MICR Reader-Sorters (900 cpm; 8 or 12 pockets)	—	x	x	
MICR Reader-Sorter (1,000 cpm; 13 pockets)	—	—	x	
MICR Reader-Sorter (1,625 cpm; 4-16 pockets)	—	—	x	
Data Communications Single Line Control	—	x	x	Max 2 controls/processor, controls need line adapters.

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 1700 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 2 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.

System/3 offers time sharing; B 1700 does not, although release of an interactive Basic compiler is planned. 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 users' 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.

History

Burroughs, founded in 1905, is one of the 2 largest manufacturers of electronic accounting machines, as well as one of the largest computer manufacturers. The company employs over 52,000 people, grosses approximately $900 million a year, and maintains a worldwide marketing force.

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.

Bit Addressability

For the B 1700 Burroughs is advertising "bit addressability," a concept that has been existent at least since IBM's ill-fated STRETCH. Burroughs claims that this is the ability of the B 1700 processors to address an individual bit in memory. Microinstructions' memory fetch addresses are at the bit level. However, the CPU addresses main memory physically only on byte boundaries in order to check and create parity bits for the 8-bit words (into which the memory is physically divided). The difference with Burroughs' access of main memory is that it can be done either in negative or positive increments respective to the desired bit; the data can be rotated to isolate the appropriate starting bit during the memory fetch.

Normally, bit manipulation at this level isn't noteworthy. However, Burroughs has thoughtfully provided a varying word length which optimally means that storage can be allocated in bits. The interpreters can directly invoke calls to microinstructions that operate on bits. More importantly, this avoids the crime of wasted storage classically committed by higher-level languages that require byte boundaries for values that could be represented in less than a byte. This manipulation of individual bits — generally a systems programmer's concept — is an interesting development from a manufacturer whose machines are oriented toward the higher-level languages.

One result is that bit addressability gives the ease of higher-level language coding, plus some of the storage utilization of a systems language, namely, Assembler — an almost ideal blend. Add to this, the microcoded interpreters, which allow dynamic reconfiguration of the hardwired microinstructions on the basis of a series of software microinstructions tailored to the appropriate higher-level language, and the B 1700 becomes a technological blend of minicomputer sophistication and general-purpose computer flexibility.

A logical extension of this sophistication is that the 1700 systems are well suited to be "universal emulators." Technologically, the 1700 systems are so flexible at the microcode level that they could emulate any machine.

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 8 to 12 distribution pockets and sorting speeds of 600 or 900 documents per minute, or 4 to 16 pockets at 1,000 or 1,625 documents per minute.

High-Speed Peripherals

Disc storage is available in 3 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 only on the B 1726.

Magnetic tape equipment is a subset of the equipment that is offered for the larger 700 series computers. Both 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 2 lines on the B 1714 and 3 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.

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 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, 3 programs are a reasonable multiprogramming mix. Burroughs claims that the 1710 systems also can multiprogram effectively.

We were sceptical 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 3 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 3 programs was run serially; the timings were recorded. The programs were than multiprogrammed.

Their order of entry into the system was 2, 3, 1. In this order, the programs ran in 69% 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% 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 2: one for SDL (Systems Definition Language, Burroughs' high-level language version of Assembler), and 1 for the language that the users' 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

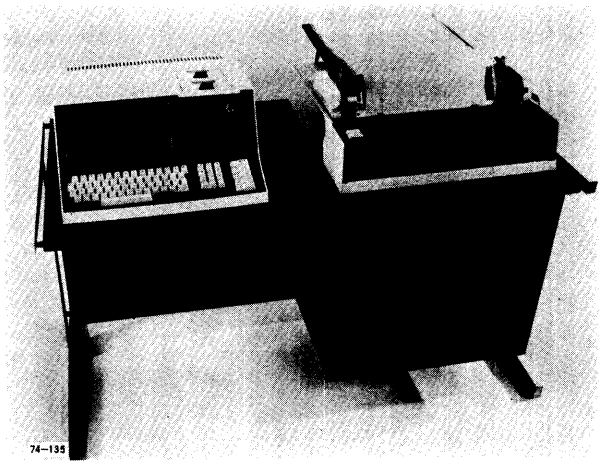
Maintenance for the B 1700 series is performed by Burroughs service personnel available on-call during mutually agreeable business hours and operating from over 200 branch locations throughout the country. First-year maintenance is included in the lease or provided by a separate contract.

HEADQUARTERS

Burroughs Corporation
6071 Second Avenue
Detroit, MI 48202

DATAPOINT

2200



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, 1.2-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 2.4M-byte cartridge disks, 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, seven versions of a special high-level language called Databus, Basic and RPG compilers, and a variety of utility routines (including sort-merge). 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" permits the simultaneous execution of Databus programs on up to eight slave CRTs. Software packages provide compatibility with IBM 2780, IBM 2741, IBM 2265, 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 recently, Datapoint specialized in two basic product lines, the 3000/3300 Series of interactive computer display terminals and the Datapoint 2200 Systems. The 2200 was introduced in 1971 as an intelligent terminal. Version II with the software and support needed for the small-business and distributed processing market was announced in January 1972. By mid-1973, the company had delivered more than 4,300 of the 3000/3300 systems, 2,500 of the 2200 systems, and had achieved a solid financial status as well as a profitable operation. In early 1974, the company announced the new 1100 and 5500 Series. The 5500 is a larger, faster distributed processing/small business computer system than the 2200; thus it allows 2200 users to upgrade and expand their capabilities. The 1100 is upward compatible with the 2200, which is upward compatible with the 5500.

Datapoint markets its systems through 18 direct sales offices and a number of sales representatives in the United States. It markets the systems through sales representatives in other parts of the world. Sales representatives in the United States include AIDES, Inc., PLS Associates, and the Systems Corporation (in Hawaii). TRW Communications directly markets the systems in Canada and Switzerland. Scandinavian sales offices include Regnecentralen (Denmark and Holland), Oy Nokia Ab Electronik (Finland and Sweden), and Scanips (Norway). Ventek, Ltd handles sales in the British Isles. Western Europe sales offices include Matras. A. (France), Gier Electronics (Germany), and Sart Electronics (Belgium) in addition to the aforementioned companies in Switzerland and Holland. CJK Company, Ltd handles marketing in Japan, Control Y Proceso Electronico SA in Mexico, Segma Data in Australia, Information Systems Ltd in Israel and Computer Advances in South Africa. TRW Electronics in Los Angeles, Toronto, and Berne is the exclusive international distributor of Datapoint system, and appoints the companies that maintain, service, and support systems outside the United States.

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.

Unquestionably, the main contender for the small businessman's computing dollar is IBM's System/3. Larger 2200 configurations compete with the smallest of the System/3 models, the interactive Model/6. Like the Model 6, support for high-level languages (Basic, RPG II) is provided. The 2200 disc storage is optional. The tape or cassette systems can provide cost advantages to a small user looking for something like System/3 Model 6, but with 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 Model 6 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. Although Datapoint does not provide the software support the larger manufacturers offer, the popularity of the 2200 has stimulated independent software houses to supplement Datapoint's own software offerings.

A considerable market exists for systems for first time small computer users—businesses that can not afford a System/3. A number of manufacturers have tackled this market with programmable accounting machines: Burroughs, Litton, NCR, Singer, Ultimac, and Nixdorf. These programmable calculators have capabilities that overlap those of small business systems, such as the Wang 2200, that also bridge the gap below computers the size of System/3 (Basic/Four, Burroughs 1700, Cascade Data, Eldorado, HIS 2020, Litton, Qantel, Singer System 10). Many intelligent terminals also compete in this market. The smaller configurations of the Datapoint 2200 have proven to be attractive to many users of this category in spite of the fact that Datapoint does not supply a complete turnkey system. The stability of the company and the software support for user-written high-level language programs, combined with the low cost and flexibility of the system, are responsible for these users' choices.

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 over 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 Is 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 is periodically 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 over 100 institutions uses 2200s in a variety of ways. Most frequently, the 2200 is a data entry terminal that can adapt to the institution'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 mostly done 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 their 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, a 600 card-per-minute card reader, a standard tape drive (seven- or nine-track), up to four single or dual disc drives with control, 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.

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

Table 1. Datapoint 2200: Mainframe Specifications

SYSTEM	
MICROPROCESSOR	
Memory Size (bytes)	4-16K
Word Size (bits)	8
Cycle Speed (msec)	1.2
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, ECMA std, 100-cpi density
Magnetic Tape	IBM cmptble 7- or 9-track
Printers	30-cps thermal; 30-cps impact; 135 lpm
Punch Card (cpm)	80-col; reads 400 cpm
Disc	2.4 Mb/removable cartridge, 1-4 cartridges/system
COMMUNICATIONS	
Line Interface	Synch or asynch
Control Procedures	IBM BSC
Standard Features	Autodial; auto answer
Optional Features	Programmable to accomplish most features
DATA TRANSMISSION	
Network	Leased; switched
Line Speed (bps)	Asynch: 37.5-9,600 synch: up to 9,600
Error Control	CRC; LRC; VRC
COMPATIBILITY	
Computer System	IBM 360; 370
Terminals	IBM 2265; 2741 2780: Mdl 4; 33 ASR ASR; Univac DCT 2000; CDC 200
Bell Data Set	103; 201; 202
SOFTWARE	Cassette, tape 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

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.

Minicomputer/Cassette Decks

The Version II 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. 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.

Disc

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).

Printers

Datapoint offers three types of printers for the 2200: a line printer (135 lines per minute), thermal printer (30 characters per second) and a Diablo printer (30 characters per second). In addition, a Selectric interface allows the attachment of the user's IBM Selectric typewriter.

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 3360 displays 25 lines of 80 characters for a total of 2,000 characters that can be transmitted at rates up to 4,800 bits per second. A special version of the 3360 with 82 characters per line (2,048 total) has been particularly designated as the terminal to be used with the Datashare package.

COMPATIBILITY

Compatibility on the Datapoint 2200 is provided by both hardware and software. The seven- and nine-track

Table 2. Datapoint 2200: Data Communications Capability

Model No.	Name	Interface	Model	Transmission Rate (bps)	Duplex
400	Communications	EIA RS232	Asynch	37.5-9,600	Full; half
401	Communications Adapter with Modem	Bell 103 equivalent	Asynch	300	Full
402	Communications Adapter with Modem.	Bell 202 equivalent	Asynch	1,200	Half
403	High-Level Keyer	Telegraph lines	Asynch	37.5	—
404	Synchronous Communications	Bell 201 or equivalent	Synch	Up to 9,600	Half
420	Parallel Data	Other mfrs peripherals		Parallel	—
460	Multiport Adapter	EIA RS232C, for attachment of 8 interactive peripherals	Asynch	100, 300 or 1,200 baud	Full

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, 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. All three operating systems require at least 8K words of memory.

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.

Databus, a high-level, string-oriented language especially designed for the 2200, currently has seven 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.

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.

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 3300 terminal. All program execution is under control of the Databus language.

Dataform 1

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

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.

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 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'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.

Utilities

Utilities include floating-point transcendental routines, floating-point/string conversion, tape lister, string print subroutines, nine-track tape drive subroutines, nine-track tape dump, and others. A new Sort/Merge package, important to business users, enables sorting and/or merging of disc files up to two million 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 (Eastport, 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 increase, the number of independent software offerings is also bound to increase.

MAINTENANCE

In the United States, Datapoint provides maintenance support for the 2200 through a staff of service engineers in 35 service centers located throughout the country. Replacement parts are also stocked at all major cities. Datapoint quotes from four to six 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 eight-hour, 24-hour, or per-call basis (price quoted in price data chart is for eight-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 two 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 partly chosen 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 the 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 a master distributorship agreement.

Headquarters

Datapoint
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DEC

Datasystem 340 Series

OVERVIEW

DEC Datasystem (DDS) 340 Series of computers are small business computers aimed at the "highly self-sufficient" end user capable of doing the applications software in-house. DEC supplies the systems software: easy-to-use high-level languages and commercial operating system. The Commercial Operating System (COS) 300 includes a DIBOL (Digital Business Oriented Language) compiler as well as system monitor, device handlers, system generation, maintenance programs, and a data entry package. It is designed for small business accounting operations, plus related applications such as inventory control, monitoring of sales and salesmen's activities, and management reports.

The DDS 340 Series is based on the 12-bit word PDP-8/E minicomputer. DEC introduced the PDP-8 computer line in 1965, a time when the prevalent trend was toward big, complex, expensive computers. The PDP-8 family went counter to this trend with a short 12-bit word, modular small memory of 4K to 32K words, simple instruction set, flexible I/O structure, and an $18,000 price tag. The system lent itself to many scientific and control applications that did not need a powerful computer, so the PDP-8 sold briskly. Its acceptance proved that a large market exists for minicomputers; over 20,000 PDP-8 computers have been installed.

Despite the proliferation of different minicomputers on the market, the PDP-8 family remains a significant system in the entire minicomputer field. It is a dynamic system. DEC keeps it competitive by introducing new PDP-8 models that reflect current technology; DEC continues to add extensive system and applications software, and DEC interfaces almost all of its broad range of peripheral devices to it. The PDP-8 also remains popular because of the amount of software users have developed for the system.

Competitive Position

The DDS 300 Series and the DDS 500 Series, announced at the same time as the 300, are the first systems DEC has marketed specifically to the commercially oriented end user. DEC has usually marketed its small computers as general-purpose systems for real-time, scientific, or time-sharing applications. Commercial processing has generally been done to use processor time left over from the primary application. Most commercial software was developed by users although DIBOL has been available for the PDP-8 for several years.

The DIBOL offered for the DDS-300, however, is a vast improvement over the older DIBOL. DEC also offers Fortran IV, Focal, and Basic for the PDP-8/E. In addition to its own software support groups, DEC supports DECUS (Digital Equipment Users Society), which maintains a library of programs contributed by users and available to all members. A special interest group has been formed for business users.

DEC was a pioneer in the small computer business and became a major computer manufacturer by catering to small computer users. DEC early recognized the need for mass storage devices, high-level languages, and operating systems for small computer systems. DECtape allowed small systems to be automatic long before discs were inexpensive enough to be used as mass storage devices for them. Focal gave users of small systems with 4K words of memory a high-level language that was easy to use. The OS-8 operating system provides features that make the PDP-8 a more versatile system than many much larger systems.

All these things have little bearing on the DDS 340 as a commercial processing system except to point out that DEC has been a real leader in developing small computer systems.

DEC recognizes that marketing small business systems is quite different from marketing general-purpose minicomputers. For one thing, small commercial users expect more help in getting their systems installed and running. DEC has set up a new commercial marketing group to handle only the DDS 340 and 500 systems. Secondly, small commercial users want to lease their equipment rather than buy it outright, and DEC offers 3- and 5-year leasing arrangements for its DDS systems.

One user of the DDS 340 is a Chicago realty company that operates 4,000 apartment buildings. It has been building its system since February 1970, two years before DEC announced the DDS 300 in December 1972. The realty company purchased a PDP-8/I with 8K words of memory, 4 tape units, a 100 line-per-minute printer, and a DECwriter terminal, and began using it with a preliminary version of DIBOL. The user replaced the system software with COS 300 as soon as it was available; the conversion took about 2 weeks. The company uses the system to do its own payroll and billing, and in addition, the bookkeeping for a small investment company and two insurance businesses. The DEC system was chosen in 1969 after evaluating many other small computer manufacturers, partly because the realty company felt it could rely on DEC for hardware maintenance and for support as it developed its software. The company now has about 200 programs and is extremely enthusiastic about the installation; it has been particularly pleased with the maintenance DEC has provided.

CONFIGURATION

The DDS 340 Series consists of four models that are based on the PDP-8/E minicomputer with 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 modules of 4K words. Peripherals, such as a card reader, high-speed printer, paper tape reader/punch, magnetic

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tape drives, and an additional terminal can be added to a system.

Model 340-A includes two disc drives, totaling 6.4M bytes, a CRT system console, a 60 line-per-minute printer, and the COS-300 operating system with the DIBOL compiler.

The 340-B system uses the same configuration as the 340-A except that the DECwriter system console replaces the CRT system.

The 340-C model duplicates the 340-A system, including the CRT system console, but employs a faster line printer—245 to 1,100 lines per minute.

Finally, the 340-D system uses the 340-B configuration (the DECwriter included) with the faster 245 to 1,100 line-per-minute line printer.

The Omnibus, a back-plane, etched circuit board, is an internal bus that provides 20 quad slots to connect all circuit modules to the PDP-8/E. A 4K-word memory module requires three slots; peripheral device controllers require one or more slots depending on the peripheral. The Omnibus can be extended by a KA8-E external interface for positive I/O devices. A DW08A bus converter is required to interface older PDP-8 family (PDP-8/I, L, and S) peripherals to the PDP-8/E. Older PDP-8 peripherals require a negative bus and the Omnibus is positive. High-speed peripheral devices such as discs require the KD8-E data break interface to control the transfer of data directly between the devices and PDP-8/E memory.

The Omnibus can be expanded to 76 quad slots through the addition of BA8-AA and BA8-BA system expander boxes.

MAINFRAME

The COS 300 Operating System has a foreground/background multiprogramming capability for the 340 Series. It can process three data entry jobs in the foreground concurrently with one background job.

No multiprocessing software is available for any of the DDS 340 systems.

Central Processor

The PDP-8/E computer 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 singleword, fixed-point add is hardware implemented in the basic system. Hardware multiply and divide and a floating-point processor are available as options to the Basic, Focal, and Fortran IV systems. DIBOL achieves 15-place accuracy without any hardware arithmetic options. All other arithmetic operations can be performed through DEC-supplied subroutines.

The FPP-12P Floating-Point Processor operates as an I/O device asynchronously with and parallel to the central processor. It requires the KA8-E external interface for positive I/O devices.

The KM8-E Memory Expansion and Timeshare option establishes two processor modes, user and executive. Executive mode programs can execute any instruction. User mode programs cannot execute halt, I/O, or load console switch instructions. Central processor characteristics are listed in Table 1.

Data Structure. The basic unit of data is the 12-bit word, which can hold two 6-bit characters. Table 2 lists the data formats used.

Instruction Set. The instruction repertoire is divided into 3 basic categories: memory reference instructions, 3 groups of operate instructions, and separate

Table 1. DEC Datasystem 340: Processor Characteristics

Characteristic	DDC 340
Processor	PDP-8/E
No. of Internal Registers	2 (ACC & MQ)
Addressing	
Direct (no. of words)	256
Indirect	4,096[1]
Indexed	NA
Instruction Set	
Number (std, opt)	56, 16
Dec Arithmetic	Subroutine
Floating-Point Arithmetic	Opt
Priority Interrupt	
Line	1
Levels	Software
Main Storage	
Type	Core
Basic Addressable Unit	Word
Cycle Time (μ sec)	1.2
Min Capacity (words)	8,192
Max Capacity (words)	32,768
Increment Size (words)	4,096
Memory Parity	Opt
Memory Protect	Yes[2]
ROM	Opt
Use	Programs and constants
I/O Channels	
Programmed I/O	Std
DMA	1- and 3-cycle data break

Notes:

(1) Per user program.
(2) Ech program confined to 4K-word field; memory extension option establishes user and executive modes.

Table 2. DEC Datasystems 340: *Data Structures

Data Name	Representation
Word	12 bits
Character	6 bits of 2/word
Decimal Operand	No
Binary Operand	
Single Precision	12 bits
Double Precision	24 bits
Floating-Point	
Operand	3 words (exponent) 11 bits + sign; fraction 23 bits + sign

* DIBOL provides 15-place accuracy, a function of the COS 300 operating system.

instruction sets for each option and I/O device. There are no direct compare instructions, but comparisons can be performed through a combination of logical operations and skip-on-condition instructions. There are six memory reference instructions, and these constitute the main power of the instruction repertoire. The three groups of operate instructions perform shift, clear, rotate, skip, and interregister operations.

The only arithmetic instructions in the basic set are add, complement, and increment. The extended arithmetic element (EAE) option provides multiply, divide, and double precision add, complement, and increment. The floating-point processor provides 34 instructions for floating-point add, subtract, multiply, and divide. Table 3 gives typical instruction execution times.

Addressing. For addressing purposes, memory is divided into 4,096-word fields and each field is subdivided into 128-word pages. The format for memory referencing instructions includes a 3-bit operation code, an indirect addressing bit, a page selector bit and an 8-bit address. The page selector bit selects either the current page (the one containing the instruction) or the zero page (the first page in the field containing the instruction). The address selects the core location within the selected page.

PDP-8 has no index registers but does have a specialized form of indirect addressing called auto-indexing for which eight memory locations in each field are reserved. When any of these locations is directly addressed, it is treated as a normal access; when addressed indirectly, the contents of the location are incremented by one and the resulting quantity is used for the effective operand address. This auto-indexing technique satisfies the major indexing chore of loop control.

To address memory beyond 4,096 words, the PDP-8/E requires the KM8-E Memory Expansion option. KM8-E provides a 3-bit data field (DF) register, a 3-bit instruction field (IF) register, and instructions to control and use the registers. The contents of DF select the memory field when an indirect address is specified. The contents of IF select the field when an instruction is fetched or when a direct memory address is specified.

Interrupt Control. There is one common interrupt line and only one interrupt level for all interrupts, regardless of their origins. Each interrupt must be identified by subroutine. The interrupt facility provides for storing current processor status and transfers control to an interrupt servicing routine. The number of interrupting sources that can connect to the interrupt line is limited only by the ability of the program to handle them. An interrupt servicing subroutine can be interrupted if the interrupt inhibit is turned off by instruction. This feature permits the programming of a software priority interrupt system.

Table 3. DEC Datasystem 340: Typical Instruction Execution Times

Instruction Type	Number of Instructions	Execution Time (μ sec)
Memory Reference	5	2.6
Unconditional Jump	1	1.2
Literal Loads	16	1.2
Register Operate (complement, shift rotate, increment)	11	1.2
Skip, Halt, OR, or load A with switch register, clear A	21	1.2
Register to Register (MQ and A)	8	1.2
Control (interrupt on/off, test interrupt on/off, get/restore flags, etc.)	8	1.2
Extended Arithmetic Option*	16	—
Multiply	1	7.4
Divide	1	7.7
Normalize	1	1.2 + 0.3N
Shift	3	2.6 + 0.3N
Double Precision	5	1.8 to 5.2
Memory Extension Option	10	1.2
Floating Point	18	—
Add	—	—
Subtract	—	—
Multiply	—	—
Divide	—	—

* These hardware options are not used by COS 300 software. DIBOL statements perform addition, subtraction, multiplication, and division with 15-place precision.

Main Memory

Main memory consists of core modules available in 8K-word increments. Each word is 12 bits long. A memory parity bit is optional. Modules can be added for a maximum memory of 32,768 words. Cycle time is 1.2 microseconds per word.

Read/write core memory with a write protect feature is available in a 256-word increment. It requires 2 Omnibus quad slots; it can be used to protect the monitor, to store frequently used monitors, or to test out programs before they are committed to read-only memory.

Read-only memory (ROM) modules are available in 256-word and 1K-word increments. Any number of ROM modules can be incorporated in a system limited only by the addressing capability of the processor and the amount of read-write core memory. ROM is used to store constants or to protect a user monitor program in a time-sharing environment.

Transfer rate in core memory is 156,250 words per second within a page and 113,636 within a field.

Input/Output Control

Devices connected directly to the Omnibus transfer data one word at a time under program control between the accumulator and the peripheral device. Devices connected to the KA8-E external interface can transfer data one word at a time under program control or can transfer blocks of data directly to or from core memory under control of the KD8-E data break interface. Only one device can connect to a KD8-E unit, but up to 12 KD8-E units can connect to a PDP-8/E system.

A KD8-E unit operates as a 1-cycle transfer control register or a 3-cycle data break facility, depending on whether the interfaced peripheral device has word count and current address registers. If the device controller has transfer control registers, the device uses one memory cycle for each word transferred. If the device controller does not have control registers, core locations are used to store the word count and current address, and two memory cycles are used to access them before the data word is transferred. Thus, these devices use the 3-cycle data break facility and require three memory cycles for each word transferred.

Maximum I/O transfer rate is 833,333 words per second using the single cycle data break facility and 277,778 words per second using the 3-cycle data break facility. Maximum transfer rate, using programmed I/O transfers, is a function of the number of devices connected to the interrupt line and the length of the servicing routines.

Console

The operator's console is a VT05 alphanumeric keyboard display terminal that includes the keyboard, cathode ray tube (CRT), refresh memory, multiterminal software, and interface. It is portable and weighs 55 pounds. The CRT screen displays a total of 1,440 characters in 20 lines of 72 characters per line. A keyboard controller cursor is operated under program control to allow interactive data entry.

The characters on the CRT screen are refreshed 50 or 60 times per second, synchronized to the power line frequency. Characters are generated using a 5 x 7 dot matrix. The keyboard is the familiar typewriter keyboard. A 10-key numeric pad insert is added for entering all numeric fields. The keyboard has the following control keys and switches:

- Power on/off switch.
- Remote/local switch—in local mode data can be typed without entering it into the computer.
- Contrast and brightness controls—used to adjust display clarity and brightness.
- Vertical and horizontal sync controls—used to adjust picture on the CRT.
- CR key returns cursor to the left margin of screen.
- LF key moves cursor down one line in the same position in line.
- Rubout key works in remote mode in conjunction with monitor/editor to erase characters.
- Tab key moves cursor to the right to the next tab stop.
- Alt key has no effect on display but provides an alternate escape character for use in a user program—replaces carriage return or line feed.
- Ctrl key used in conjunction with character keys to perform special control functions.
- Shift lock enables shift function when in the down position.
- Space produces a blank and moves cursor one position to the right.

PERIPHERALS

Peripherals offered for the Datasystem 340 Series include discs, block-addressable DECtape, a serial printer, a card reader, a paper tape reader/punch, a CRT terminal, a high-speed line printer, magnetic tape drives, and a hardcopy terminal. Table 4 lists the specifications for these devices.

There are a large number of PDP-8/E peripherals not designated as peripherals for the Datasystem. If a user wants to convert his purchased PDP-8/E to a Datasystem or has special requirements for his application, DEC will try to accommodate him.

DATA COMMUNICATIONS

DEC provides optional asynchronous communication at up to 9,600 baud on all 340 Series processors. This option enables the Datasystem to communicate with another Datasystem or with an IBM System/360 or 370. The 340 Series does not have the extensive communication software required to use it as a communication processor or "front end."

Table 4. DEC Datasystem 340: Peripherals

Peripheral Device	Performance Characteristics	Comments
MASS STORAGE		
RK05-AA Removable Cartridge Drive	Capacity 1.6M words; positioning time 12 to 85 msec; avg latency 20 msec; transfer rate 250K words/sec; 2 surfaces; 200 tracks/surface; 16 sectors/track; 256 words/sector	Uses cartridge similar to IBM 2315; requires RK8-E controller for up to 4 drives for over 13M bytes of on-line storage
TD8-EM Dual DECtape Drive	Two drives; capacity 188,672 words; transfer rate 8,325 words/sec; block size 128 words	10-track tape; controller for up to 4 drives; control connects to Omnibus
CONVENTIONAL I/O		
CRF-8 Card Reader	Reads 300 cpm; input and output hoppers hold 550 cards	80-col cards; tabletop unit
PC8-E Paper Tape Reader/Punch	Reading speed 300 char/sec; punching rate 50 char/sec	Separate interrupt for reader and punch
LS8-EA Serial Printer	Prints 165 char/sec; 132 cols/line; 64-char set	Slew speed 4 in./sec; line advance time 45 msec; carriage return time 200 msec
LE8-JA Line Printer	Prints 356 lpm for 80-col lines and 245 lpm for 132-col lines; 64-char set	Prints on multiple forms of up to 6 parts; slew speed 13 in./sec; line advance time 20 msec
DS3TM-E Magnetic Tape Drive	800-bpi density; 9 tracks	Control and software utility included
TERMINAL		
VT05 Alphanumeric Keyboard Display	Display of 20 lines, 72 char/line; keyboard conventional typewriter plus control keys; normal transmission speed 240 char/sec; multiterminal software and interface	Optional switch selectable of 10, 15, 30, 60, and 120 char/sec; numeric key pad
LA30 DECwriter	Speed 30 char/sec; 250 msec for carriage return; 64-char print set; 97- or 128-char keyboard; 80 char/line	Prints 1 original and 1 copy; uses 5 x 7 dot matrix

Additional Terminals Available

SOFTWARE

COS 300 includes the following programs:

- SYSGEN—configures system I/O handlers, assigns logical devices to physical I/O units, and prints table of device assignments.
- Editor—consists of a basic source language editor for input from source console keyboard, cards, or paper tape; and outputs file to 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)—consists of a 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 PDP-8/E data files that run under OS-8 to the COS 300 environment.
- 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.

The Foreground Data Entry Option is an extension of COS 300 for the DDS 340. It allows an operated/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. They may be sharing the line printer at the same time. Fifteen files may 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; 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 displayed on the screen, display coordinates, editing checks to be performed on the input fields, and field descriptions to be displayed.

The data entry option requires 4K words of memory in addition to the COS 300 minimum configuration for one terminal and 8K words for 2 or 3 terminals.

Assemblers and Compilers

The standard language compiler for COS 300 is the integral DIBOL compiler. DIBOL is a high-level language much like Cobol, Level 1. DIBOL offers 15-place accuracy, device independent data files, multivolume data files, interactive program debugging, program chaining or overlaying, line printer overlap, and internal subroutines. Typical compilation time is under 10 seconds. DIBOL uses simple English-like statements for the following categories:

- Compiler—tells the compiler the kind of statements to follow.
- Data Specification—describes type, size, and location of data elements.
- Device Control—opens and closes data files used by the application program.
- Data Manipulation—controls calculations and movement of data within memory.
- Control—sequences the execution of statements with a program.
- Input/Output—moves data within memory and between memory and peripheral devices.
- Debug—traces program execution.

Fortran IV, frequently used for scientific and mathematical applications, and Basic-Plus, an expansion of the Dartmouth time-sharing Basic language, are also optionally available on the 300.

Utilities

The SORT/Merge routine in COS 300 is a particularly powerful part of the software. The user can specify up to 8 subfields in the sort key, and unlike many other sorting routines, the size of the key does not affect sort timing. An 80-column card sort on 20,000-card image records takes 23 minutes on a DDS 340. SORT also has a merge file capability.

The system's editor is interactive, allowing a number of types of input. The SYSGEN routine allows the user to reconfigure or modify the current system using simple English-like statements. COS 300 also has a Peripheral Interchange Program (PIP) to transfer files from one device to another. The BUILD routine allows the user to create data files from a data entry terminal. An UPDATE routine provides facilities to maintain master files. Conversion programs allow the use of PDP-8/E OS-8 data files in the COS 300 environments. A Monitor controls all program operations.

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

HEADQUARTERS

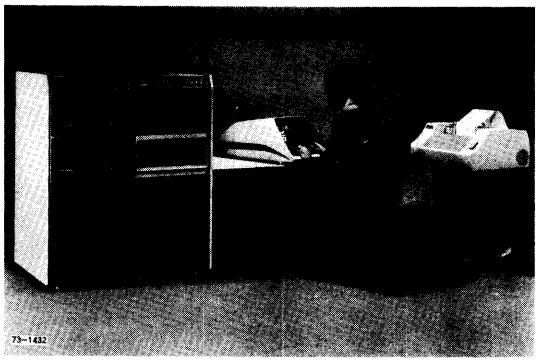
Digital Equipment Corporation
DEC Datasystem 300
146 Main Street, Building PK3-1
Maynard MA 01754

PRICE DATA

Model Number	Description	Monthly Rental: 3-Year Lease ($)	Monthly Rental: 5-Year Lease ($)	Purchase ($)	Monthly Maint. ($)
	DEC DATASYSTEM 340 SERIES				
	Central Processor and Working Storage				
DS-340-A	PDP-8/E 16K-byte Processor 2-RK05 Disc Drives (6.4M bytes total) 1-VT05 CRT System Console 1-LS8E Line Printer (60 lpm) COS-300 Commercial Operating System with DIBOL Compiler	1,216	818	37,180	288
DS-340-B	PDP-8/E 16K-byte Processor 2-RK05 Disc Drives (6.4M bytes total) 1-LA30 DECwriter System Console 1-LS8E Line Printer (60 lpm) COS-300 Commercial Operating System with DIBOL Compiler	1,211	815	37,030	294
DS-340-C	PDP-8/E 16K-byte Processor 2-RK05 Disc Drives (6.4M bytes total) 1-VT05 CRT System Console 1-LE8-JA Line Printer (245 to 1,100 lpm) COS-300 Commercial Operating System with DIBOL Compiler	1,633	1,098	49,925	315
DS-340-D	PDP-8/E 16K-byte Processor 2-RK05 Disc Drives (6.4M bytes total) 1-LA30 DECwriter System Console 1-LE8-JA Line Printer (245 to 1,100 lpm) COS-300 Commercial Operating System with DIBOL Compiler	1,628	1,095	49,775	324
MM8-E	8K-12-bit Words of Core Memory	82	55	2,500	20
MM8-EJ	16K Bytes Core Memory	128	86	3,900	40
	MASS STORAGE				
RK05-AA	DEC pack Disc Drive (3.2M bytes)	167	112	5,100	60
TD8-EM	Dual DECtape Drive and Control	164	110	5,000	40
	INPUT/OUTPUT				
	Punched Card				
CR8-F	Punched Card Reader (300 cpm)	159	107	4,860	50
CM8-F	Mark Sense Card Reader	159	107	4,860	50
	Paper Tape				
PC8-E	Paper Tape Reader/Punch	128	86	3,900	30
	Printer				
LS8-E	Line Printer and Control (60 lpm)	193	130	5,915	48
LE8-JA	Line Printer and Control (245-1,100 lpm)	572	385	17,500	75
	MAG TAPE				
DS3TM-E	9-Track, 800-bpi Tape Drive Control and Software Utility	441	297	13,500	95
	Terminals				
DS3D1-AA	First VT05 CRT Terminal, Multiterminal Software, and Interface	153	103	4,675	32
DS3D2-AA	Additional VT05-CRT Terminal and Interface	117	79	3,575	32
DS3D3-AA	First LA30 DECwriter Terminal, Multiterminal Software, and Interface	166	112	5,075	40
DS3D4-AA	Additional LA30 DECwriter Terminal and Interface	130	87	3,975	40

DIGITAL EQUIPMENT (DEC)

Datasystems 500 Series



OVERVIEW

The Digital Equipment (DEC) 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 turn-key system with completely customized applications software, DEC 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 3 choices of operating systems, the disc-based COS 500 (a batch processing system that utilizes Macro assembler, RPG II, and Fortran IV), the time-sharing CTS 500 (a general purpose, interactive multi-use timesharing system that supports up to 16 users) 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, DEC'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 nsec, and range in memory size from 16K 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. DEC 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 DEC's commercial marketing of the PDP-11 minicomputer (i.e., Datasystem 500) and presents only a broad outline of the system's architecture. Tables 1, 2, and 3 present a few specifications on PDP-11 processor characteristics, main storage characteristics, and data structure. All DDS systems support the COS 500 operating system. The DDS 530 upward can also support the commercial Timesharing System, CTS 500. Current emphasis is on CTS 500, but DEC states DDS 530 upward can also support CDMS (Commercial Data Management System). Configuration possibilities are endless; DEC has identified standard configurations: 520, 530, 540, 550 and 560 Systems.

The basic DDS 520 configuration used with COS 500 consists of an 11/40 processor with 32K bytes of memory, 2 RKO5-AA disc drives totaling 4.8 million bytes capacity, a CR11 card reader, an LS11-A printer, and a VTO5 CRT console terminal. Included with the processor is a real-time clock, a mounting cabinet, power

Table 1. DEC PDP-11 Central Processor Characteristics

Model	No. of Registers	Addressing			No. of Instructions (Std; Opt)	Arithmetic		Interrupts	
		Direct	Indirect	Indexed		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)

(1) A specialized form of indirect addressing called "auto-indexing."

Table 2. DEC PDP-11 Main Storage Characteristics

Model	Cycle Time, msec	Parity	Adressable 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
11/50	0.45 (2)	Opt	Byte, word	1 or 2	8K	64K	8K	Option

(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. Datasystem Data Structures

Series	500
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

supplies, bootstrap loader, and an interface for the VT05. Up to 56K bytes of memory can be added to the basic configuration; more disks (including RPO3-AS drives with 40M bytes capacity each), magnetic tape drives (including the TU10 IBM-compatible 7- and 9-track models as well as DECtape) LP11-JA high speed line printers, PC11 paper tape reader/punches, and LA30 or LT33 hard copy terminals can also be added.

DDS 530 includes a PDP-11/40 with 32K bytes of memory expandable to 56K bytes. It can support up to 8 disc, 8 tape storage units, and 4 on-line terminals.

Model 540 memory is expandable to 248K bytes, the 11/40 has extended arithmetic features and memory protection. Floating point arithmetic is optional. It can handle 16 disc, 8 tape units, and up to 16 on-line terminals.

The Model 550 is based on the PDP-11/45. Memory is expandable to 248K bytes and floating point arithmetic is optional. Model 550 supports an extended version of CTS 500.

Model 560 has all the features of the 550 plus 32K bytes of MOS solid state memory with a 450-nanosecond cycle time.

COMPATIBILITY

PDP-11 computers used in Datasystems are upward compatible from the 11/40 through the 11/45 and 11/50. All can use the same peripheral devices and core memory modules, as well as the same instruction and data formats. All use the same basic instruction set; the 11/40 and the 11/45 use supersets of the basic instruction set used on earlier models.

PDP-11 is only compatible with other manufacturer's computer systems through magnetic tape or data communications.

Competitive Position

The Datasystem 500 is based on the DEC PDP-11, a major minicomputer system from the leading minicomputer manufacturer — it is the system with which all other minicomputers in the marketplace are compared.

DEC announced a series 300 Datasystems, based on the PDP-8E, at the same time as the 500 series was released. The 300 and 500 series are related to each other somewhat like the 2 models of IBM's System/3. The 300, like the System/3 Model 6, is a smaller, slower system with more processing limitations than its companion model. The 500 series, on the other hand, like System/3 Model 10, is faster, can be expanded to sizes competitive with much larger general-purpose systems, handles a number of high-level languages, can do multiprogramming, and can be configured to meet a variety of different needs.

Although the 300 and 500 series are related to each other like the 2 IBM models, they do not compete equally well with IBM. The 300 series is neither as fast nor as versatile as the IBM System/3 Model 6. Also, the 300 Series uses DIBOL, a Cobol-like language that is not compatible with the 500 series. IBM RPG applications can be upgraded from the Model 6 to the compatible System/3 Model 10. The Datasystem 300 Series, however, does offer a significant price and growth advantage over the System/3 Model 6.

The DEC 500 Datasystems, on the other hand, can compete directly with the IBM System/3 Model 10. Comparable configurations are available at the lower end of the line, and the maximum memory size of 256K bytes on the PDP-11 is considerably more than the 40K maximum of the Model 10. The upper end of the 500 line competes with IBM System 370 Models 115 and 125. Other competitors are the Burroughs B1700, which has a similar range of configurations, and the NCR Century 100 series.

The Datasystem 500 computer is also faster than the System/3 Model 10, with a main memory cycle time of 0.90 microsecond as compared to the 1.52 microseconds on the System 3. Model 560 is even faster with its 32K bytes of 450-nanosecond MOS memory. It also has a dual bus structure that allows more parallelism, thus the 560 processing speed can be over twice as fast as the Model 550.

DEC system software allows time-sharing, as well as batch processing, on a wide variety of configurations. DEC feels that the Datasystem 500 in its multitasking timesharing version (CTS-500) has no real competitor. The wide range of the series allows for a long growth cycle that should be one of its most attractive features to potential users.

IBM offers application programming systems that can be tailored to the user's requirements and a special Application Customizer Service to minimize the in-house programming needed, whereas DEC, in catering to the more sophisticated small-business user, does not provide these services. In addition to their own software support group, however, DEC supports a voluntary, non-profit users group called DECUS (Digital Equipment Computer Users Society), which maintains a program library of programs contributed by users and available to all members. Special interest groups like the Business Users have sample application write-ups that are of interest to DEC Datasystem users.

MAINFRAME

The PDP-11 line has 3 characteristics that distinguish it from other computers in its class: the UNIBUS, multiple general-purpose registers, and the manner of handling I/O operations.

All PDP-11 models except the PDP-11/45 are 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.

The 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 a 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 2 possible processor modes and a floating point 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 3 processing modes. It is designed for applications requiring large memories, fast computation speeds or multiprocessor configurations.

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

The 3 basic operating systems for the Datasystems have parallels in the PDP-11. COS 500, (with its Macro Assembler, Fortran IV, and RPG II) is the same as DOS, except the RPG facility is available only to the Datasystem series users. CTS 500 corresponds to RSTS on the PDP-11, and CDMS corresponds to MUMPS-11.

COS 500 is a disc-based operating system, which is basically keyboard oriented, for the preparation and execution of programs. It provides the user with access to system programs, performs I/O transfers, and manages secondary storage in response to control commands from the console or the user's program. The user can generate, edit, assemble or compile, debug, load, save, call, and run programs under COS 500 control. As the basic operating system for the series, it is modular and open-ended, allowing the user to add programs needed for a particular application.

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, 2 DECtapes, a real-time clock, and user terminal interfaces.

CDMS 500 is a compact time-sharing system designed for use primarily as a data management system. It was originally developed for the PDP-15 by the Laboratory of Computer Sciences, 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 DECdisk, the RP02 Disk 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.

RPG II, an easy-to-learn business-oriented language particularly useful for generation of clear reports, is available only to Datasystem 500 users, not to users of the PDP-11. The Basic Plus used with CTS is DEC's own superset of the Dartmouth Basic Language.

MAINTENANCE

Service is provided by DEC 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 DEC usually in either Maynard, Massachusetts, or Sunnyvale, California. The training courses, which last from 2 to 3 weeks, are provided free of charge for users of purchased systems.

HEADQUARTERS

Digital Equipment
Maynard, MA 01754

HONEYWELL

Series 60, Level 61

OVERVIEW

Honeywell Series 60, Level 61 includes two keyboard-oriented, virtual memory, small business computers that can also be used as intelligent remote job entry terminals to larger Honeywell and IBM systems. They are marketed primarily to entry-level users and users upgrading from smaller keyboard-oriented accounting systems such as Honeywell's own Series 50. They can also be used by large companies in their outlying factories and offices for both local accounting and data entry tasks, and as intelligent message concentrators and batch terminals.

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. They are used primarily for on-line source data entry but they 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 contol up to 16 synchronous or asynchronous communication 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 in the field can be upgraded to full System 61/60 specifications by adding a front-end processor and the required terminals. System 61/60 is available for rental at 15,000 French francs ($3,750) per month upwards.

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.

Series 60 Level 61 was designed by Compagnie Honeywell-Bull SA (at Angers, France) who will also manufacture the system. It will be marketed throughout Europe and overseas by local Honeywell companies. Table 1 lists system specifications.

Compatibility

Within the Honeywell Series 60, Models 61/58 and 61/60 are fully upward compatible at all levels. A Model 61/58 in the field can be upgraded 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 by recompiled without alteration to run on Levels 62 (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, Models 61/58 and 61/60 are fully compatible at all levels, including GESAL assembler and machine code levels. Models 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 in the field can be upgraded to full System 61/60 specifications by the addition of a front-end processor (FEP) and the required additional 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

Table 1. Honeywell Series 60 Level 61: Configuration Guide

System Components	Model 61/58		System 61/60		
	Card	Disc	MWS/B	MWS/TP	MWS/TP +B
CENTRAL PROCESSOR					
ROM Capacity, 350 ns (Kbytes)	5-7.5	7.5	7.5	10.0	10.0
MOS/LSI Main Store, 1.2 μs (Kbytes)	5-10	5-10	10.0	10.0	10.0
MOS/LSI EMS, 1 ms/page (Kbytes)	0-64(1)	0-64	0-64	0-64	0-64
FRONT-END PROCESSOR	NA	NA	NA	Std	Std
MOS/LSI Main Store, 1.6 μs (Kbytes)	NA	NA	NA	8-16	8-16
Twin MT Cassette Drive, 750 b/s	NA	NA	NA	1	1
CONSOLES	1	1	1	1-2	2
Card Reader Console	Std	Std	Std	Opt	Std
FEP Console	NA	NA	NA	Std	Std
Alphanumeric Keys	46	46	46	41	41+46
Numeric Keys	13	13	13	11	11+13
Functional Keys	2	2	2	5	5+2
Display (char positions)	6-10	6-10	6-10	960	960
DISC SYSTEMS (no. drives/sys)	NA	1 std	1 std	1 std	1 std
DSS 070: 100 cyl 2.3Mb, 312 Kbs	NA	2-4	2-4	NA	NA
200 cyl 4.6Mb, 312 Kbs	NA	2-4	2-4	3-4	3-4
DSS 110: 200 cyl 2.3Mb, 156 Kbs	NA	2-4	2-4	NA	NA
DSS 162: 200 cyl 5.6Mb, 156 Kbs	NA	2-4	2-4	2-4	2-4
DSS 178: 200 cyl 23Mb, 312 Kbs	NA	2-4	2-4	2-4	2-4
INPUT/OUTPUT DEVICES					
Card Reader (80-col) (100/200/300 cpm)	Std	Std	Std	Opt	Std
Line Printer, 96-128 Print Positions (100, 200, 400, or 800 lpm)	Std	1-2	1-2	Opt	1-2
Card Punch (80-col) (40 col/sec)	Std	Opt	Opt	Opt	Opt
Paper Tape Reader (125 cps)	Opt	Opt	Opt	Opt	Opt
Paper Tape Punch (105 cps)	Opt	Opt	Opt	Opt	Opt
Magnetic Tape Drives (30 Kbs)	NA	0-4	0-4	0-4	0-4
DATA COMMUNICATIONS					
Single-Line Controller (SLC) Synchronous (600-4,800 bps)	Opt	Opt	Opt	NA	NA
FEP Synchronous Adapter (1 line, 600-4,800 bps)	NA	NA	NA	Std	Std
Multi-Line Controller (MLC) (4 asynch lines, 110-1,200 bps)	NA	NA	Std	NA	NA
FEP Multi-Workstation Adapter (8 lines asynch/synch 110-4,800 bps)	NA	NA	NA	1-2	1-2
Number of Key-terminals/System chosen from among:	NA	NA	1-4	1-16	1-16
Teletype ASR 33 (10 cps)	NA	NA	Opt	Opt	Opt
Kode 33 RT/TS (10 cps)	NA	NA	Opt	Opt	Opt
GE TermiNet 300 (10/15/30 cps)	NA	NA	Opt	Opt	Opt
GE TermiNet 1,200 (120 cps)	NA	NA	Opt	Opt	Opt
DTS 7200 Display (25 lines, 72 char, asynch, TTY-compatible)	NA	NA	Opt	Opt	Opt
DTS 7513 Display (25 lines, 80 char, synch, message buffer, 2,000 char)	NA	NA	NA	Opt	Opt
SOFTWARE					
GCOS 61 Operating System, Level with Facilities for	NA	61.1	61.2	61.3	61.3
On-line Data Entry/Batch dual prog	NA	Opt	Opt	NA	Opt
On-line File Enquiry	NA	NA	Opt	Opt	Opt
Real-Time File Enquiry/Update	NA	NA	NA	Opt	Opt
Multiprogramming (16 programs)	NA	NA	NA	Opt	Opt
LANGUAGE COMPILERS					
GESAL Assembler	Opt	Opt	Opt	NA	NA
Mini-Cobol	Opt	Opt	Opt	Opt	Opt
ANSI Cobol 68	NA	Opt	Opt	NA	Opt
ANSI Cobol 74	NA	NA	NA	Opt	Opt
Basic	NA	NA	NA	Opt	Opt
Fortran IV	NA	Opt	Opt	NA	Opt

Table 1. (Contd.)

System Components	Model 61/58 Card	Model 61/58 Disc	System 61/60 MWS/B	System 61/60 MWS/TP	System 61/60 MWS/TP +B
APPLICATIONS PACKAGES					
AGAP Retail/Wholesale Management	NA	Opt	Opt	NA	Opt
FACTOR Industrial Inventory Control	NA	Opt	Opt	Opt	Opt
PERT	NA	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 Models 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.*

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 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 of 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 keyboard for variable transactions; this 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 interrupting 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. They 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 updating, 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 favourably with those of competing Burroughs, IBM, and ICL systems; at first sight, they appear high compared with those of other listed small business manufacturers. This is 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, with which 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 who expect their data processing requirements to grow rapidly will be reassured by the "top cover" offered by Honeywell on the higher Series 60 levels. These 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 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, of course, but this 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 to 64K bytes of immediate access "extended main store" (EMS). The transfer of a 288-byte page from EMS to CPU main store takes only one 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 these appear to have been foreseen by the system's designers. All communication 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 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 communication 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 communication 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 utilizes 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 upgraded to a mixed transaction/batch processing system in the field 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 processing 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.

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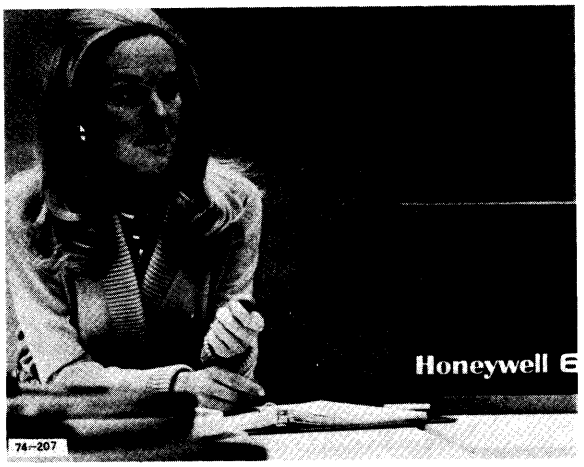
HONEYWELL

Series 60, Level 62



OVERVIEW

Honeywell's Series 60 Level 62 is a family of batch processing, multiprogramming small business computers with limited real-time transaction processing capabilities. It is marketed primarily as a system upgrade to small- and medium-sized businesses already committed to batch processing using unit record accounting machines or card, magnetic tape, or small disc-oriented computers. Honeywell offers extensive program and file conversion software aids to current users of the Honeywell-Bull Gamma 10 and G-100 Series, IBM 360/20, NCR Century Series, and Univac 9000s.

As announced on April 23, 1974, Level 62 comprises two upward-compatible models. The small Model 62/40 available for rental at $4,000 per month upwards, offers 48K to 88K bytes of main memory, 5.6 to 23.2 million bytes of fixed/exchangeable cartridge disc backing storage, card reader (600 or 1,050 cards per minute) and line printer (400, 600 or 800 lines per minute). Optional peripherals include card punch, paper tape reader and punch, and a data communications controller for up to four asynchronous or synchronous lines. Teletypewriter, bank teller, and CRT display terminals can be connected to the data communication lines for real-time file inquiries and/or transaction processing. As yet the system does not support remote batch terminals. Peak aggregate I/O throughput for the up to six channels is 900,000 bytes per second.

The larger Model 62/60, available for monthly rental of $6,000 upwards, offers 64K to 128K bytes of main memory and up to 116 million bytes of disc backing storage on multiplatter exchangeable discpack (IBM 2314 type) drives. Peak aggregate I/O transfer rate for the up to six channels is raised to 1.8 million bytes per second. One channel can be a multiplexer channel with four subchannels for the connection of slow I/O devices. Optional peripherals include magnetic tape drives (transfer rates of 30K and 60K bytes per second). Up to nine data communication lines (75 to 9,600 bits per second) can be connected to its data communication controller.

Level 62 processors are designed around advanced multiprocessor architecture with extensive error checking circuitry. All input/output functions are delegated to an Input/Output Processor (IOP). The IOP handles disc access optimization, communication line control, and all I/O channel error checking and retry procedures in parallel with central processor programs. Both the IOP and CPU have separate access to the main MOS/LSI memory.

Error checks provide duplicate arithmetic and address calculation circuits: The system accepts only arithmetic results and addresses on which both sets of circuits agree. Memory protection includes traditional lock-in circuitry to prevent user programs from accessing main memory not allocated to them. User memory areas are divided into "program areas" that are write protected from all programs and "data areas" that cannot store instructions for execution.

All Level 62 systems run under the GCOS 62 (also called GCOS 2 in some countries) operating system. It offers variable length multiprogramming facilities within the user area of main memory: uncompleted programs are dynamically relocated to consolidate all unused areas of main memory when a program is unloaded. An advanced disc data management system is fully compatible with GCOS data management facilities offered at Series 60 Levels 64 and 66. A choice of direct, indexed sequential, and sequential access methods to records are provided for disc files. The indexed sequential method allows records to be referenced by any number of different indexes based on different selection criteria. Sequential and indexed sequential files can be searched dynamically for records answering certain criteria.

ANSI Cobol 74 and RPG II are the only programming languages currently offered on Level 62. Honeywell has added extensions to both languages to allow them to be used for real-time transaction processing programming. The Cobol 74 language and GCOS 62 job control language (JCL) are fully compatible supersets of the languages available on Series 60 Level 61 and are subsets of those available at Levels 64 and 66.

Honeywell Series 60 Level 62 computers were designed by Honeywell Information Systems Italia S.p.A. and are manufactured for world-wide distribution at its plant in Caruso, Italy. They are marketed throughout Europe and in overseas countries by local Honeywell companies. Model 62/40 is not marketed in the United States and some other countries. Table 1 lists system specifications and configuration rules.

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.

Within Honeywell Series 60, all Level 62 processing systems are fully compatible with each other at all levels.

Table 1. Honeywell Series 60 Level 62: Configuration Guide

System Components	Model 62/40	Model 62/60
CENTRAL PROCESSOR		
Read-Only Store (ROS) Capacity: Bytes	30K	
Cycle Time: Nanoseconds	175/2 bytes	175/2 bytes
Number of Instructions	140	140
Registers: General	16(1)	16(1)
Base	8	8
Index	8(1)	8(1)
MAIN MEMORY		
Min Capacity (bytes)	49,152(2)	65,536
Increment (bytes)	8,192	8,192
Max Capacity (bytes)	90,112	131,072
of which: Reserved for firmware, GCOS	24,576	24,576
Cycle Time: Microseconds	1.05/2 bytes	1.05/2 bytes
INPUT/OUTPUT PROCESSOR		
Peak Throughput: Bytes/Sec	900,000	1,800,000
Maximum Number of Channels	6	6
of which: Multiplexer Channel	–	1
Subchannels/Multiplexer	–	4
Maximum Peripheral Simultaneity	6	9
DISCS: No. of subsystems	1 standard	1 standard
Chosen from among: (No. drives/subs)		
MSU 0112: 5.8Mb, 312 Kbs, 52.5 ms acc	2–4	2–4
MSU 0310: 29.2 Mb, 312 Kbs, 46.5 ms acc	No	2–4
Max on-line capacity (bytes)	23,200,000	116,800,000
CONSOLE	Standard	Standard
Keyboard	64 keys	64 keys
Serial Printer	30 cps	30 cps
Magnetic Tape Cassettes, 700 bytes/sec	1–2	1–2
OTHER INPUT/OUTPUT DEVICES		
Card Reader, 600 or 1,050 cards/min	1 standard	1 standard
Line Printer, 400, 600, or 800 lines/min	1 standard	1 standard
Card Punch, 120 cards/min	X	X
Paper Tape Reader, 600 or 1,000 chars/sec	X	X
Paper Tape Punch, 110 chars/sec	X	X
Magnetic Tape Drives, 30 or 60 Kbs	None	2, 4, or 6
DATA COMMUNICATIONS		
No. of Lines	0–4	0–9
Line Speeds (bps)	75–9,600	75–9,600
Terminals:		
Teletype 33, 35 10 cps	X	X
Teletype 37 15 cps	X	X
GE TermiNet 300, 10/15/30 cps	X	X
BTT 7300 Bank Teller Terminal	X	X
DTS 7200 Display, 1,800 chars, asynch	X	X
VIP 7700 Display, 2,024 chars, buffer, synch	X	X
SOFTWARE		
GCOS 62 Operating System	Standard	Standard
Batch Multiprogramming	X	X
Real-Time Transaction Processing	X	X
LANGUAGES		
Cobol 74	X	X
RPG 2	X	X

Notes: *(1) The 16 general registers include 8 index registers.*
(2) Minimum 62/40 main memory capacity is 65,536 bytes in France, West Germany and other European countries under the jurisdiction of Compagnie Honeywell-Bull.
X Device optionally available on this system.

Model 62/40 systems can be upgraded in the field to full Model 62/60 specifications.

The Cobol and GCOS job control languages for Level 62 systems are upward source code-compatible with other Series 60 levels. The Level 62 ANSI Cobol 74 and GCOS JCL are supersets of Cobol and JCL available at Level 61 and are subsets of Cobol 74 and JCL available at Levels 64 and 66. Cobol source programs can be transferred between Series 60 levels without alteration; recompilation is necessary, however.

A disc database must be recreated when it is transferred from a Level 61 to a Level 62 system to take advantage of the more sophisticated Level 62 data management system. The Level 62 data management system is fully compatible with the Level 64 and 66 data management systems, so database recreation is not necessary when transferring files to higher levels. Level 62 RPG II programs cannot be transferred to any other Series 60 levels.

For Honeywell-Bull Gamma 10 Systems, Honeywell offers the following software conversion aids:

- Object code program translator with output Level 62 object code; facilities are available for adding GCOS 62 JCL statements if required.
- File conversion from Gamma 10 card files to Level 62 discs or magnetic tape.
- Card sorter simulator.
- Card collator simulator.

For Honeywell Series 50, the Model 58 is fully compatible with the new Series 60 Level 61. Thus, Model 58 follows the same rules as Level 61 to Level 62.

For the Honeywell Series G-100 users, Honeywell offers the following software conversion aids:

- Code conversion generator incorporating GCOS 62 JCL statements.
- G-100 object code translator to Level 62 object code, with GCOS JCL statements specified by conversion generator.
- Two-pass G-100 to Level 62 disc file converter with intermediate storage on 9-track magnetic tape.

Honeywell marketing policy differs among countries as to which G-100 users will be offered these conversion aids. In Italy, all G-100 users are offered conversion to Level 62. In most other countries, the conversion aids are offered only for small G-115, G-118 and G-120 systems with 32K bytes or less of main storage, running under COS, TOS, DOS or DOS II operating system. Users of larger G-120 and G-130 systems running under ETOS or EDOS are encouraged to migrate directly to Level 64, where programs can be executed without any conversion in Series G-100 Program Mode.

For Honeywell Series 200 and 2000, no conversion aids are offered in either direction between these series and Level 62. Although Level 62 Cobol 74 is a compatible superset of Series 200/2000 Cobol, operating system JCL statements and data structures are quite different.

The Honeywell Series 6000 is fully compatible at all levels with the new Series 60 Level 66. Thus, it offers the same Cobol and GCOS 62 source code compatibility with Level 62 as does Level 66.

For IBM 360/20 users, Honeywell offers the following software conversion aids:

- IBM 360/20 to Level 62 conversion control language to incorporate GCOS 62 JCL statements.
- RPG to RPG II source program translator.
- Two-pass 360/20 to Level 62 disc file converter with intermediate storage on 9-track magnetic tape.

The RPG to RPG II translator produces a printed program conversion report and a Level 62 RPG II source deck. Users can write GCOS 62 JCL statements directly and incorporate them in the RPG II source deck or can use the conversion control language to produce GCOS JCL statement cards during the source code conversion pass.

For IBM System/3 Models 10 and 15 users, Level 62 RPG II is an upward-compatible superset of IBM System/3 RPG II. System/3 Model 10 source programs require the addition of GCOS JCL statements before recompilation for Level 62. Compilation efficiency is aided by the fact that the Level 62 machine code is virtually identical to the IBM System/3 machine code. However, Level 62 offers a larger character set than IBM System/3, and different disc file formats. As yet, no conversion aids are offered for these.

For NCR 4100 and Century series users, Honeywell offers a NEAT 3 to Level 62 Cobol source program translator. As yet, no disc file conversion aids are offered.

For Univac 9000 Series users, Honeywell offers a 2-pass disc file converter to Level 62 disc formats, but no special program conversion aids. These are virtually unnecessary, however, because the 9000 Series ANSI Basic Cobol is a compatible subset of Level 62 ANSI Cobol 74. Thus, Cobol source programs need only be recompiled after manual incorporation of GCOS 62 JCL statements.

The Univac 9000 Series RPG follows IBM 360/20 RPG definitions closely, so Univac 9000 Series users can use the RPG to RPG II translator available to IBM 360/20 users to produce Level 62 RPG II source code.

PERFORMANCE AND COMPETITIVE POSITION

Honeywell Series 60 Level 62 Systems are multiprogramming batch processing small business computers with a limited capability for real-time transaction processing. They are aimed at small- and medium-sized businesses which already possess a small computer, or at the very least, a unit record accounting system. These include Honeywell's own customer base of Gamma 10 card processor and small G-100 Series users. Level 62

offers an attractive migration path with adequate software conversion aids for these users as well as for users of comparable competitive equipment. More than any other level, Series 60 Level 62 has been designed to raid competitive customer bases. Both program and disc file conversion aids are offered for current users of the IBM 360/20, NCR 4100 and Century Series, and Univac 9000 Series.

Level 62's main competitors are the IBM System/3 Models 10 and 15: Level 62 uses the same machine instruction code as System/3 and a similar range of main store sizes, peripherals including disc subsystems, and programming languages. Competition between the two systems will be particularly fierce in Italy, where both systems are manufactured and the small-to medium-size market has been dominated in recent years by System/3 and the Honeywell G-100 Series.

Other competitors include the Burroughs B 1714 and B 1726, ICL 2903, NCR Century 75 and 150, Siemens System 404/3, and Univac 9200, 9200II, and 9300. How do Level 62's facilities compare with those of its competitors?

The Level 62 system architecture is more advanced than that of most of the competing small business computers: They use single-processor architecture; Level 62 uses multi-processor architecture, with all I/O functions, including error checking and retries, delegated to an autonomous I/O Processor which operates in parallel with the central processor. This should give the Level 62 CPU a higher throughput, but this will be apparent only on processor-limited tasks, which are mostly scientific/mathematical. Level 62 is not likely to compete in this market as long as it does not offer users at least a Fortran compiler. A Fortran compiler is currently being written in England, but no release date has yet been announced.

Users will find the Level 62's error checking and prevention features more relevant to their needs. The duplication of arithmetic and address calculation circuits means that machine errors caused by a component's intermittent failure will be prevented or detected more frequently at the time they occur, thus avoiding many costly reruns.

Level 62 GCOS offers more advanced multiprogramming facilities than IBM System/3, ICL 2903 and Siemens 404/3, but it is no more advanced than the Burroughs B 1700 series facilities. It offers variable-length multiprogramming of any number of user programs that will fit into main memory, with automatic dynamic relocation of uncompleted programs when a program is unloaded to consolidate all spare memory areas ("garbage collection"). Unlike Burroughs MCP II on the B 1700 Series — and GCOS on all other Series 60 levels – GCOS 62 is not a virtual memory operating system: apart from user defined overlays, entire programs must be loaded into main store to be executed.

Users will find it safer to use the Level 62 multiprogramming facilities for testing new programs during normal working hours. Protection features make it quite impossible for any untested rogue program to corrupt production programs or the operating system itself.

In some other respects, Level 62 is currently weaker than its competitors. The unavailability of a Fortran compiler has already been noted, but this is only temporary. More serious are its limitations in the data communication field: Up to four (62/40) or nine (62/90), Teletypewriter, bank teller and/or CRT display terminals can be connected for real-time file enquiries and simple transaction processing programs. At this time, Honeywell does not offer any software for using terminals as direct data entry stations, comparable to the IBM System/3 Model 10 and ICL 2903 facilities. Currently, remote batch terminals cannot be connected to Level 62 systems, whereas they can be connected to IBM Systems 3/10 and 3/15, Burroughs B 1726, NCR Century 75, and Univac 9200II. Unlike any of its competitors, including the ICL 2903 and Siemens 404/3, Level 62 systems cannot be used as intelligent remote job entry terminals or data concentrators to larger Series 60 systems.

Honeywell has imposed these limitations on Level 62 for marketing rather than technical reasons. They are designed to prevent costly duplication of facilities between the Italian-designed Level 62 and the French-designed Level 61. The latter offers all the direct data entry, data concentration, and intelligent RJE terminal facilities missing from Level 62. This weakens Level 62, nonetheless, in competing against manufacturers with less heterogeneous product lines.

In offering extensive software program and file conversion aids to current IBM 360/20, NCR Century, and Univac 9000 users, Level 62 will occasionally be in competition with substantially more powerful systems, such as the IBM System/370 Model 115, Unidata 7.720, and Univac 9480. Level 62 is substantially less powerful than these systems in I/O throughput and simultaneity, range of languages, data communications facilities, and, on IBM and Unidata, virtual memory programming. But it will also be substantially cheaper, and will appeal to users who do not require the additional power offered by IBM, Unidata, or Univac.

CONFIGURATION GUIDE

A minimum Model 62/40 configuration has the following components:

- Central Processor.
- MOS/LSI Main Memory of 49,152 bytes: The first 24,576 bytes are reserved for I/O firmware microprograms and the GCOS 62 operating system.
- Input/Output Processor with six channels.
- One MSU 0112 cartridge disc drive, with one fixed and one exchangeable disc drive, each drive holds 5.8 million bytes; the drive connects to IOP Channel 1.

- Card Reader, 600 or 1,050 cards per minute, connects to Channel 3.
- Line Printer, 400, 600 or 800 lines per minute, connects to Channel 2.
- System Console: Keyboard and 30 characters per second printer, connected to Data Communications Controller on Channel 5.
- Single or twin magnetic tape cassette drive, 700 bytes per second, connected to Channel 6.

The MOS/LSI main memory can be expanded in 8K-byte increments to a maximum of 90,112 bytes. An additional MSU 0112 fixed/exchangeable or MSU 0113 exchangeable cartridge disc drive can be added to the Mass Storage Controller on Channel 1 for an online disc capacity of 16.1 or 23.2 million bytes. Four data communication lines can be added to the Data Communications Controller on Channel 5 to connect local and/or remote teletypewriter, bank teller or CRT display terminals.

Channel 4 is a spare and can be used to connect either a card punch (120 cards per minute) or a paper tape subsystem with reader (600 or 1,000 characters per second) and punch (110 characters per second).

I/O operations are simultaneous on all channels under I/O Processor Control. Data communication transfers on Channel 5 to/from the console keyboard, printer and four communication lines to/from terminals are multiplexed.

The basic Model 62/60 configuration differs from the minimum 62/40 configuration in the following ways:

- Minimum 62/60 main memory is 65,536 bytes.
- The card reader and line printer are connected to two of the four subchannels of the Unit Record Multiplexer on Channel 4. This leaves two multiplexer subchannels, as well as Channels 2 and 3 as spares for additional peripheral subsystems.

In addition, Model 62/60 can be expanded much further than the 62/40.

The MOS/LSI main memory can be expanded in 8K-byte increments up to a maximum of 131,072 bytes. Online backing disc storage can be expanded beyond 23.2 million bytes by the substitution of MSU 0310 exchangeable multiplatter discpack drives. Each MSU 0310 drive can hold one 11-disc high pack with a capacity of 29.2 million bytes. Up to four MUS 0310 drives can be connected to the Mass Storage Controller, giving a maximum online disc capacity of 116.8 million bytes.

The spare I/O Channels 2 and 3 can be used to connect one or two industry-compatible magnetic tape subsystems. Each subsystem comprises two, four, or six tape drives. A choice of two subsystems is available: reading/recording 9-track, 1,600-bit-per-inch magnetic tape at 30,000 or 60,000 bytes per second. Each subsystem can include one or more 7-track NRZI drives for reading/recording 7-track tape at 556 or 800 bits per inch for transfer rates at 10,425/15,000 and 20,850/30,000 characters per second.

Five additional data communication lines can be connected to the Data Communications Controller on Channel 5, for a combined total of nine data communications lines. Individual lines can be asynchronous, 75 to 1,200 bits per second, or synchronous, 2,400 to 9,600 bits per second. Synchronous lines can connect only to buffered VIP 7700 CRT display terminals. Remote batch terminals or other computer systems cannot be connected on-line to any Level 62 system.

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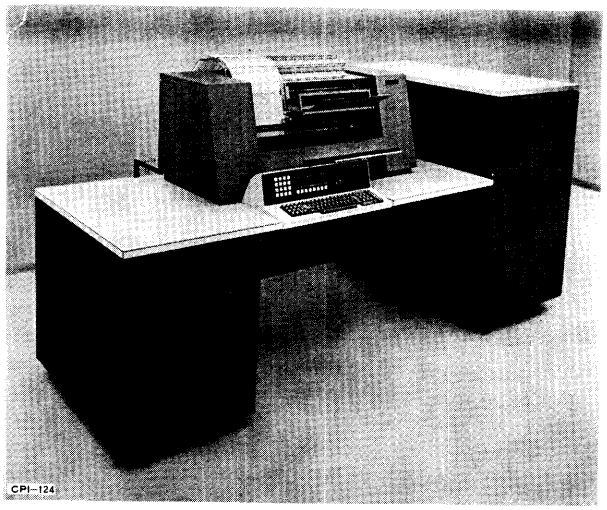
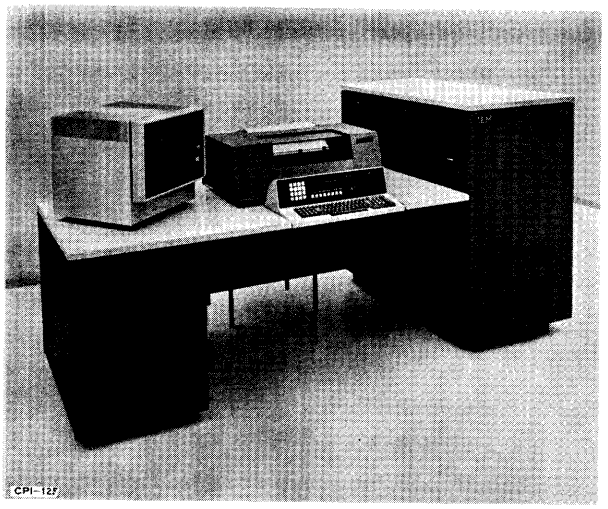
IBM CORPORATION
System/3 Model 6



IBM System/3 Model 6 with Ledger Card Device



IBM System/3 Model 6 Problem Solving System

OVERVIEW

IBM's System/3 extends EDP to small businesses. It is an extremely flexible system, meeting the varied requirements of different industries and individual companies in the small computer market. The System/3 family has two models: Model 6 and Model 10. Both models have many features in common but are distinctly different systems, too. An examination of throughput, which is a measure of the speed with which computer will input, process, and output a transaction underscores the major differences between Models 6 and 10.

Model 6 is basically a low-throughput operator-oriented system, attributable largely to heavy reliance upon man-machine communications. Model 10's throughput capability is greater. The characteristics of I/O devices in Model 10 configurations are output oriented in both the card and disc systems. For example, the Model 6 system printer is a serial unit that prints one character at a time at a maximum rate of 85 characters per second; it can output approximately twenty 132-character lines per minute. Model 10, on the other hand, uses line printers. The 5213 printer is capable of 100, 200, or 300 lines per minute; this can be increased to 600 or 1,100 lines per minute by using a 1403.

Model 6 and 10 architecture is identical in the areas of central processing unit (CPU), I/O structure, interrupt system, and communications. In certain instances the software and some devices for the two systems are the same, but it is also in these areas that the two models are distinguishable (Table 1). The software and I/O devices reflect procedural methods and system use and, from the applications viewpoint, underline the two systems' differences.

System/3 Model 6

System/3 Model 6 is a small, general-purpose, commercial data processing and interactive problem-solving system. Smaller and cheaper than System/3 Model 10, it 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. In this setting, 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 6 is also intended for small businesses who subscribe to a time sharing or service bureau system. Besides being a flexible system that can be configured to fulfill the diverse commercial requirements of small business, Model 6 can also serve a user who requires financial (bonds and lease analysis, rate of return) accounting, scientific, or interactive processing; data input; and engineering and mathematical problem solution.

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.

It is field expandable to include two disc drives with four times minimum system capacity (9.82 million bytes), data recorder (for on-line card I/O), either ledger card processing capability or a CRT display station (the latter for interactive use), MICR input processing, and a communications facility.

Model 6 language facilities include a Basic compiler for interactive problem solving, RPG II

Table 1. IBM System/3 Models 6 and 10: Distinctions

Point of Comparison	Model 6	Model 10
System	Disc oriented only; emphasis on operator interaction	Card or disc oriented; emphasis on batch processing
Central Processor	16K max; no multiprogramming	48K max; multiprogramming to 2 levels opt
I/O Devices Dis Storage	Slow cartridge unit only; 1 unit required	Slow cartridge unit; speeded-up version and disc pack fast file unit available; none required
Magnetic Tape	None available	20, 40, and 80 kb/sec units available
Card Units	Slow on-line data recorders available in 80- or 96-col models; units can be used off-line	Fast multifunction printing card read punches available in 80- and 96-col models; units are on-line
Printers	Serial units for slow output; 1 type can post magnetic stripe ledger cards	Line printers for fast output; 100, 200, 300, 600, and 1,100
Console	Interactive console keyboard with function switches std; unit can function as calculator	Console I/O opt; printer-keyboard and data entry keyboard available; latter + card unit permit use of system as data recorder
Display	CRT display unit available for use as console or output device	No display unit available
Optical Mark Read Input	None	OMR available
Communications	Single line opt	1 or 2 lines available
Software Languages	RPG II; Basic	RPG II; Fortran; Cobol; Assembler
Application Programs	Few available	Many available

for generating report programs, and Fortran IV for batch processing of mathematical-oriented problems. The Model 6 capitalizes on the strength of the Basic language (easy-to-learn, conversational problem solving) to simplify the transition to computer data processing for new EDP users. A function of Basic is Desk Calculator (DCALC), which enables the user to convert the system into a large, highly sophisticated, electronic desk calculator.

RPG II facilitates programming commercial applications for Model 6. Applications such as accounts receivable, billing, inventory control, payroll, and sales analysis are organized on disc files where they are readily accessed by inquiry programs. RPG II is a relatively easy-to-learn programming language that expands the capabilities of the inexperienced programmer.

Fortran, the widely accepted language specifically oriented to the solution of mathematical problems, enhances the Model 6 programming capabilities.

Table 2 summarizes System/3 Model 6 specifications.

Table 2. IBM System/3 Model 6: Specification Summary

CENT PROCESSOR	
Word Size (bits)	8 + parity
Capacity (words)	8-16K (K = 1,024)
Cycle Time (μsec)	1.52
Working Storage	Core
AUX STORAGE	Disc
DATA OUTPUT	
Line Printer (lpm)	None
Serial Printer	Yes; 85 cps
Card (cpm)	22 (96-col)
Paper Tape (cps)	—
DATA INPUT	
Keyboard	Standard
Card (cpm)	22 (96-col)
Paper Tape (cps)	—
SOFTWARE	
Assembler	No
Operating System	System Control Program
Compiler	Basic; RPG II

CONFIGURATION GUIDE

System/3 Model 6 can be assembled in various configurations to meet different user needs. Three CPU core storage sizes are available: 8,192 bytes (Model B2); 12,288 bytes (Model B3); and 16,384 bytes (Model B4). Core storage cycles take 1.2 microseconds per byte.

Auxiliary storage (5444 Model 1, 2, 3) is available in four combinations of the dual disc drive system. The on-line storage capacities of the four combinations are 2.45, 4.90, 7.35, and 9.80 million bytes. A removable disc cartridge on the 5444 drive provides virtually unlimited off-line file storage. Model 6 configurations require at least one disc drive.

Serial printers feature a dot matrix print head that moves at a constant velocity back and forth across the paper.

- Serial Printer (5213) — prints 132-column lines at 85 characters per second (all models). Model 1 is a single-line advance, pin-feed, unidirectional printer; Model 2 adds vertical forms control; Model 3 has both forms control and bidirectional printing. A print enhancement feature increases printing speed to 118 characters a second.

- Printer (2222) — the system printer or a ledger card device. As a printer, it produces 220-column lines at 85 characters per second. Model 1 is a unidirectional printer; Model 2 is bidirectional. The 2222 allows posting of ledger cards, which can vary in size from 6 x 8 inches to 11 x 14 inches.

- Display Station (2265) — rapid, silent, TV-type display, used for man-machine communication. It is especially useful in interactive Basic application systems, and can display up to 15 lines of 64 characters each. IBM programming systems require a Model 6 with at least 12,288 bytes of core storage to support this device. The 2265 and 2222 cannot be used together on one system.

- Binary Synchronous Communications Adapter (feature 2074) — permits Model 6 to function as a terminal processor communicating over leased, switched, or private communications lines. It attaches one transmission line. In conjunction with the System/3 Model 6 RPG II Telecommunications program, a Model 6 with feature 2074 can communicate in a binary synchronous mode with another System/3, System/360, System/370, a 2770 Data Communications System, or a 2780 Data Transmission Terminal. With the foregoing, the Model 6 can communicate only on a point-to-point basis at 600; 1,200; 2,000; 2,400; 4,800; 7,200; 19,200; 40,800; or 50,000 bits per second.

Model 6 can be a tributary station (capable of responding to call, but not calling) to System/360 Models 25 and larger and System/370 in a multipoint network. In this mode it operates at speeds between 1,200 and 7,200 bits per second. Model 6 binary synchronous communications are in half-duplex mode.

- Magnetic Character Reader (1255 Model 1, 2, or 3) — can be attached to a disc-oriented System/3 with 12K bytes of memory to input data for on- or off-line operations. Model 1 reads 500 documents per minute; Models 2 and 3 read 750 per minute. Models 1 and 2 have six sorting pockets; Model 3 has 12. All models read characters printed in the American Banker's Associations E13-B font. The 1255 can also be used with System/360 and 370 or an IBM 2770 Data Communications System.

Model 6 is basically a disc system. It can also provide limited card facilities by using the 5496 or 129 Data Recorder.

- Data Recorder (5496) — a key entry unit normally used off-line for batch recording of data and preparation of System/3 programs on 96-column cards. With the appropriate attachment, the 5496 can be used on-line for card I/O. It reads or punches and prints on 96-column cards at up to 22 cards per minute. Recently, IBM introduced a 5496 attachment for System/360 and 370, to allow System/3 card data input to those systems. This was reciprocated in announcing attachability of the 129 Data Recorder to Model 6.

- Data Recorder (129) — an 80-column card data recorder, which, can be used on-line with Model 6 to read up to 50 cards per minute. It can punch, or punch with printing, 80-column cards at rates from 12 to 50 cards per minute and thus can be used to prepare cards for System/360 or 370. Off-line, it functions as a conventional card data recorder.

Configuring an IBM system involves paying particular attention to a variety of requirements, prerequisites, and limitations specified by the manufacturer. For example, use of the RPG II Telecommunications feature 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 on the unit; this is true of the data recorders and MICR unit.

A feature can have subfeatures available; these are usually standard in nature. For example, auto call, internal clock, station selection, and test transparency are available once the BSC adapter is installed. In a similar fashion, attachable devices can have optional features available (listed in the accompanying price data report). Their uses are quite easy to understand, so that users are unlikely to become confused by the abundance of items.

In addition, a number of features — called "specify items" by IBM — are required in all situations. These, however, are always no-charge, are ordered by IBM sales personnel, and are installed gratis. They correctly identify such specifications as the transmission speed to be used by a communications adapter or the color of the system's panels. For simplicity, they do not appear in the price data list.

SOFTWARE

Three high-level languages are available to Model 6 users: RPG II, Basic, and Fortran IV. RPG II and Basic were the original programming languages offered. Fortran IV, the most widely used language for solving problems that can be stated in terms of formulas or arithmetic procedures, has enhanced Model 6's appeal.

Report Program Generator II (RPG II) is a language designed for the creation of reports based on source data contained in peripheral storage files. Basic is an easily learned conversational language that also has powerful Fortran-like capabilities for numerical problem solution.

System Control Programming

With the exception of Basic, SCP handles control of the Model 6 system environment. SCP supplies the functions necessary for commercially oriented Model 6 applications. It is available with the hardware at no charge. Programs within SCP include the following:

- Disc System Management — generates and maintains a disc-resident system for creating and executing programs. It permits selective loading of programs from disc; program execution under control of Operation Control Language (OCL) a limited set of statements that allows the user to communicate with SCP; I/O control; and rollin/rollout operations. Rollin/rollout

lets the system suspend a program during its execution, place it on disc, and bring in an inquiry program to be executed. Upon completion of the latter, the original program is restarted from the point of interruption.

- Copy-Dump — copies disc files onto another disc or prints them on the printer. Portions of the original file can be deleted and certain limits can be set for printing.

- Library Maintenance — enables the user to create, maintain, and service the source and object program libraries.

- Utility (disc) — permits the user to prepare and maintain disc files, including initialization, alternate track assignment and rebuilding, file and volume display, and file delete.

- Overlay Linkage Editor — creates loadable programs from multiple relocatable modules.

Program Products

Program products available at a monthly charge include the following:

- Conversational Utility — contains three separate programs that operate under SCP: Keyboard Data Entry (dedicates the system to keying data directly onto a disc); Keyboard Source Entry (allows a user to key RPG II source statements directly into the source library on disc); and Data Interchange Utility (facilitates conversion between RPG and Basic disc files).

- Disc Sort — sorts any file, which is organized in a way that is supported by Model 6 RPG II, in either ascending or descending sequence. The program provides six means of recognizing a record; control fields can be in different locations in records within the file.

- Utility for 1255 Magnetic Character Reader — support systems that include a 1255; permits data read from MICR encoded documents to be placed on disc, tape, or printer output files.

Report Program Generator II (RPG II). RPG II is a programming language oriented towards automatically generating reports. Programming is output oriented, because the primary concern is delivery of clear reports based on the 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 provides for the creation and execution of Model 6 programs and is compatible with Model 10 RPG II. II also supports ledger card units, display station, and keyboard console — devices that are available for Model 6 but not for Model 10.

Two additional features are available for RPG II:

- RPG Telecommunications feature — enables the system to transmit and receive synchronous data over communications lines.

- 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.

Basic. The Basic language is a stand-alone, (not operating under system control program), 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.

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.

DESIGN FEATURES

Model 6 embodies a number of features that contribute to its interactive use by relatively untrained personnel. It also appeals to the

first-time user by offering complete system control in operator-oriented data processing applications. The Model 6 interactive Basic language, which features desk calculator mode, offers personalized computing to the user. A limited batch processing capability for card applications is provided by optional 80- or 96-column card I/O devices. Model 6 allows the novice to get started in data processing; if the user applications outgrow Model 6, the RPG applications can be easily upgraded to the compatible System 3 Model 10.

Being a versatile small computer, Model 6 can handle the requirements of a small business computer, a computer terminal, a ledger card computer, and a problem-solving computer.

PERFORMANCE

Model 6 competes with time sharing terminals and service bureaus in serving small businesses that need computation for varied applications and do not require high throughput.

The Model 6 Basic compiler language offers the user a capability for engineering and scientific calculation, in addition to such simple computations as interest and amortization schedules. Basic, like RPG II, permits the programming of output format to provide well-organized reports. It can be used by anyone from the beginner to the programmer. Basic programs of up to 990 statements can be processed. RPG II can be used for analysis of bonds, securities, portfolios, leases, potential acquisitions and mergers, sales, cash flow, and performance of advertising media. It is also well adapted to cost estimation, job scheduling, project control, and pricing analysis.

MAINTENANCE

System/3 maintenance is available through the more than 50 Basic System Centers that IBM operates across the country. Other IBM services include comprehensive customer training courses and system engineering assistance; these, unlike maintenance under a rental contract, are separately priced.

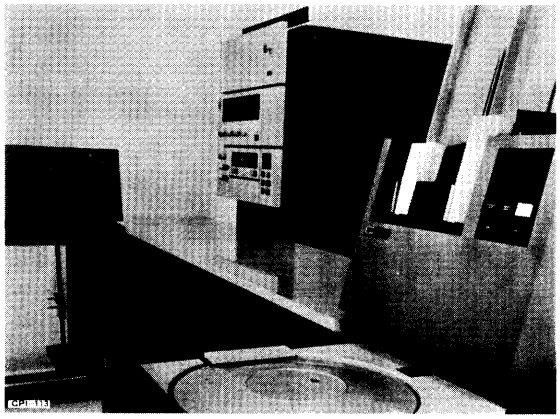
The education courses provide sound knowledge of basic System/3 concepts, application design, disc system design, and programming fundamentals. System engineers are ready to operate a turnkey system for the user who doesn't want to acquire a programming staff or who doesn't want to assign System/3 programming tasks to his current programming group. The IBM system engineers furnish user support ranging from simple aid to design of entire application systems.

HISTORY

System/3 is IBM's highly successful entry into the market represented by smaller businesses with limited or no computer experience. Since its inception, IBM has continually expanded System/3's capabilities by adding new peripherals as well as more models to the product line. Model 10 was announced June 30, 1969; Model 6 on October 20, 1970.

At IBM's April 1972 stockholder's meeting, it was revealed that, since January 1970, the firm had shipped more than 100,000 System/3s. In the words of the company's president, System/3 ". . . is rapidly becoming the most popular single system that IBM has ever produced."

IBM CORPORATION
System/3 Model 10



IBM System/3 Model 10-disk

OVERVIEW

IBM's System/3 extends EDP to small businesses. It is an extremely flexible system, meeting the varied requirements of different industries and individual companies in the small computer market. The System/3 family has two models: Model 6 and Model 10. Both models have many features in common but are distinctly different systems, too. An examination of throughput, which is a measure of the speed with which a computer will input, process, and output a transaction, underscores the major differences between Models 6 and 10. Model 6 is basically a low-throughput operator-oriented system, attributable largely to heavy reliance upon man-machine communications. Model 10's throughput capability is greater.

The characteristics of I/O devices in Model 10 configurations are output oriented in both the card and disc systems. For example, the Model 6 system printer is a serial unit that prints one character at a time at a maximum rate of 85 characters per second; it can output approximately twenty 132-character lines per minute. Model 10, on the other hand, uses line printers. The 5213 printer is capable of 100, 200, or 300 lines per minute; this can be increased to 600 or 1,100 lines per minute by using a 1403 printer.

Model 6 and 10 architecture is identical in the areas of central processing unit (CPU), I/O structure, interrupt system, and communications. In certain instances the software and some devices for the two systems are the same, but it is also in these areas that the two models are distinguishable (Table 1). The software and I/O devices reflect procedural methods and system use and, from the applications viewpoint, underline the two systems' differences.

System/3 Model 10

Model 10's appeal is to novice computer users, primarily businessmen with straightforward commercial data processing requirements. It's a low-cost, versatile data processing system that integrates the capabilities of punched card equipment into a compact electronic processing system. The versatility of the system is demonstrated by its ability to support a turnkey operation for novice computer users or a complex operation required by the procedural systems of the moderately experienced user.

Model 10 is available as either a card or disc system. Each encompasses different data file storage media and data management techniques. In either type, six processor models (memory storage size from 8K to 49K) are offered to accommodate a wide range of user applications. The availability of the larger memory sizes provides growth capability for the small user who will need to upgrade later due to an expansion of business. A plausible sequence of events for some beginning users could be conversion from accounting cards to card System/3 and later conversion to disc System/3.

All Model 10 systems (card and disc) can support a magnetic tape subsystem, utilizing industry-compatible tape equipment, to furnish auxiliary storage. The disc-oriented systems can support up to four disc drives, providing up to 50.8 million bytes of on-line storage and virtually unlimited off-line storage.

Model 10 was designed to use the Multi-Function Card Unit (MFCU) as the system card I/O device. This card unit characterizes the design of System/3. The MFCU handles the entire gamut of punched card functions for a system: It reads, punches, interprets, sorts, and collates cards. Historically these operations required an assembly of separate machines, yet the MFCU dispenses to the user services formerly obtained from several other unit record devices while containing less hardware and occupying less space.

The Model 10 card-oriented systems appeal to present users of electromechanical punched card systems for several reasons. Because the function of the basic medium, punched cards, remains the same and is understood by the user's current personnel, conversion from older card systems to the Model 10 is simplified. Although the basic medium remains the same, its form (a 96-column card contains 20% more characters but is only about one-third the size of the common 80-column card) and handling are streamlined by the Model 10 information system.

Table 1. IBM System/3 Models 6 and 10: Distinctions

Point of Comparison	Model 6	Model 10
System	Disc oriented only; emphasis on operator interaction	Card or disc oriented; emphasis on batch processing
Central Processor	16K max; no multiprogramming	48K max; multiprogramming to 2 levels opt
I/O Devices		
Disc Storage	Slow cartridge unit only; 1 unit required	Slow cartridge unit; speeded-up version and disc pack fast file unit available; none required
Magnetic Tape	None available	20, 40, and 80 kb/sec units available
Card Units	Slow on-line data recorders available in 80- or 96-col models; units can be used off-line	Fast multifunction printing card read punches available in 80- and 96-col models; units are on-line
Printers	Serial units for slow output; 1 type can post magnetic stripe ledger cards	Line printers for fast output; 100, 200, 300, 600, and 1,100 lpm
Console	Interactive console keyboard with function switches std; unit can function as calculator	Console I/O optional; printer-keyboard and data entry keyboard available; latter card unit permits use of system as data recorder
Display	CRT display unit available for use as console or output device	No display unit available
Optical Mark Read Input	None	OMR available
Communications	Single line opt	1 or 2 lines available
Software		
Languages	RPG II; Basic	RPG II; Fortran; Cobol; Assembler
Application Programs	Few available	Many available

Model 10 language facilities include RPG II, Cobol's powerful business language capabilities, and the scientific problem-solving facilities of Fortran. Model 10 also has an assembler.

A Model 10 can be linked to IBM's System/360 and System/370 computers as a remote tributary station on a multipoint communications line. This feature makes Model 10 especially useful as an intelligent terminal offering additional batch processing capabilities.

The disc-oriented System/3 Model 10 with 12K bytes or larger memory can use the Dual Programming feature. With the feature installed, two separate programs can share the system, permitting more effective use of the surprisingly high internal speed (in view of the low cost) central processor, and meaningful use of dual-feed carriage printers. Programs switch when a special instruction (treated as no operation in other System/3 systems) is encountered or when one program halts processing to wait for completion of an I/O operation.

See Table 2 for summarized System/3 Model 10 specifications.

CONFIGURATION GUIDE

A wide range of configurations is available for Model 10, starting with the central processor unit

Table 2. IBM System/3 Model 10: Specification Summary

CENT PROCESSOR	
Word Size (bits)	8 + parity
Capacity (words)	8-48K (K=1,024)
Cycle Time (μsec)	1.52
Working Storage	Core
AUX STORAGE	Disc; mag tape
DATA OUTPUT	
Line Printer (lpm)	100; 200; 200; 600; 1,100
Serial Printer	No
Card (cpm)	60; 120 (96-col)
Paper Tape (cps)	None
DATA INPUT	
Keyboard	Opt
Card (cpm)	250; 500 (96-col)
Paper Tape (cps)	None
SOFTWARE	
Assembler	Yes
Operating System	System Control Program
Compiler	Cobol; RPG II; Fortran IV

(CPU). A total of 12 CPU versions are available, six memory sizes for card-oriented systems and six for disc-oriented systems. The basic difference among the models in each category is core memory capacity, ranging from 8K to 49K bytes. Each CPU provides arithmetic functions and control for its core memory, as well as a single I/O interface to communicate with multiple I/O devices in a cycle-stealing or programmed I/O mode, depending upon the attached devices' characteristics. IBM programming systems, however, support neither 8K disc systems nor 48K card systems.

Minimum configuration for a card system consists of a 5424 MFCU or 1442 Card Read Punch, and a 5203 or 1403 Printer. In addition to these units the minimum disc-oriented configuration requires at least one 5444 Disk Drive.

Basic auxiliary storage (5444 Model 1, 2, or 3) is available in four combinations. In addition, the speeded-up versions of the basic disc units (5444 Model A1, A2, or A3) can be used, but the basic and faster models cannot be intermixed. For additional disc file capacity, up to two high-capacity, high-performance (5445) units can be attached. These use IBM 2316 disc packs, the disc pack used in 2314 discs on the System/360. The 5445 drives, however, can be connected only to systems having a 5444 disc because the System Control Programming operating system must reside on a 5444.

Permitted Model 10 disc configurations are as follows: one 5444 Model 1 (or A1), one 5444 Model 2 (or A2), one 5444 Model 2 (or A2), and one 5444 Model 3 (or A3); or two 5444 Model 2s (or A2s). A 5445 Model 1 or a 5445 Model 2 can be added to any 5444 disc configuration.

Each 5444 disc uses a 5440 Disk Cartridge, a single removable disc unit. A 5444 can also include a fixed disc, equivalent to the 5440, mounted on its drive spindle (depending on the model). Models 1 and 2 (or A1 and A2) have one fixed and one removable disc. The difference between Models 1 and 2 is the number of tracks per disc: Model 1 (or A1) uses 100 tracks per disc surface, with an average access time of 153 per 86 milliseconds; Model 2 (or A2) uses 200 tracks per disc surface, with average access time 269 or 126 milliseconds. Model 1 (or A1) capacity is 2.45 million bytes; Model 2 (or A2) capacity is 4.90 million bytes. The remaining model, Model 3 (or A3), uses a single 5440 and has no secondary fixed disc. It uses 200 tracks on the disc surface and has a storage capacity of 2.45 million bytes; average access time is 269 or 126 milliseconds.

If the Model 10 has an MFCU, the 5444 discs are housed in drawers within that unit. If the system card unit is a 1442, a 5422 Disc Enclosure must be used to house the disc units. The A-series of the 5444s requires attachment features on the CPU, as do the 5445 large file discs. Depending on the disc configuration, the use of other devices and/or features, a number of processing unit expansion features can be required. Most I/O units require the appropriate attachment feature on the CPU.

The Magnetic Tape and Control Unit (3411) and Magnetic Tape Units (3410) permit magnetic tapes that are completely compatible with IBM 2400- or 3400-type magnetic tape units used in System/360 and 370, to be used as another auxiliary storage medium. The 3411, available in three nine-track models, can attach up to three 3410 drives. Models 1, 2, and 3 operate in a phase-encoded mode and transfer data at 20, 40, or 80K bytes per second, respectively; the Models 2 and 3 can be equipped to record at 800 bit-per-inch NRZI but transfer data at half their phase-encoded speeds.

Line printers (5203 Model 1, 2, or 3) produce 96-, 120-, or 136-column lines at respective rates of 100, 200, or 300 lines per minute. Models 1 and 2 are chain printers, and Model 3 is a train printer. Dual-feed carriages, which permit concurrent printing of separate forms on the

printer, are optional. The feature requires a matching control adapter on the CPU.

The 1403 Line Printers (Model 2 or N1) are also available. They print 132-column lines at speeds of 600 (Model 2) or 1,100 (Model N1) lines per minute. Model N1 uses the 1416 Interchangeable Print Train Cartridge. A 5421 Printer Control Unit is required for 1403 use.

MFCUs (5424) perform a full range of card functions (reading, punching, printing, interpreting, sorting, and collating). Using 96-column cards, MFCU Model A1 reads at 250 cards per minute and punches and prints at 60 cards per minute. Model A2 operates at double these rates.

Card Read Punches (1442 Models 6 and 7) are available for 80-column card I/O. Model 6 reads 300 cards per minute and punches 80 columns per second; Model 7 reads 400 cards per minute and punches 160 columns per second.

The Printer-Keyboard (5471) is a combination inquiry device and auxiliary printer, it keys operator input directly into core storage. When printing, it operates under program control at a speed of 15.5 characters per second. IBM programming systems require a disc-oriented System/3 Model 10 with 12K bytes of memory for 5471 support.

Binary Synchronous Communications Adapter (BSCA 2074 and 2084) features are single-channel communications adapters that permit System/3 Model 10 to function as a point-to-point or multipoint processor terminal. BSCA 2074 supports various data rates between 600 and 50,000 bits per second and allows half-duplex or full-duplex operation over leased, switched, or private communications lines. Communications can be between System/3 and another System/3 or between a System/3 and various System/360 or 370 units with the correct attachments. Feature 2084 permits Model 10 to add a second data transmission line.

A Magnetic Character Reader (1255 Model 1, 2, or 3) can be attached to a disc-oriented System/3 with 12K bytes of memory to input data for on- or off-line operations. Model 1 reads 500 documents per minute; Models 2 and 3 read 750 per minute. Models 1 and 2 have six sorting pockets; Model 3 has 12. All models read characters printed in the American Banker's Association E13-B font. The 1255 can also be used with System/360 and 370 or an IBM 2770 Data Communications System.

The Data Entry Keyboard (5475) is a unit similar to the keyboard of the data recorder. It provides dedicated system on-line data recording and verifying using the MFCU and a system program.

The 3881 Model 1 Optical Mark Reader, a new unit from IBM, was announced for on-line use with Model 10 disc systems at the end of July 1972.

An off-line key entry unit, the Data Recorder (5496), can be used for batch recording and verifying data and programs on 96-column cards. It can be attached to a 2770 Data Communications System for transmission and punching of cards.

The off-line 5486 Card Sorter is a compact tabletop unit for sorting cards into numeric, alphabetic, and alphanumeric sequence. Two models are available, sorting 1,000 and 1,500 cards per minute.

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 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.

A feature can have subfeatures available; these are usually standard in nature. For example, auto call, internal clock, station selection, and text transparency are available once the BSC adapter is installed. In a fashion, attachable devices can have optional features available (listed in the accompanying price data report). Their uses are quite easy to understand, so that users are unlikely to become confused by the abundance of items.

In addition, a number of features — called "specify items" by IBM — are required in all situations. These, however, are always no-charge, are ordered by IBM sales personnel, and are installed gratis. They correctly identify such items as the transmission speed to be used by a communications adapter or the color of the system's panels. For simplicity, they do not appear in the price data list.

SOFTWARE

Report Program Generator II (RPG II) is the main programming language of the Model 10 systems (disc and card). It is a high-level language especially designed for the creation of clear reports based on input data contained in peripheral

storage files. Besides RPG II, Model 10 disc-oriented systems support the Fortran IV and Cobol compiler languages. Fortran IV handles scientific, engineering, and mathematical problems; Cobol is an effective business-oriented language that has been in wide use for more than a decade. Basic Assembler, a machine-oriented language, is available for programming applications on disc systems. Readers should not confuse this last-mentioned language with Model 6 Basic, a high-level compiler language unavailable for Model 10.

System Control Programming

To simplify the user's programming tasks, System Control Programming (SCP) programs are supplied with the Model 10 hardware. All programs, except some produced by the Assembler, operate under SCP. Because SCP performs the control functions for the computer installation, its components differ somewhat for card and disc systems.

Card SCP includes the following programs.

- Program maintenance — incorporates programming changes in the card programming system decks. The program maintains card system software.
- System initialization — enters user data and user switches into the communications area at the beginning of each day.
- Remote job entry (RJE) workstation support — permits a Model 10 equipped with a 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) or larger or a System/370.
- Device counter logout — serves as an aid in problem determination by recovering the contents of counters accumulated in the previous communications program.
- Magnetic tape counter logout — recovers the contents of the magnetic tape error counters immediately following the execution of any program that updates these counters.
- Magnetic tape initialization utility — allows the creation and deletion of standard tape volume labels, checks for unexpired labels, and displays volume and data file labels.

Disc SCP includes the following programs.

- Disc System Management (DSM) — generates and maintains the disc-resident system, which facilitates compilation, generation, and execution of programs.
- Disc system library maintenance — analogous to the card system's program maintenance in that it maintains and services the system disc and libraries.
- Disc copy/dump — an easy-to-use method of file creation that can provide file backup or produce hard copies of disc data files.
- RJE workstation support — functionally identical to the card version, with the added feature of support for discs as I/O devices.
- Overlay linkage editor and checkpoint/restart feature — linkage editor creates loadable programs from multiple relocatable modules. Overlays can be created automatically or as designated by the user. Checkpoint allows the user to write checkpoint records. Restart allows the programmer to resume from the last checkpoint rather than from the beginning of the program in case of machine or operator failure.
- Magnetic tape support feature — provides support for the use of magnetic tape as a data storage device. Tape initialization support is functionally the same as the card version magnetic tape initialization utility program.
- 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.
- Macro feature — provides data management and I/O support to the assembler language user for control of I/O services.
- Disc utility — includes five programs that allow the user to prepare and maintain his discs, including initialization, alternate track assignment, alternate track rebuild, file and volume display, and file delete.
- IBM 5445 Disc Storage Drive feature — offers the users of 5445 disc units the same services as the disc utility program already

mentioned. In addition, a disc copy/dump program is included.

Program Products

Program products, including the language processors, are available at a monthly fee. These products allow the user to submit his applications to the system. Program products for card-oriented systems include the following:

- Card RPG II — the basic programming language used to produce object programs for a wide range of commercial data processing jobs. RPG II is compatible with IBM System/360 RPG, but it has extended features over System/360 RPG and provides greater capabilities.
- Reproduce/Interpret — console-entered card function options allow reproduce, interpret, reproduce and interpret, reproduce with reformatting, and reproduce and interpret with reformatting.
- 96-Column Card List — cards listed on the printer without reformatting; printer lines are single, double, or triple spaced, and the cards are counted; list can be suppressed if only a card count is desired.
- Sort/Collate (5424 MFCU) — a well-rounded sort/collate program that can sort, merge, match, select, or sequence cards.
- Data Recording — dedicates the system with a 5475 data entry keyboard to use as on-line data recorder.
- Data Verifying — like the data recording program, permits the system to be used as a data verifier.
- 80-96 Conversion — applies to systems with a 1442 card read punch and a 5424 MFCU; converts 80-column card decks to 96-column System/3 decks.
- Card RPG II Telecommunications feature — provides the capability to transmit and receive synchronous data over communications lines.
- Card RPG II Braille feature — supplies an option to list compilations and object programs in braille.

The disc version program products include:

- Disc RPG II — has same functions as card RPG II, but it also supports three types of file organization: sequential, indexed, and direct.
- Disc RPG II Telecommunications feature — functionally identical to card RPG II telecommunications feature.
- Disc Sort — facilitates sorting of any file organization (sequential, indexed, direct) in either ascending or descending sequence. The program provides six means of recognizing records.
- Disc RPG II 5445 Disk Storage Drive feature — processes data files for systems, utilizing 5445 Disk Drives.
- Disc Sort 5445 Disk Storage feature — extends the disc sort program to systems configured with 5445 Disk Drives.
- RPG II Auto Report feature — simplifies programming in RPG II by reducing much of the preparation and coding normally required in producing a user application program.
- Disc Resident Card Utilities — provides disc users with the same services offered by the card system programs (reproduce, interpret, 96-column list, MFCU sort/collate, data recording, data verifying, 80- to 96-column conversion).
- Utility for 1255 Magnetic Character Reader — supports systems that include a 1255; permits data read from MICR-encoded documents to be placed on disc, tape, or printer output files.
- Basic Assembler — 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 ANS Cobol — furnishes the user with the most widely accepted and used standard higher-level programming language. Cobol, originally designed for business applications, is available to Model 10 programmers.
- System/3 Disc Fortran IV — provides a high-level programming language for the

solution of scientific and mathematical problems.

Application Programming Systems

There are eight 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.

The following applications programming systems are available.

- Apparel Business Control — provides the apparel industry with an easily installed order processing system that performs order editing, order writing, booking reporting, fabric requirements reporting, finished goods requirements reporting, stock allocation, and invoicing.

- Hospital Patient Billing — contains 15 programs to be used with card system utilities to provide patient billing processing and management information.

- Property and Liability Agency Accounting — designed for property and liability insurance agents or brokers to handle their accounting requirements.

- Utility Billing — manages the utility billing for local governments and small utility companies. Potential customers for this system are utilities that supply water, gas, and/or electric services to 25,000 to 250,000 homes.

- Law Enforcement — furnishes local police departments with a variety of information processing capabilities. Six subsystems provide offense reporting, arrest reporting, accident reporting, radio dispatch analysis, field interview reporting, and police personnel reporting.

- Unit Inventory Techniques — furnishes the retailer with reports on merchandising activity and inventory status. Nine program elements make up a comprehensive inventory control system for retailers.

- Bill of Material Processor — allows the user to load, maintain, and organize four files: item master, product structure, work center master, and standard routing. Information can be retrieved from these files to generate reports on the requirements for any of the materials that go into the end product.

- Optimum Blending — uses linear programming directed to applications in the agriculture and food processing industries. The blend function obtains an optimal combination of raw material based on product specifications and ingredient analysis information.

- Appropriation Accounting — provides appropriation, revenue, and general accounting system for public institutions (cities, counties, states, school districts, hospitals, colleges, universities, etc.). This package helps public institutions conserve public property and plan, direct, and control revenues and dollar costs.

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 output of this program produces the following for the user:

- Editing listings — indicate the accuracy and consistency of the specifications.

- Flowcharts — define the processing and clerical steps involved in each application.

- Data dictionary — defines the terms used in the particular application.

- Record listing — shows record formats.

- File cross-reference listing — references each record and the pertinent application.

- Program description — specifies detailed input specifications, calculation logic, and

output printing requirements for the program to be coded in RPG or Assembler language.

- Sample reports — show the format of the final report according to the original specifications.

This 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.

DESIGN FEATURES

Model 10 has a large selection of central processor units, peripherals, and software support. It is a versatile computer system with appeal to small businesses that adapt it initially or convert their present data processing methods to System/3. Software and hardware have been designed to embrace the diverse small business environments. The software provides many techniques that were previously accessible only on larger computer systems; the devices, in a number of instances, have been compacted to obtain maximum utilization of hardware.

Because of its optional communications features, Model 10 is especially attractive to those users who want to link several small divisions or branch offices with a centrally located System/360 or System/370, at the same time providing each remote site with a flexible batch computer facility of its own. System/3's exterior design is desk-like in size and appearance, a quality particularly desired by small companies that have limited office space and are novices in data processing.

PERFORMANCE

Model 10 is well-suited to the typical scope of business data processing needs. In fact, the technical specifications of Model 10 equal or surpass those of the more costly IBM 360/20 and IBM 1401-G in all categories except card punching rate. Model 10 card punching rate is one half or one third that of Model 20 and 1401-G. The Model 10 lacks the punched paper tape capability of the 1401-G, but it offers magnetic tape and higher capacity disc storage. I/O transfer rate is higher than that for System/360 Model 20.

System/3 disc organization techniques simplify the programmer's work in dealing with files. While easing the programmer's task, it presents one of the obstacles to compatibility with System/360 or 370. Potential users, who start with System/3 and contemplate moving to the 360 or 370 system when growth requirements necessitate it, should note that System/3 and System/360 and 370 disc files are not compatible. System/360 and 370, however, can be programmed to input data from 2316 Disk Packs that were recorded on a 5445 disc on a Model 10 system.

Because RPG II can be used to process data files and generate summaries of the results, it is ideal for ready-to-read analysis of a broad variety of data. RPG II incorporates many desirable features that extend its capabilities over System/360 RPG. System/3 Model 6 can use Model 10 RPG II files.

MAINTENANCE

System/3 maintenance is available through the more than 50 Basic System Centers that IBM operates across the country. Other IBM services

include comprehensive customer training courses and system engineering assistance; these, unlike maintenance under a rental contract, are separately priced.

The education courses provide sound knowledge of basic System/3 concepts, application design, disc system design, and programming fundamentals. System engineers are ready to operate a turnkey system for the user who doesn't want to acquire a programming staff or who doesn't want to assign System/3 programming tasks to his current programming group. The IBM system engineers furnish support ranging from simple aid to design of entire application systems.

HISTORY

System/3 is IBM's highly successful entry into the market represented by smaller businesses with limited or no computer experience. Since its its inception, IBM has continually expanded System/3's capabilities by adding new peripherals as well as more models to the product line. Model 10 was announced June 30, 1969; Model 6 on October 20, 1970.

At IBM's April 1972 stockholder's meeting, it was revealed that, since January 1970, the firm had shipped more than 10,000 System/3s. In the words of the company's president "System/3. . is rapidly becoming the most popular single system that IBM has ever produced."

IBM
System/3 Model 15 Advance Report

OVERVIEW

IBM's System/3 Model 15 is a small business computer that is capable of servicing the needs of many different kinds of industries and interests, including clothing, law enforcement, hospitals, finance, TV and radio, and manufacturing. Its use in a teleprocessing and remote data entry capacity is being stressed by IBM.

The Model 15 is currently the largest computer in IBM's System/3 series of small business computers; the other 2 computers in order of power are the Model 6 and the Model 10.

The Model 15 can do more work than the Model 10 because it has additional facilities: some new processor instructions, larger memory, more on-line disc storage, and a multiprogramming operating system. It uses the more modern memory technology of IBM's System/370 Models 115 and 125 instead of that used in the System/3 Model 10. The Model 15 has basically the same communication offerings as the Model 10; a special option, however, can provide for up to 8 communications lines instead of the limit of 2 that are currently available as standard with both the Model 10 and the Model 15.

The Model 15 can use more than 15 peripherals, including discs, magnetic tapes, card equipment, printers, a display station, OCR, MICR, and communications equipment.

Programs can be written in RPG II, Cobol, Assembler, and Fortran IV. System support programs for disc or tape sorts and utilities are also available. Conversational Basic (used on System/3 Model 6) is unavailable.

The operating environment is a new one for System/3; it is beginning to look like a miniature System/360/370 Disc Operating System. The System/3 Model 15 SCP (System Control Program) is a disc-based, multiprogramming, operating system that should take advantage of the increased main storage available with the Model 15 to provide significantly greater throughput than has been available on the Model 10. Specific throughput comparisons should be available after the machines are installed next year. The new SCP is not a virtual memory operating system.

Also announced was a conversational-type program, DATA/3, that will be available on both Models 10 and 15. DATA/3 allows a remote terminal and the central system to communicate, plus a few other things.

The Model 15 was announced in July, 1973, and first delivery will be in March, 1974. The largest Model 15 system will be delivered in June, 1974. No availability date has been specified for multiple systems.

Typical monthly rentals will range from $3,240 to $7,127, and purchase prices will range from $136,575 to $298,480. DATA/3 will be available under a license agreement for $120 monthly.

EVALUATION AND COMPETITIVE POSITION

System/3 users are perhaps unique in the industry in that they knew when they obtained their 3s they could go nowhere without conversion pains except to more 3s. The larger System/360 computers were, and the System/370 models are now, incompatible with the 3s.

In spite of this, System/3 users have hoped for a bridge system between the System/3 and the System/370 lines. What they want is a system that does more, costs only a little more, and acts as an entry system into the System/370 migration path.

When IBM announced the System/370 Model 125, System/3 users saw a system several times more expensive than their 3s, and conversion costs as the only route. Faced with that, most System/3 users simply continued to upgrade by buying additional 3s.

When the System/370 Model 115 was announced, System/3 users saw conversion costs, plus a machine with major instruction timings simply not as fast as the System/3 in many cases and, at more than twice the cost. System/3 users simply continued to upgrade by buying additional System/3s.

The July, 1973 announcement of the Model 15 is a different story. It does represent, at least temporarily, the upgrade that Model 10 users have been hoping for; offers more main storage capacity (48K, 96K, and 128K bytes) at prices reasonably proportionate to those of the Model 10; offers twice the on-line direct access capacity (over 80 million bytes, compared to the 40 million bytes of the Model 10; and uses the advanced technology of the System/370 Models 115 and 125 (MOSFET memory) instead of the slower, larger, more expensive magnetic core and also offers features that had been available only from independent vendors for the System/3 Model 10, specifically, multiprogramming and spooling.

Something System/3 Model 15 doesn't offer is the System/360 Model 20 simulation available from independent vendors. System/3 Model 15 users, if they stick with only IBM offerings, will have to convert their RPG II programs, if they're coming from the System/360 Model 20. The new System/3 model still doesn't offer System/370 compatibility or conversion aids. So, in perhaps a year or two, System/3 Model 15 users will be exactly where the Model 10 users were before the new announcement — nowhere to go except to more 3s without conversion pains.

Of course, IBM could continue what seems to be its commitment to the System/3 by announcing another model. The new model could have features such as conversational Basic, currently enjoyed by the System/3 Model 6 user. Or it could have a System/360 Model 20 emulator and attach faster peripherals. It might even have a virtual storage operating system, which would be interesting in a 16-bit addressing machine. But it probably won't have System/370 compatibility.

Conversion from the Model 10

Model 10s cannot be field upgraded to Model 15s, so the first thing a Model 10 user who expects to upgrade should prepare for is a new processor. The next thing he should prepare for is a different minimum configuration requirement (see CONFIGURATION GUIDE). Among other things, he must now have a 3277 Display Station. If he's using the 5203 printer, he will probably need a 1403 printer, since an attachment for the 5203 printer has not yet been announced. Tapes and discs can be transferred, with the appropriate attachments and, happily, the user can now double his on-line disc storage capacity if he chooses.

The Model 10 user must recompile all of his programs, if he chooses to use the new multiprogramming operating system, which takes advantage of the new processor facilities available for multiprogramming; for example, storage protection, I/O operation end interrupt, and program check interrupt. The Model 15 can run object programs from the Model 10 provided the I/O is the same, the Model 10 SCP is used, and the user does not want the advanced Model 15 capabilities (e.g., multiprogramming).

The Model 15 user can expect increased throughput compared to the Model 10.

Competitive Position. The IBM System/3 Model 15 competes with Burroughs B 1728, HIS 2030, and IBM System/370 Model 115, among others. These 3 major competitors will be discussed because, assuming a main memory capacity near 96K bytes, they can be configured into systems of comparable price, within $1,000 of each other in monthly rental.

When comparing systems, the first thing to consider is the operating environment and the current specific applications. Then the growth potential should be considered.

Table 1 shows the major characteristics of the Model 15 and its 3 major competitors. They are relatively well-matched for straight batch processing. They vary in the amount of on-line data storage capacity and in their communication facilities.

For a large amount of on-line data in a communications environment, the B 1728 is definitely the best suited. It is currently the top of its line, however, and the migration path can require recompilation of all programs to go to a medium system, which runs under a different operating system.

The next most suitable system for communications is probably the System/370 Model 115, which supports its lines via an integrated communications adapter that is program compatible with the 2703 transmission control unit. The 115 is also in the attractive position of being an entry system to the System/370 line, but its on-line disc capacity is currently only half that of the B 1728.

The HIS 2030, if it had enough main storage to run OS/2000 effectively, would probably be the best communications contender. OS/2000 would allow DATANET front end processor, which cannot be used with the MSR operating systems now available on the 2030. The MSR systems will support either the 285 communications adapter or the 286 communications adapter. The 285 handles a single line; the 286 handles 4 to 6 lines. The MSR operating systems are naive by comparison with IBM's DOS/VS and Burroughs MCP.

CONFIGURATION GUIDE

The minimum System/3 Model 15 configuration consists of a 5415 processor (Model A17) with 49,152 (48K) bytes of memory. In addition to the 5415, the Model 15 requires a 3277 display station with a 78-key operator console keyboard, a 1403 printer (Models 5, 2, or N1), a 5421 printer control unit, a minimum of one 5444 disk storage drive Model A2, and one of the following: a 5425 multi-function card unit; a 1442 card read punch Model 6 or 7; or a 2560 multi-function card machine.

Table 1. System/3 Model 15: Competitive Statistics

Characteristic \ System	IBM S/3 Mdl 15	HIS 2030	Burroughs B 1728	IBM S/370 Mdl 115
Max comm line	2(1)	7	16	5 sync or 4 sync and 8 async
Max on-line disc storage capacity	91.8 mb(2)	300 mb	565.6 mb(3)	280 mb
Multiprogramming oper system	Yes (SCP)	Dual (MSR)	Yes (MCP)	Yes (DOS/VS)
Languages:				
RPG	Yes	Yes	Yes	Yes
Cobol	Yes	Yes	Yes	Yes
Fortran IV	Yes	Yes	Yes	Yes
Assembler	Yes	Yes	No	Yes
PL/1	No	No	No	Yes
Basic	No	No	Yes	No

Notes:

(1) Eight communications lines can be attached through an RPQ item only.
(2) 9.8 mb on fixed disc, 82.0 mb on removable disc.
(3) 40.5 mb on head-per-track disc, 525.6 mb on removable disc.

This minimum configuration differs from that of the Model 10 in that the 5203 printer cannot be used on the Model 15 (although it can be used on the System/370 Model 115); the 2560 multi-function card machine will satisfy the Model 15's card requirements (not so on the Model 10); and the 3277 display station with the operator console keyboard is required (again, not so on the Model 10).

Devices are connected to the computer via attachments, not by channels (with 2 exceptions). Attachments are fitted to the 5415 processor, and most of them are field installable. All of the devices mentioned in the minimum configuration list are connected by attachments. Other devices that can be attached are: 5445 disk storage drive; 3410/3411 magnetic tape drives; 2501 card reader; a local communications adapter; and 1 or 2 binary synchronous communications adapters.

A maximum of four 5445 discs can be attached to the Model 15, which can support 4 tape drives, the same number as the Model 10. Only 1 printer can be attached; 2 card readers can be attached, if the second is a 2501. A 1255 magnetic character reader or a 3881 optical mark reader can be attached if a serial I/O channel is installed (extra cost). But they are not yet supported by Model 15 programming and must use the Model 10's programming.

Main memory is available to 64K, 96K, and 128K bytes. Memory is field installable. Some expansions, depending on the system configuration, may also require a power supply expansion.

(Additional information on the individual peripherals capacities and configurations appears in the Peripherals and Data Handling segments of your AUERBACH Computer Technology Reports.)

MAINFRAME

The System/3 is a small, single-processor, business-oriented system. 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 Model 15 CPU utilizes monolithic systems technology (MST), the same as that of the Model 10, for circuit logic. The cycle time is 1.5 microseconds, the same in both machines. The main storage is Metal Oxide Semiconductor Field Effect Transistor (MOSFET), the same as that of the System/370 Models 115 and 125. The Model 15 also uses 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.

The basic addressable unit is an 8-bit byte. Data is coded in EBCDIC. The card code is a 64-character set using 6 bits; up to 96 columns of information can be contained in a card.

System/3 uses a 16-bit address (System/370 uses a 24-bit address); 16 bits can address up to 64K bytes. The Model 15 Address Translation Table (ATT) consists of 32 registers, which address up to the upper limits of 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 128K bytes of memory.

Other Model 15 features that differ from the Model 10 are CPU storage protection; program check interrupt; 8 levels of interrupt; a mask interrupt capability; privileged mode operation; operation end interrupt, and cycle-stealing overlap of I/O operation with processing.

A feature to increase I/O transfer rate is the 2-byte wide data path for discs (5444 or 5445). 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

Over 15 peripherals — slow-speed, high-speed, and special-purpose — have been announced as available with the new System/3 Model 15. Conspicuous by their absence are the 5203 printer currently available to System/3 Model 10 users (perhaps a connection will be announced later) and paper tape facilities. Paper tape has never been available on System/3 but is available on competitors' systems.

Slow-Speed Peripherals

Printers, 80-column card units, and 96-column card units are available.

5424 Multi-Function Card Unit Model A1 or A2. For 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.

1442 Card Read Punch Models 6 and 7. For 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.

2560 Multi-Function Card Machine. For 80-column cards: Model A1 reads at 500 cards per minute, punches at 160 columns/second; can also collate, interpret, and print documents.

1403 Printer Model 2, 5, or N1. 132 print positions; printing speed, respectively, is 600, 465, and 1,100 lines per minute.

2501 Card Reader Model A1 or A2. Reads 80-column cards; 600 and 1,000 cards per minute, respectively.

High-Speed Peripherals

Discs and magnetic tape drives are available. The tape drives are also available on the System/370 models, the discs are not.

5444 Disk Storage Drive Model A2. Combination removable and nonremovable discs; 200 cylinders on each; 4.9 million bytes (9.8 million packed) capacity.

5445 Disc Storage Drive Model 1. Removable; 20.48 million bytes capacity; 60-millisecond average access; Model 2 is attached to Model 1, up to 2 Model 1s (and therefore 2 Model 2s) can be attached.

3410/3411 Magnetic Tape Unit and Control, Models 1, 2, or 3. 800 or 1,600 bits per inch; 7- or 9-track; transfer rates of 20, 40, or 80K bytes per second.

Special-Purpose Peripherals

A magnetic character reader and an optical mark reader can be attached to the Model 15 via the optional Serial I/O Channel. (See CONFIGURATION GUIDE.)

1255 Magnetic Character Reader, Models 1, 2, or 3. Reads/sorts 6-inch documents at speeds of 500, 750, and 750 documents per minute. Models have 6, 6, and 12 stackers, respectively.

3881 Optical Mark Reader. Reads documents 3 x 3 inches to 9 x 12 inches with marks made by number 2 pencils or appropriately equipped printers.

Operator's Console

The 3277 Display Station, together with an operator console keyboard, is required for operator/system communications. This station is optional on the Model 10, where it can be used for inquiry, secondary output, limited key entry of data, and operator/program interaction. The same functions are available with the Model 15.

The 3277 is a cathode ray tube which displays up to 480 characters (12 lines of 40 characters each). The 78-key operator console keyboard has 45 alphameric keys, 21 control keys, and 12 program keys.

DATA COMMUNICATIONS

The Model 15 provides the same communications capability as the Model 10; it can function as a processor terminal or a host or sub-host system.

One or two binary synchronous communication adapters (BSCA) are available to provide synchronous transmission rates from 600 to 50,000 bits per second.

The Model 15 BSCA supports the System/3, System/7, Systems/360/370, 2770 data communications 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 at either device.

A local communications adapter (LCA) allows direct local attachment of 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 cannot be installed with the first BSCA.

A 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 1 to 8 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

Specific information on how the Model 15's software varies from that of the Model 10 is not yet available, but a few things are known. The Model 15 will support programming languages, utilities, and data communications, and a new disc-based multiprogramming operating system will be available.

Programming Languages. Cobol, RPG II, Assembler, and Fortran IV will be available. The compilers will be enhanced to reflect the new operating environment and the increased peripheral support.

Utilities. Disc sort, tape sort, and various other utilities already available to System/3 users will be available for the Model 15 and will be enhanced to support the new operating environment and additional peripherals.

Data Communications. The Communications Control Program (CCP) will 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. The concurrent program execution in a partition creates subpartitions that can handle multijob streams.

The CCP was originally announced for the Model 10, and included support for Cobol, Fortran, and RPG II. As announced for the Model 15, only Cobol and RPH II are available.

CCP requires no additional hardware over the minimum Model 15 configuration except, of course, an MLTA or a BSCA and at least 1 terminal.

Data/3. The newly announced Data/3 will provide conversational displays on a remote 3270, allowing the operator to interact with data files during inquiry and data entry.

Operating System. The new System Control Program (SCP) features multiprogramming and spooling, plus support for the additional peripherals supported by the Model 15 (that is, the discs). Three new commands — LOAD CPU, STORE CPU, and COMMAND CPU — are used to support the multiprogramming environment.

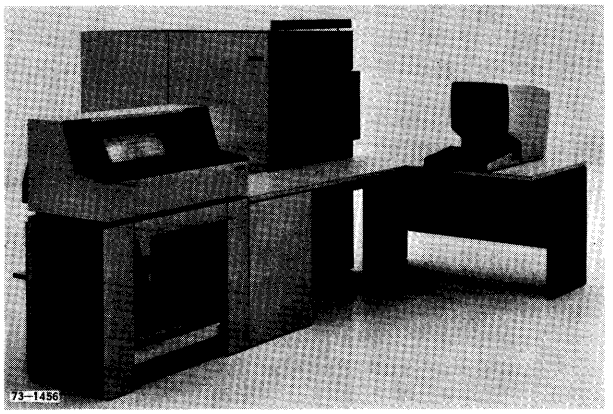
Multiprogramming allows 2 or more programs to execute at the same time, but the maximum number allowed and the method of implementation have not been released.

Spooling allows data in input or output queues to be stored on disc for reading, printing, or punching at a later time. Until now, this significantly faster way of handling data I/O has been available from independent vendors for System/3, but are not available from IBM.

The Model 10 SCP will run on the Model 15, without, of course, taking advantage of the new processor features, or the new SCP instructions.

Application Programs. Application programs will have to be recompiled to run on the Model 15, but that is the only restriction on programs already written for the Models 6 and 10. No new application programs have been announced so far. Existing programs available from IBM include apparel business control; bill of material processor; business analysis; health, welfare, and pension fund; hospital accounts receivable; hospital patient billing; inventory and requirement planning; law enforcement; a system for TV and radio; and a utility billing system. Many others are available from independent vendors.

IBM
System/370 Model 115



OVERVIEW

System/370 Model 115 is a small general purpose computer marketed primarily for business applications. It supplants the System/370 Model 125 as the smallest, fully upward compatible member of IBM's System/370 family of computers, as well as the smallest entry-level computer into the System/370. It can also be considered an upgrade system for present users of System/360 Models 20, 22, and 25; System/3 Models 6, 10; and the 1130 system. Although the 115 may not be an upgrade system for System/3, Model 15 users, the 115 does offer a migration path into the System/370.

Conversion to the System/370 via the Model 115 allows all but the System/3 Model 15 users to benefit from a more efficient multiprogramming capability; more processor instructions; more modern hardware technology in CPU and main storage; cost-effective facilities of virtual storage; and faster, larger-capacity, lower cost-per-byte discs. Model 115 is directly compatible with the 360/22 and 25 and can emulate the 360/20. It offers no compatibility bridges to the System 1130, although it does offer similar applications programs. The 115 does, however, offer 1401/1440/1460 compatibility.

As for compatibility with System/3, the 115 can handle programs written in RPG II and Cobol, and it is equipped with both 80- and 96-column card equipment. IBM calls this "entry level" compatibility.

In fact, this compatibility with System/3 is no different from that offered by the Model 125; that is, the systems are not compatible. The 115 and System/3 record and handle data differently, and they use different addressing schemes. IBM has not yet announced any conversion aids. In effect, the Model 115 differs little from the Model 125; it has less total core capacity and costs less. Both systems offer the same improved performance over the 1130, 3/10, 360/20, 360/22, or 360/25.

Whether or not the 115 will offer improved performance over the System/3 Model 15 has yet to be seen. Both use the same memory technology. The 115's virtual storage operating system may be a little too sophisticated for the entry level user. A knowledge of program mixes is all-important to avoid operating system overhead and thrashing, and this knowledge requires training. The Model 15's operating system appears nicely suited for entry-level operation, and it probably can be run with on-hand personnel with minimum training. Neither system has been delivered yet, so it is too early to tell exactly how the 2 systems will compete. The 115, as well as the System/3 Model 15, is slated for first delivery in March, 1974. Figure 1 shows a plot of price versus memory capacity for various models of System/3, System/360 and System/370. According to this Figure, the only systems that can be upgraded to a 370/115 without increasing costs are a 360/30 with 64K-byte memory and a 360/25 with 48K-byte memory. In terms of performance, however, these systems should probably be upgraded to the 370/125.

To increase processing power beyond the Model 15, System/3 users must upgrade to the 125, not to the 115; and that upgrade costs more than double that of a System/3.

IBM is increasing its emphasis on the communications market, and the 115 can be used as a front-end processor, a host processor, or a remote job entry (RJE) workstation. A total of 4 synchronous and 8 asynchronous lines or 5 synchronous lines can be attached to integrated communications processors; that is, the lines are directly attached to the CPU.

Programming support for the Model 115 is DOS/VS. Language processors available are RPG II, Cobol, Fortran, PL/1, and Assembler. Conversational Basic, as enjoyed by System/3 Model 6 users, is not supported. Initial applications at which the 115 is targeted are banking, manufacturing, and automobile industries.

Compatibility

The Model 115 is totally upward compatible with other System/370s. Most DOS programs from 360s can run immediately under DOS/VS. Current Model 22 and 25 programs can be run using the optional System/360 I/O compatibility and 2311-1 compatibility features. The changes

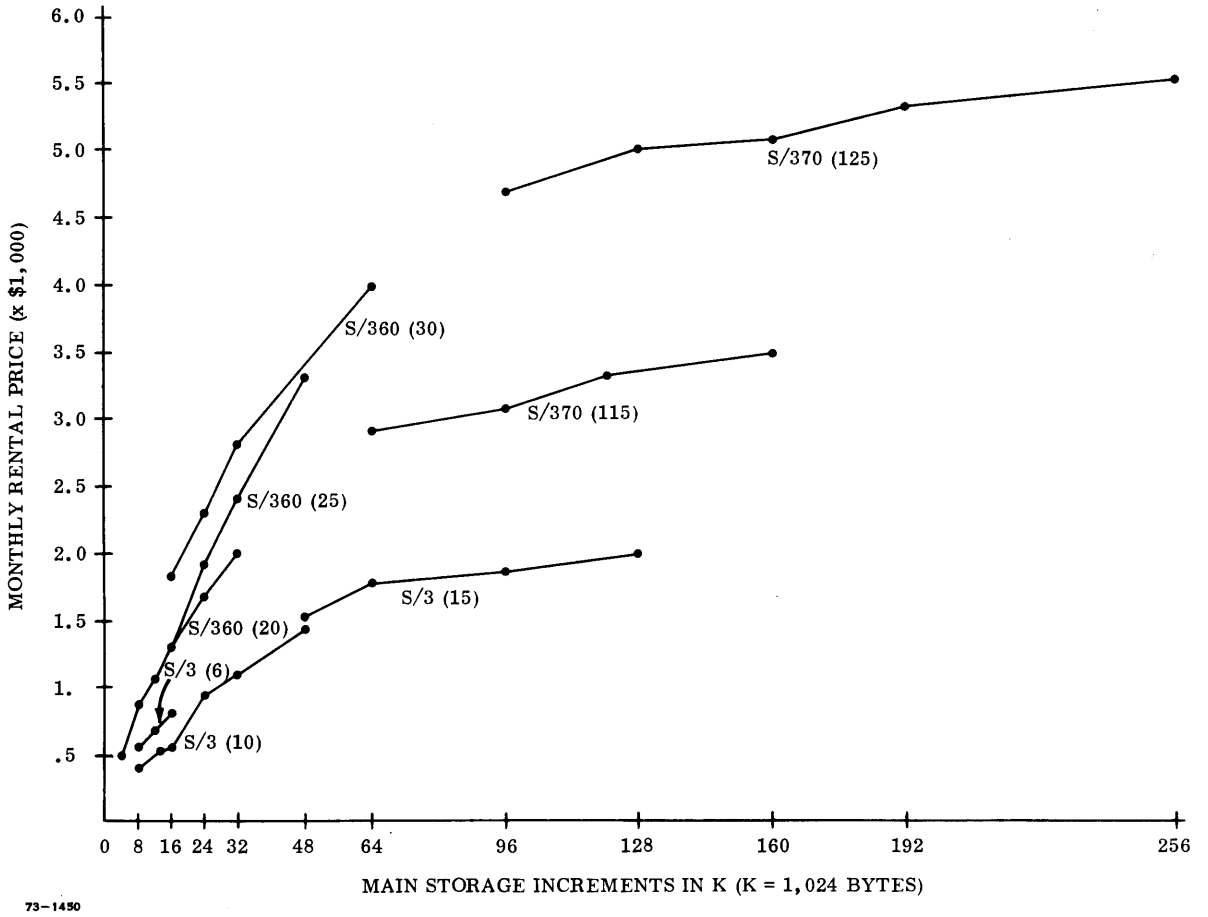


Figure 1. IBM S/3, S/370, and S/360 Storage: Rental Comparison

are reflected in the control language because disc storage under DOS is allocated by specific volume, track, and extent.

DOS/VS supports an integrated System/360 Model 20 emulator which includes access to pseudo-2311 discs.

DOS/VS allows the definition of 5 memory partitions. One will probably be dedicated to the spooler program (Power), which requires 18K bytes; another could be dedicated to teleprocessing; and perhaps another to background processing. Any memory below 128K bytes appears barely sufficient to use the virtual system fully. Albeit the 115 is a flexible, small general-purpose machine in terms of hardware, its software seems potentially ponderous and susceptible to thrashing.

PERFORMANCE AND COMPETITIVE POSITION

Systems that compete from the standpoint of performance with the S/370, 115 are the Burroughs B 1726, the HIS 2030, and others. Currently, the Burroughs B 1726 is a powerful machine very well suited for small- to medium-scale general-purpose processing with a business orientation. With optional equipment, the 1726 can accommodate over a half-billion bytes of online storage; up to 8 communications lines on a multiline controller; and addresses for up to 96K bytes of main storage. The MCP-II operating system utilizes the same paging technique used on the very large multiprogramming, multiprocessing B 6700/7700 machines.

Currently, the 1726 is most suitable for Cobol programs; however, the sophisticated architecture for reconfigurable microprograms is easily adaptable to other languages, to a multiprocessing environment, or to the emulation of other machines. To date, only emulation of the IBM 1400 series, however, has been announced. IBM recently announced the same capability on the 115.

The 115 has a larger main memory addressing capacity, (a current maximum of 160K bytes),

fewer communications lines, and a more complicated operating system than the 1726. DOS/VS requires more processing overhead than does the 1726's MCP-II; that is, DOS/VS requires more main storage addresses, more direct access storage space, and more instructions for paging and address translation than the MCP-II. A specific example is the size of routines resident in main storage: 8K bytes for the MCP-II, and 18K bytes minimum for DOS/VS.

Both DOS/VS and MCP-II perform spooling operations; MCP-II allocates resources in a more sophisticated way than does DOS/VS. For ex- MCP-II assigns data sets dynamically while DOS/VS requires specific device information.

The HIS 2030 with a maximum core capacity of 96K bytes does not use modern storage technology, nor does it offer an operating system of the sophistication of DOS/VS or MCP-II. It does offer a large amount of on-line storage, and it is oriented toward communications processing. A dedicated system running under OS/2000 and the DATANET 2000 is a strong contender for communication applications, but the 2030, because of its limitations on main storage addressing, could do little else. Honeywell apparently realizes this because they have announced the MSR/2000 operating system for exclusive use of the 2030. This offers dual-programming capabilities and communication facilities that are slightly better than those of the 115, but they are not equivalent to the powerful DATANET 2000.

Certain characteristics are common to all of the competing systems; all offer Cobol, RPG, and Fortran. The 1726 does not offer an assembler language, but the other systems do. All are upward compatible with larger medium system models of general-purpose computers. All offer more or less industry compatible peripherals.

CONFIGURATION GUIDE

One central processor is available for the 115. The 3115 has a 480-nanosecond, 2-byte, memory cycle time; it provides arithmetic and logic circuits, plus a direct disc attachment, reloadable control storage (20K words of 22 bits, a concept borrowed from the 125), and main storage. The main and control storage use MOSFET (metaloxide semiconductor field-effect transistor) technology. Main storage is available in 4 sizes: 64K, 96K, 128K, and 160K bytes.

The 115 has also borrowed the "floppy disc" concept from the 125. The removable magnetic diskette contains the microcode for the basic system, the optional features ordered for the system, and CE diagnostics. Error logging therefore is on the diskette instead of in CPU registers, as is done on all larger 370s, except the 125.

Standard Features

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, byte-oriented alignment, and special reliability, availability, and serviceability features. Also included are the Display Operator Console (DOC), a CRT plus keyboard, and direct attachment of the 3340 Model A2 two-disc drive storage. Additional 3340s, Model B1 or B2, are attached to the 3340, to a maximum of 4 drives.

The reloadable control storage is provided with the optional card I/O attachment, printer attachment, integrated communications adapter, and the byte multiplexor channel.

I/O devices attached via integrated controls or adapters are the 3340 direct access disc drive, the 3411 magnetic tape units, the 2560 and 5425 multifunction card units, the 5203 printer, and the communications adapter.

I/O devices connected via the byte multiplexor channel are the same as those that can be connected to the byte multiplexor channel on System/360 Models 22, 25, 30, and 40. The byte multiplexor channel has 32 subchannels (8 shared; 24 unshared), giving 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.

PERIPHERALS

Except for the 3330 disc storage facility and the 3803/3420 magnetic tape substations, the Model 115 supports the same peripheral devices as the Model 125. These devices attach as already described in the Configuration Guide.

Table 1 lists the specific punched card peripherals available and Table 2 the magnetic tape units. Other peripherals available include the 3203 printer, which is a faster and considerably more expensive version of the 1403 printer, and the 3340 disc storage and control. The 3340 can be used only under virtual storage operating systems. It uses the 3348 single cartridge data module to hold the disc recording surface, the

access arms, and the read/write heads. The 3540 Diskette I/O unit can also be used.

Other peripherals available are the 1287 Optical Reader, the 3881 Optical Mark Reader and

Table 1. IBM S/370 Model 115: Card Equipment

Identity	Columns	Channel 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	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)	80	I	Internal
2596 Card Read Punch	96	C	Internal
5425-A1, A2 MFCU	96	I	Internal

Note:

(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 2. IBM S/370 Model 115: 3411/3410 Magnetic Tape

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.

the 3886 Optical Character Reader. The 7770 Audio Response Unit is also available.

Users considering a migration or a change from their present IBM system will find Table 3 interesting; it lists selected device availability on the probable growth/migration systems.

DATA COMMUNICATIONS

The Model 115 can be used as a stand-alone communications processor or as a front-end processor with other members of the System/360/370 family.

Software support includes BTAM (Basic Telecommunications Access Method) and QTAM (Queued Telecommunications Access Method) but not TCAM (Telecommunications Access Method).

An impressive array of terminals can attach via either the Integrated Communications Adapter (ICA) or a control unit on the multiplexor channel. The ICA is program compatible with the 2703 transmission control unit. It allows direct attachment of up to 5 synchronous or up to 4 synchronous and 8 asynchronous lines. The ICA is equivalent to 2701s, 2702s, or 2703s or 3704s/3705s in emulation mode attached by a byte multiplexor channel. The data transfer rate is 45.5 bits per second for asynchronous lines and up to 50,000 bits per second for synchronous lines.

The following terminals can be attached: the 3270 Information Display System units, the 3735 Programmable Buffered Terminal, the 3780 Data Communications Terminal, the 2922 Programmable Terminal, the 2740 and 2741 Communications Terminals, the 2760 Optical Image Unit,

Table 3. IBM S/370 Model 115: Comparison of Device Availability on Probable Growth/Migration Systems

S/370 Mdl 115 Characteristic or Device	1130	S/360			S/3			S/370	
		20	22	25	6	10	15	125	135
3340 Direct Access Storage Facility (34.9 or 69.8 mb; 25 msec seek; 885 kb/sec data rate)	—	—	—	—	—	—	—	X	X
3203 Printer Mdls 1 & 2 (600 or 1,200 lpm; 132 PP, 10 cpi; 30- to 240-char sets)	—	—	—	—	—	—	—	X	—
5213-1 Console Printer (85 cps)	—	—	—	—	X	—	—	X	—
3872, 3875 Communications Modem	X	X	—	X	X	X	X	—	X
5425 Multifunction Card Unit (96 col)	—	—	—	—	—	—	X	X	—
2560 Multifunction Card Unit (80 col)	—	X	—	X	—	—	X	X	—
5203 Printer Mdl 3	—	—	—	—	—	X	—	—	—
3410/3411 Magnetic Tape Units (20, 40, 80 Kb; 6 max/controller)	—	—	—	—	—	X	X	X	X
2260 Display Station	—	—	X	X	—	—	—	X	X
3271 Display Station	—	—	—	X	—	X	—	X	X
2501 Mdl A1 or A2 Card Reader	X	X	X	X	—	—	—	X	X
1231 Optical Mark Reader	X	—	X	X	—	—	—	—	—
1627 Plotter	X	—	—	—	—	—	—	—	—
Cobol	X	—	X	X	X	X	X	X	X
RPG	—	X	X	X	X	X	X	X	X
ASM	—	X	X	X	—	X	X	X	X
Fortran	X	—	X	X	X	X	X	X	X
PL/1	—	—	X	X	—	—	X	X	X

the 2770 and 2790 Data Communication Systems, the 2780 Data Transmission System and the 2260 and 2265 Display Stations.

Additional communications control beyond that provided by the ICA can be implemented using the 2701, 2702, or 2703 units or the 3705 communications controller. Line adapters (each of which requires a channel control unit position) are also available: the 2711 line adapter and the 3872, 2875, and 4872 modems.

SOFTWARE

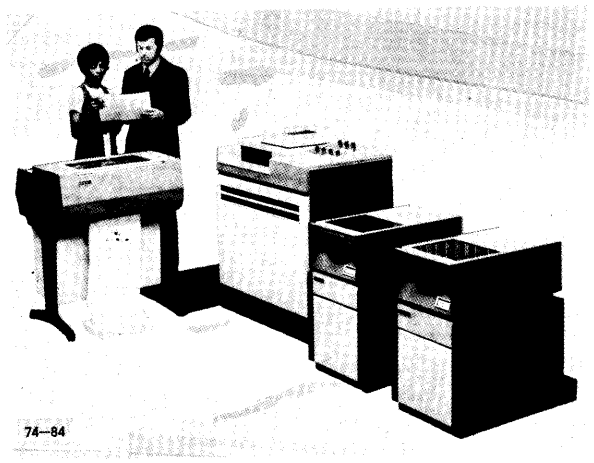
The software available has already been discussed under OVERVIEW and PERFORMANCE AND COMPETITIVE POSITION. A thorough analysis of the DOS/VS operating system can be found in the System Software Segment of your AUERBACH Computer Technology Reports.

HEADQUARTERS

IBM Corporation
White Plains NY 10601

NCR CORPORATION

Century 101



OVERVIEW

NCR's Century 101 is a small but versatile machine that handles straight batch and on-line processing for a variety of industries. In addition to normal business processing, such as general ledger, the 101 has already been applied to banking, retailing, reservation systems, production control, feed mix analysis, academic scheduling, and problem solving for students at terminals.

The strengths of the 101 are its relative low cost as compared with its competitors'; its simplicity and straightforwardness of operation; and its expansion capabilities which offer a definite growth path within the 101 itself and upward to the Century Series of general-purpose computers. The 101 has available a library of applications programs that represent more than 24 major processing categories.

A disadvantage of the 101 lies in NCR's handling of various software releases and users sometimes complain that released software is not tested as thoroughly as it should be. Users have indicated that program fixes are usually quickly presented, however.

NCR's Century Series is a family of general-purpose computers designed for first-time computer users as well as for users who already have installed a small computer system. The series currently has six members. The smaller members are the Century 50, 100, and 101; the larger members are the 200, 251, and 300. The 101 is marketed in Europe under model numbers 75 and 150.

The smaller members of the Century Series are particularly suited for upgrading from punched card or electronic accounting machine data processing to the more powerful and flexible facilities available with disc-oriented small computers.

A major advantage of the Century Series is that software is directly interchangeable between members of the series. When going upward in the series, recompilation may be desirable to take advantage of better hardware, but it is not necessary. Software is available to simulate any instructions absent from a computer's repertoire. Therefore, software is also downward compatible. Also, the operating system used on the smaller Century models is a pure subset of the operating system used on the larger Century models. These features are distinct advantages in a market where most manufacturers offer only incompatibilities and conversion problems.

The Century 101 was designed to replace the 100 in the NCR Century product line. About 2.5 times as fast as the 100, the 101 has a more expandable core memory, more instructions (34 plus three optional), and greater I/O simultaneity and throughput. It accommodates more integrated I/O units: card or paper tape reader, control console, optional I/O write for console messages (six character-per-second impact printer or a 30-character-per-second thermal printer), and optional communication multiplexor for up to 10 lines.

CONFIGURATION GUIDE

The Century 101 is sold in a basic configuration which includes a processor with 16K of main memory and a control console; a line printer (300 lpm); a card or paper tape (COT) reader; and 4.9 megabytes of 656-101 disc file storage. The basic configuration also includes two channels (NCR calls them "trunks"), one multiplexor (low-speed), and one selector (high-speed).

European versions of the 101 are slightly different in their basic configurations. The Century 75 (called the Century 150-656 in the United Kingdom and Scandinavia) has a dual-spindle master/slave unit of 9.96 megabytes of 656 disc storage capacity as standard, instead of the 4.9-megabyte master that is standard with the domestic 101. The Century 150 has 657-102 disc drives as standard. These IBM 2314-type discs give a capacity of 29.8 megabytes per disc pack, thus significantly increasing the basic system capacity.

Many expansion capabilities are available for the 101; they involve replacements, enhancements, or additions to the basic configuration.

Main Memory

Main memory can be increased from the basic 16K bytes to 24K, 32K, 48K, or 64K bytes maximum. Memory is contained on 11 x 14-inch boards in the processor. Memory is added simply by inserting additional modules in the mainframe, which can contain all of memory.

Input/Output Trunks (Channels)

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.

Peripherals

Many peripheral units of varying performance levels can be added to or substituted for the basic system. These include an Input/Output writer; dual-spindle disc units; high capacity disc units; high-speed printers; paper tape units; magnetic tape units; additional punched card units; Card Random Access Memory (CRAM) units; and special-purpose peripherals such as MICR reader/sorters, optical journal readers, visual display units, and remote terminals.

Communications

The processor uses either an integrated communication interface (position three Trunk zero) 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.

COMPETITIVE POSITION

The NCR Century 101 competes domestically with the IBM System/3 Models 6 and 10, the Burroughs B 1712 and 1714, the Univac 9200II, and the Singer System Ten (among others). In the United Kingdom and Europe, the 101 (75 or 150) competes with the ICL 2903 and Siemens 404/3. Among the domestic competitors, the Singer System Ten, the Burroughs B 1712 and the IBM System/3 Model 10 are price-competitive with the NCR 101. The Univac 9200II is performance competitive, but comparable configurations are about 25 percent more expensive. Ironically, the Univac 9000 Series is the only series offering comparable upward expansion capabilities, including compatibility between processors moving upward. Burroughs and IBM offer limited upward expansion for the B 1700 Series and System/3, respectively; Singer offers none.

Of the price-competitive systems, all offer on-line communications capabilities and direct access file capabilities. Burroughs, however, offers only disc cartridges; no removable disc pack storage devices are available on either the 1712 or the 1714. This, of course, limits the available on-line storage. Also, the current operating system for the B 1700 is a little too sophisticated to be operated easily with any effectiveness.

The Singer System Ten shares with the 101 simplicity of use and straightforward operating system; it also shares a "configuration package" marketing philosophy and an orientation towards data communications. Singer, however, excels in multiprogramming "multipartitioning" capabilities. Currently, the 101 is limited to one foreground partition dedicated to on-line processing, and one batch partition dedicated to serial processing on its largest configuration. Singer's System Ten can handle up to 20 separate jobs. Although Singer's System Ten has been extremely well received by its users, Singer seems to be limiting the marketing of the System Ten. It is difficult to find salesmen for the system.

IBM's System/3 Model 10 is competitive with the 101 in price, in the number of available application packages, and in service. The 3/10 supports fewer lines and disc storage communication, but it has a more powerful operating system which requires a trained operator. The 3/10 is also limited in its expansion capabilities; thus far, after Model 10, Model 15 is the next available system for growth within a compatible line. Also, the 3/10 does not offer a conversational Basic compiler, which limits the orientation of its terminal environment considerably. While the System/3 Model 6 does offer Basic, it offers practically no expansion capability. The 101 is truly more flexible and versatile than the 3/10. This is not the case with the 3/15, but the 3/15 is considerably more expensive than the 101.

The European market position of the NCR 101 (75, 150) is not so straightforward as the domestic market position. For example, the Century 75 is purchased unbundled; only a NEAT 3 compiler is included with the hardware; all other software is available at additional cost. Although the Century 150 is marketed at higher prices, it is bundled. The 150 also includes multiplatter discs.

The two strongest European competitors, in addition to U.S. systems marketed abroad, appear to be the ICL 2903 and the Siemens 404/3. Neither system offers a range of batch I/O devices comparable to those available on the NCR, IBM, and Burroughs competitors.

The ICL 2903 can accommodate direct data entry keystations on-line and multiprogram its operation with normal batch processing and/or on-line file inquiries. At equivalent prices, the 2903 also offers larger main storage and higher I/O throughput than its competitors. Still another factor in favor of the 2903 is its full upward compatibility with all members of ICL's 1900 Series, which has a larger range than NCR's Century Series.

The Siemens 404/3 offers fast execution times for hardware-performed single- and double-word fixed-point binary operations as well as for the program-controlled multiplexing of almost all I/O operations. The 404/3 was initially designed for industrial control operations, but Siemens has extended its market to include small batch-oriented disc processing business computer applications. Its position is not particularly strong at this time. It should become more competitive, however, as Siemens continues to provide complete application packages, thus relieving the user of programming worries.

USER REACTIONS

NCR's main markets, the small to medium computer users in retail firms, banks, and commercial organizations, are also the principal customers for the firm's cash registers, accounting machines, terminals, and business machines. As of October 1973, over 275 NCR 101s had been installed; many more are on order domestically and elsewhere.

Most users of the 101 are not immediately affected by, and not overly interested in, NCR's agreements with CDC, including their cooperative ownership of the subsidiary, Computer Peripherals, Inc. CPI was formed to produce mainframe parts, line printers, punched card machines, and magnetic tape handlers exclusively for the parent firms. Users of the 101 are interested in NCR's plans to build a swing system to link the Century Series and CDC's systems, but this interest is only as a long-range curiosity.

Users of the 101 differ greatly in their backgrounds. Installations range from areas with no EDP personnel to areas with more than a dozen personnel; from first time computer users to those who have used NCR equipment for over a decade; from turnkey systems where NCR is looking after the users and training clerks for data entry to sophisticated academic environments where users tailor their own system. The workloads range from one and one-half shifts of dedicated accounting and general ledger to on-line mathematical problem solving plus extensive service-bureau batch processing for 20 hours daily to full-time, round-the-clock on-line processing.

All users indicated that the system's hardware is most satisfactory; this and one other are the only aspects that all users agree on. 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 temperature in the environment-controlled rooms to reach 80 degrees (only eight degrees above the recommended 72 degrees), read/write errors will occur on discs and in memory. Problems also occur if the temperature falls below 58 degrees.

Users in areas near large cities or service centers are delighted with the service received for maintenance and trouble calls. Users in outlying areas are generally displeased with the maintenance, but they do add that representatives usually arrive at the location within a half-day after a problem occurs.

Banking

A bank with approximately 10,000 customers has installed a Central Information File (CIF) and "Unified Statement Banking" through its NCR 101. Installed in September 1973, the 101 has 32K bytes of main memory, two removable spindles of 656 disc storage, a 670 MICR reader/sorter, 1,200 line-per-minute printer, and a 300 card-per-minute card reader.

The CIF package is supplied by NCR. Five applications are now in operation: demand deposits, regular and special checking, certificate of deposit and general ledger. Installment loans will be added within the next few months. The bank has made a few modifications to the software, but it has a software contract with NCR who did most of the coding. The installation consists of three people: two operators and one overseer/coordinator. Two NCR software representatives are present 80 percent of the time and they handle all coding changes.

Problems have occurred with the installation, but the bank representatives feel these were minor and, at worst, "average for any installation."

The bank is a first-time computer user. It considered the System/3 Model 6, but felt it was "too small" with "no growth possible," a small Burroughs system with "no removable discs" as was rejected later was a Honeywell system. The Honeywell bid was received too late to be thoroughly considered.

The NCR system was selected for the following reasons: the bank was close to a service center; NCR is the only manufacturer of small computers with a CIF package available; and NCR offered the greatest capacity for the money.

The bank is well satisfied; expansion plans include adding communication facilities in the next 2 or 3 years.

Academic Environment No. 1

A college specializing in business training has installed an NCR 101 and an NCR 399. The 101 has been in operation for over a year. Currently, it has 32K bytes of main memory; an addition of 16K bytes is planned. Other equipment includes two card readers (card-or-tape COT reader and a high-speed reader/punch); dual-drive 655 disc; and four terminals: two NCR 260s connected by standard telephone interface and two hardwired Western Union 33 KSRs. The terminals are attached via the integrated communications adapters.

Students run Basic I for 3 hours each day, on the four terminals, during which time the system is dedicated. Batch is run afterwards, for an average total of 20 hours daily, 7 days a week. Batch programs include NCR packages for payroll, accounts receivable, accounts payable, general ledger, inventory (ORBIT II), and class scheduling. The university has prepared programs for attendance, grades for its 12,000 students, and miscellaneous programs for service bureau work for other educational institutions in the area. NEAT/3, Cobol, Fortran, RPG, and Basic languages are used.

Maintenance has been excellent. NCR representatives visit the college at least once a week and request time to perform maintenance when they don't get it. Since there is a service center in the town, the response time to

trouble calls is fifteen minutes. The college feels it has excellent rapport with NCR and benefits from educational price discounts. The institution had serious problems with its air conditioning which led them to the conclusion that the 101 cannot run above 80 degrees or below 58 degrees.

The college also considered a Burroughs B 1700 before obtaining the NCR 101. The major advantage of the 101 was price.

The only criticism this highly satisfied customer voiced was that NCR "releases its software programs a little too early. Patches are immediate, but. . . ."

Airlines

A commuter airline installed the 101 for a computerized reservation system to handle its more than 1,400 flights each week. The system has the maximum memory of 64K bytes, 657 discs (one controller and two drawers), an Input/Output writer, a reader (300 cards per minute), and printer (450 lines per minute). It also has 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 still has several NCR 315s installed; but its commitment to communications is an entirely new experience. This company did not evaluate competitive systems. The decision to go on-line was made very quickly and NCR was contacted immediately, since 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 four months. NCR developed the software I/O and the interfacing with Bunker-Ramo; the airline handled the user programming. The package, jointly developed by the three companies, is written in NEAT/3, and runs under S2 (the dedicated on-line operating system).

Occasionally, there are disc read errors due to false timings; but since the airline has duplicate files, the errors are merely a temporary annoyance. This user also indicated the NCR 101 malfunctions at a temperature of about 80 degrees.

The airline is extremely pleased with the 101 and is proud of the speed with which the system was created and installed. When asked about maintenance, they admitted they have a special problem, since they are on-line 24 hours daily, seven days a week. The airline indicated that NCR personnel try to do most of the work while the system is on-line. Occasionally, however, when they simply must bring the system down, they perform their maintenance during the night shift.

Academic Environment No. 2

A second academic location uses an NCR 101 alternately for on-line problem solving and batch processing. The 101 has 32K bytes of main memory (an extra 16K bytes is on order); two spindle 655 disc drive, printer (450 lines per minute), Input/Output writer, and card reader. Five Western Union 33 KSR terminals are attached, one to each of five of the integrated communication adapters.

Forty hours weekly are dedicated to on-line processing with Basic I, "an acceptable subset of Dartmouth Basic." The college also runs programs written in Cobol and NEAT/3. These include NCR's Budgeteering Package and Payroll Package. Applications prepared by the institution include registration for two colleges in addition to itself, plus surveys for mental health in the five surrounding counties, and address labels for the alumni file. The college is writing a management planning program which includes resource prediction and planning models.

The college also looked at an IBM System/3 Model 10. They found the price to be about the same as the 101 but found the performance of the 101 to be superior to the Model 10's.

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 has found NCR's service philosophy to be, "wait until it happens, then fix it," rather than preventive maintenance. This user acknowledges the problem may be attributed to its location which is in an outlying area. NCR representatives make a maintenance call every two weeks, but at that time they simply clean and oil the printer. Service calls are answered within 3 to 4 hours.

NCR's service annoys this user by "continually discouraging" applications the user deems possible and reasonable. One such application was on-line registration from the terminals; NCR service personnel said it was impossible because of the necessary modifications to the I/O interface. Other users are performing this application, and NCR is, in fact, teaching the method at its Dayton educational center. The user cited other examples of NCR representatives failing to help or guide; he was often told that something that had already been done would be impossible to accomplish.

Farming

A farming cooperative has an NCR 101 with 32K bytes of main memory (an extra 32K bytes are on order), two spindle 655 discs (two 657s are on order), three tape handlers (800 bits per inch), printer (450-900 lines per minute), card reader/punch (300 cards per minute), and communication multiplexor using two integrated adapters. The 12 people in 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. They have purchased one package from NCR.

The system runs under the B1 operating system. This user feels that NCR's software support could be improved. This user has also found that at 80 degrees or above, read errors occur on the discs and also some memory failures take place.

This user had a Univac 1005 card processor prior to the NCR 101. The 101 was chosen over IBM's System/3 Model 10, Burroughs B 1700 and 2500, and Univac's 9300 II because of the 101's cost and its simple yet effective operating system.

This user feels the NCR maintenance as well as the overall relationship with the company is fine.

MAINFRAME

The relationship between the central processor, input/output channels (trunks) and peripheral devices is shown in Figure 1. Main memory, the arithmetic/logic unit (processor), and input/output control are contained within a single mainframe cabinet. Table 1 lists the mainframe characteristics.

Table 1: NCR Century 101: Mainframe Characteristics

CENT PROCESSOR	
Word Size (bits)	8 + parity
Capacity (words)	16K to 64K
Cycle Time (μ sec)	1.2/2 bytes
Working Storage	Core
AUX STORAGE	Disc; mag tape; mag cards (CRAM)
DATA OUTPUT	
Line Printer (lpm)	150; 200; 300; 450; 900; 1,200; 1,500
Serial Printer	Yes
Card (cpm)	60-180; 83-294
Paper Tape (cps)	200
DATA INPUT	
Keyboard	Opt
Card (cpm)	300; 560; 800; 1,200
Paper Tape (cps)	1,000; 1,500
SOFTWARE	
Assembler	Yes (NEAT/3)
Operating System	Yes
Compiler	Cobol; Fortran; RPG

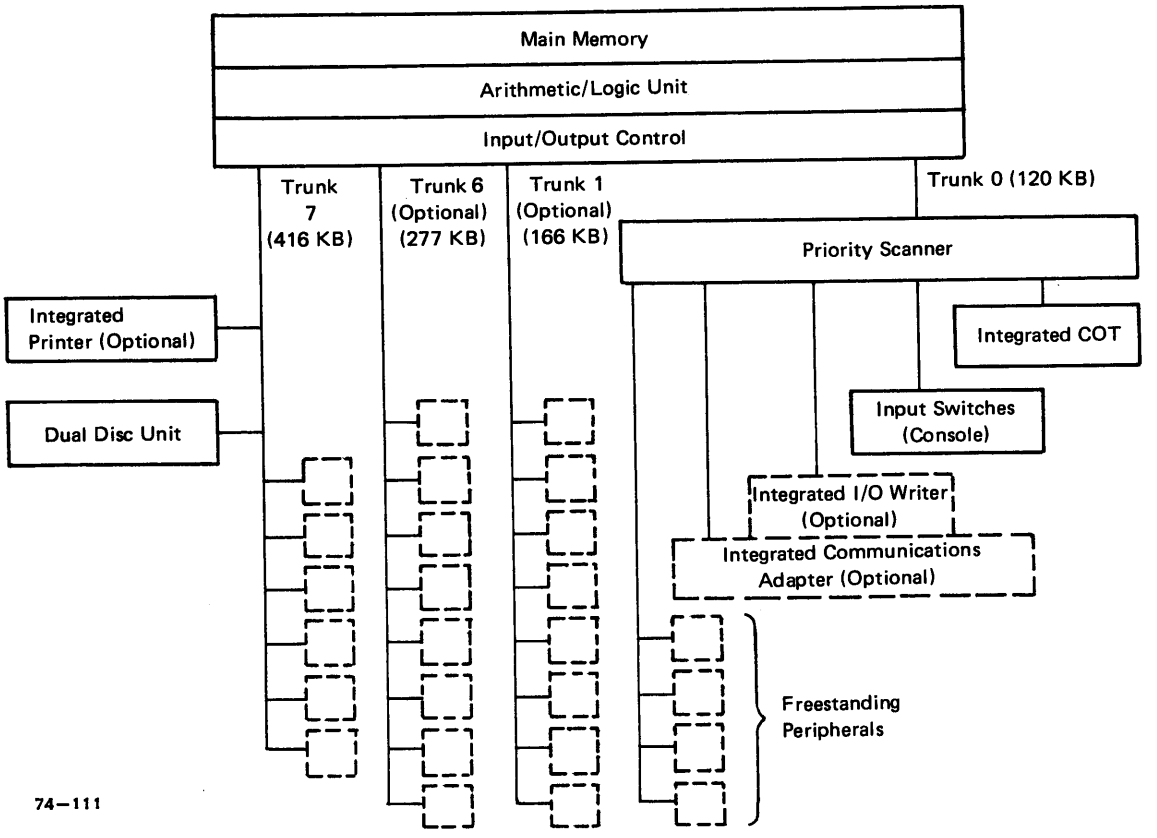


Figure 1. NCR Century 101: Basic and Maximum Configurations

Central Processor

The central processor 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, eight bits plus one parity bit. Data formats can be 8-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 65,536 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 63 32-bit index registers implemented in main storage beginning with relative address zero of each active program. Conventionally, 19 index registers are reserved for use by the operating system.

The addressing facilities of the 101 are more sophisticated than those usually found on a small business computer. This is due to the 101's 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. The 101's instruction repertoire is fully upward compatible with the Century 50 and 100 instruction set; it also 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; 12 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 101.

Main Memory

Main memory is magnetic ferrite core. Memory is byte-addressable, and an attempt to access greater than the capacity of memory results in an error signal. This differs from the Burroughs B 1700, for example, where such an error goes unnoticed by the hardware and where, in fact, memory wraparound occurs.

The first 1,280 bytes of main memory in the Century 101 (also 50, 75, 100, and 150) 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

All peripherals attach to the NCR 101 processor 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 (a unique feature of the 101 processor) 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 101 processor's second standard trunk, designated trunk seven, is a high-speed selector channel with a maximum 416K 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.

Basic Century 75, 101, and 150 configurations in addition are capable of 15-way I/O simultaneity to compute: one disc or magnetic tape transfer of up to 416K bytes per second; one card or paper tape read, one other slow I/O transfer, such as the line printer; one console message; one input/output write transfer; and up to 10 data communication transfers.

Two optional additional trunks can be added to Century 75, 101, and 150 processors. They are designated trunk one with a 166K byte-per-second transfer rate, and trunk six with a 276K byte-per-second transfer rate. Each has eight positions for the attachment of nonintegrated peripherals; each has the characteristics of a selector channel. Installation of these additional channels reduces the maximum combined transfer rate of trunk zero to 120K bytes per second. A fully expanded Century 75, 101, or 150 system is thus capable of up to 17-way I/O simultaneity in addition to computation, including up to three disc or magnetic tape transfers of up to 416K, 276K, and 166K bytes per second, respectively; four other central-site slow I/O and 10 data communication transfers.

Console

An integrated card or paper tape reader (COT) is the console for the NCR 101. Keyboard facilities are furnished by an optional I/O writer, which includes a keyboard and serial printer that operates at six characters per second using the 7-bit ASCII character set (the NCR Century character). A 30 character-per-second I/O writer is also available on the 101.

The 101 does not have a CRT display console (standard on the higher processors in the Century series).

PERIPHERALS

Century Series peripherals have a wide range of card, printer, and paper tape equipment. High-speed peripherals include a variety of discs as well as a complete range of industry-compatible magnetic tape units. Less conventional equipment includes OCR and MICR readers, magnetic card memory for on-line access to large data banks, and a key-to-tape device for on-line or off-line use.

Direct Access Storage

Two types of direct access storage are available for the NCR 101: magnetic discs and card random access memory (CRAM) units.

Three disc systems are available: the 655, 656, and 657 discs. Century Series software requires at least one disc for every system. Table 2 lists the disc characteristics.

Model 655 discs. The 655 discs are dual-spindle units that record data on all six surfaces of a 3-platter interchangeable disc pack.

The 655-201 is a stand-alone version of the 655-101 for use with the 101 and higher numbered processors in the Century Series.

Model 656 discs. The 656 discs are similar to the IBM 5444 discs used on the IBM System/3. Each unit read/records on the two surfaces of a single-disc pack; it can also use an optional fixed disc on the same spindle as the interchangeable disc pack and with the same capacity. The 656-101 unit incorporates a controller for interfacing to a common trunk position; the 656-102 unit is controlled by the same controller as the 656-101.

Table 2. NCR Century 101: Disc Characteristics

MODEL NO.	CAPACITY			PERFORMANCE		
	Bytes/Track	Bytes/Cylinder	mb/Pack	Average Latency (msec)	Average Positioning (msec)	Transfer Rate (kb/sec)
655-101	4,096	262,144	4.2	20.8	44.7	108
655-102	4,096	262,144	4.2	20.8	44.7	108
655-201	4,096	262,144	4.2	20.8	44.7	108
656-101 (1)	6,144	12,288	4.9 + 4.9 fixed opt (2)	12.5	35.0	312.5
656-102	6,144	12,288	4.9 + 4.9 fixed opt (2)	12.5	35.0	312.5
657-101 (single-spindle)	Up to 7,461	Up to 149,100	29.8	12.5	60	300
657-102	Up to 7,461	Up to 149,100	29.8	12.5	60	300

Notes:
(1) Includes disc controller for connection to common trunk interface. This can control host 656-101 and one 656-102 drive.
(2) Each 656-101 and 656-102 drive has standard facilities for reading/writing one 4.9-Mb removable disc pack, and may be optionally equipped with a fixed disc module of equal capacity on the same spindle.

A 656-101 and a 656-102, with or without their optional fixed disc modules, are a standard component of every Century 75 (alias 150-656) configuration; each occupies position one on trunk seven. The 656 discs can also be connected to common trunk positions, or can be intermixed on configurations with the larger 657 discs.

Model 657 discs. The 657 discs are high-performance, large capacity discs with characteristics similar to IBM 2314, 2319, and 5445 discs. The 657, however, uses different data formats. A 657-102 dual-spindle unit and controller is a standard component of every Century 150 configuration; the controller attaches to position one on trunk seven.

Up to eight spindles (eight 657-101s or four 657-102s) can be controlled by a common controller. The 657 controllers can also be attached to common trunk positions on trunk seven of the Century 75, 101, and 150 systems, and they can be mixed on the same configuration with 655 or 656 disc systems.

There is no "double-density" 2314-type replacement available for the 101 although they are available for the higher-numbered processors.

Bulk Storage. The 653-101 CRAM (Card Random Access Memory) unit available for Century 75, 100, 101, and 150 provides low-speed access to large quantities of data. Each CRAM unit contains 384 magnetic cards in changeable cartridges; each card has 144 data tracks. Data track capacity is 2,623 bytes, giving total capacities of 377,712 bytes per card and 145,041,408 bytes per unit. Up to eight CRAM units connect to an I/O channel via a 623-201 CRAM controller.

Selecting a card and transporting it to a capstan equipped with read/write heads takes 125 milliseconds. After the card is positioned at the capstan, average latency to access a specific record is 24.25 milliseconds. Peak transfer rate for the CRAM unit is 83,125 bytes per second.

Magnetic Tape

Six models of magnetic tape units are available on the 101. These units provide magnetic tape capabilities for all industry-standard tape formats at a variety of tape speeds. Table 3 lists characteristics of Century Series magnetic tape transports. Both single and dual units are available; the dual units provide two transports in the same housing.

Tape transports connect to a channel via a controller, also specified in Table 3. Each controller attaches a maximum of eight tape transports to a single I/O channel. Different tape transports can be mixed on the channel provided they are compatible with the same controller. Simultaneous operation of tape units connected in this manner, however, is impossible, except for rewinding.

Unit Record Peripherals

Card readers, printers, and card punches are available for all Century systems. Table 4 lists their salient characteristics. An integrated card reader can be replaced by an integrated paper tape reader.

Special-Purpose Peripherals

Table 5 lists characteristics of MICR, OCR, and paper tape units that can attach to the Century 101. NCR also markets a key-to-tape Mohawk-produced data recorder as the NCR 736. A control available for Century processors permits shared use of the 736.

DATA COMMUNICATIONS

NCR Century supports hardwired communication controllers and an impressive range of modern terminals.

Table 3. NCR Century 101: Magnetic Tape Transport Characteristics

Model No.	Type	Tape Speed (ips)	No. of Tracks	Recording Density (bpi)	Recording Method	Peak Data Transfer Rate (I:b/sec)	Applicable Controller
633-117	Single	50	7	200	NRZI	10	624-179
				556		28	
				800		40	
633-119	Single	50	9	800	NRZI	40	624-119
							624-179
633-111	Single	50	9	1,600	PE	80	624-111
633-121	Dual	50	9	1,600	PE	80	624-111
633-211	Single	90	9	1,600	PE	144	624-211
633-311	Single	150	9	1,600	PE	240	624-311

Table 4. NCR Century 101: Card Units and Printers

Model and Applicable Processors	Rated Speed	Comments
CARD EQUIPMENT		
682-100	300 cpm	Reader; integrated
686-102	Reads 800, punches 83-294 cpm	Reader/punch
686-201	750 cpm	Reader
686-111	Reads 560, punches 60-180 cpm	Reader/punch
680-201	1,200 cpm	Reader
687-301	100 cpm	Punch (also reads)
686-302	83-294 cpm	Punch
686-311	60-180 cpm	Punch
PRINTERS		
640-102 (all models)	450/900 lpm	132 col, integrated
640-200/210	1,500/3,000 lpm	132/160 col
640-300	1,200 lpm	132 col
640-205/215	750/1,500 lpm (OCR); 1,500/3,000 lpm (non-OCR)	132/160 col; integrated
649-150	150 lpm (127-char set) 300 lpm (numeric only)	132 col; 127-char print set
649-200	200 lpm	132 col; 64-char set
649-300	300 lpm	132 col; 64-char set

Table 5. NCR Century 101: Paper Tape, MICR, and OCR

Model and Applicable Processors	Rated Speed	Comments
PAPER TAPE EQUIPMENT		
622-100	1,000 cps	Reader; integrated*
660-101	1,500 cps	Reader
665-101	200 cps	Punch
MICR EQUIPMENT		
670-101	600 doc/min	11 pockets
671-101	1,200 doc/min	18 pockets
OCR EQUIPMENT		
420-1	26 lps	Up to 32 char/line
420-2	52 lps	

Note:
*Replacement for 682-100 integrated card reader.

Especially important terminals are the NCR 399, an intelligent terminal computer; NCR 260 (ASR/KSR/RO) thermal printer terminal; NCR 270 financial terminal; and the NCR 280 point-of-sale retail terminal. NCR Century computers support asynchronous and binary synchronous line disciplines.

Communications Controllers

Century 75, 101, and 150 systems can be equipped with the 6002 Integrated Communications Adapter. The 621-103 Communications Controller can also be connected to Century 75, 101, and 150 systems in addition to or as a substitute for the 6002 ICA.

Century 75, 101, and 150 Integrated Communications Adapter (ICA). The 6002 ICA is an optional feature of Century 75, 101, and 150 processors. This feature allows up to 10 communication lines to take advantage of trunk Zero's I/O control scanner's multiplexing ability without inhibiting any other I/O transfers on trunk Zero. Each active communication line must be terminated by an adapter, which can be either a 692-600 Asynchronous Data Adapter or a 693-600 Binary Synchronous Adapter. Table 6 specifies the line speeds at which these adapters operate and the terminals that connect to them.

621 Series Communications Controllers. Communication lines can be controlled by a 621-101 or 621-103 communication controller that connects to a common trunk position. Both controllers have multiplexing facilities for the communication lines and adapters connected to them. However, they inhibit other data transfers on the trunk to which they are connected while in use since these trunks have no processor-controlled multiplexing facilities.

The 621-103 Communications Multiplexor is a high-efficiency state-of-the-art unit capable of multiplexing up to 253 remote telegraph or telephone lines into a common trunk interface on any Century processor, including the Century 50, 75, 101, and 150. Each active line must be terminated by an adapter. The same range of adapters is available for the 621-103 as for the 6002 ICA, as shown in Table 5.

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 really an advantage for Century 75, 101, and 150 users since it is most effective when there are 32 or more lines in use. The multiplexor also has a standard interval timer.

Table 6. NCR Century 101: Adapters for 621-103 Communications Controller and 6002 Integrated Communications Adapter

Terminal Compatibility	Transmission Speeds
692-600 Asynchronous	
NCR 260 Thermal Printer NCR 270 Financial Terminal NCR 280 Retail Terminal NCR 399 Electronic Accounting Machine NCR 42 Window Machine Data 100 Model 73 CRT Teletype Models 33 and 35, ASR and KSR Teletype Model 28 (see Note)	45; 50; 72.6; 75; 100; 110; 134.5; 150; 165; 200; 300; 600; 1,200; 1,800
693-600 Synchronous	
Terminals with hardware and developed software that conform to the IBM BSC discipline	600-50,000

Note: This list does not imply incompatibility with other terminals. The adapter can operate with 5-, 6-, 7-, or 8-bit data structures using odd, even, or no parity. It uses 1 start bit and a selectable 1, 1.5, or 2 stop bits. It performs the same function for the 621-103 as the 692-100 and 692-401/402/403/405/406 did for the 621-101/102.

Table 7. NCR Century 101: Adapters for 621-101

Name	Typical Uses
692-100	
Asynchronous Character Adapter	Used with private or dialup voicegrade lines (Bell System 100 or 200 Series Data Sets), or TWX Prime or Western Union asynch modems; speeds from 45-1,800 bps; any 5- to 8-bit code with 1 start bit and 1 or 2 stop bits.
692-400	
Polling Asynchronous Adapter	Specifically designed for use with NCR on-line financial terminals and 795 Data Display Systems; occupies 2 positions on controller, 1 for I/O and 1 for polling.
693-200	
Synchronous Adapter	Specifically designed to provide interface between Century system and NCR 735 or 736 Model keytape encoders. Data communications rates of 1,200, 2,000, and 2,400 baud available using 202C or 201A/B data sets.
693-300	
Synchronous Adapter	Used with synch (clocked) data sets such as Bell System 201B (2,400 bps), 301 (40,800 bps), or 303 (50,000 bps); intended for communication with other NCR Century systems, IBM BSC terminals, etc.

The 621-103 has four additional built-in hardware functions: (1) transmission control character detection; (2) block-check character generation and cyclic redundancy error checking; (3) transparent mode operation; and (4) automatic segmentation of records through the use of dual input and output buffers, a feature NCR calls "bucket operation."

The 621-103 has not yet been equipped with a line adapter for the nonstandard communication control procedures used for voice response terminals and remote 736 Data Recorder operations. Until this adapter is announced for the 621-103, such terminals and the lines to which they are connected must be controlled by an older 621-101 controller. This model is no longer manufactured by NCR, but it is still available on a used and refurbished basis.

The 621-101 is a hardwired, multiline communication control. It is modular in design and can be configured to handle one to 15 different communication lines with transmission speeds from 45 to 50,000 bits per second. It has 15 adapter positions, each of which can house a communication line adapter. The 621-101 adapters support one half-duplex line each, as specified in Table 7.

The 621-101 Communications Controller can connect to position seven on a common I/O channel of a Century processor. Each adapter has a one-character buffer and requires exclusive use of the I/O channel throughout the on-line operational period.

Terminals

Recently, NCR has promoted its image as a leading supplier of terminals as well as computers. It is leaning toward special-purpose terminals, notably for the retailing and banking industries.

NCR terminals currently usable on-line with Century processors include the 795 Data Display System, the 260 Thermal Printer, and the 270 Financial Teller Terminal for banking applications. Additionally, Century systems can be used to process the industry-compatible magnetic tapes produced by the 280 Retail System, a sophisticated point-of-sale device that includes minicomputer control of each station.

260 Thermal Printer. NCR 260 is a Teletype replacement that uses a thermal process to provide single output copies. Its keyboard has a 96-character ASCII set; printing speed is 10 or 30 characters per second; maximum line length is 80 characters.

270 Financial Teller Terminal. NCR's 270 is an elaborate bank teller terminal that includes a stored-program computer. Applications include the on-line and off-line processing of noncommercial transactions, such as loans, savings clubs, customer savings, withdrawals, and mortgage payments. The unit includes a ball-type printer that can generate output on passbooks, lister tape, or journal tape. Maximum data communications speed is 1,200 bits per second.

NCR 280. NCR 280 Retail System is a point-of-sale retail data collection system designed specifically for the retail merchandiser. It consists of a set of electronic terminals designed to replace conventional cash registers. These terminals transmit sales data to a central computer-compatible magnetic tape recorder.

NCR 399. The NCR 399 Series, announced March 10, 1972, is a modular, versatile business-oriented minicomputer that can be configured, programmed, and arranged to serve as an accounting machine, business computer, and intelligent terminal.

Main features of the NCR 399 include modular core memory as primary storage, reusable magnetic tape cassettes for program and data storage, numerous field-installable configuration options, flexible data communications facilities, and a simple yet versatile near-English programming language.

795 Data Display System. The NCR 795 is a Sanders CRT terminal comprising a keyboard and an alphanumeric data display.

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 for the Century 101: B1, B2, and S2. B1 is a basic version, B2 is more sophisticated, and S2 allows the Century 101 to be dedicated to on-line processing. Each operating system is a logical extension of its functional predecessor.

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 systems. 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. Able to run on any Century system, it consists of: an I/O executive; monitor for 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, Basic, Cobol, and Fortran compilers. All three compilers accept only disc input, so SPUR is used to prepare programs for compilation.

The B1 system can handle batch jobs only. It requires a minimum of 16K bytes of main storage; the resident executive requires about 4K bytes of this memory. 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 used to stop processing jobs in

the stream and branch to the label indicated. Processing then continues serially from the new point.

The operating system maintains a log of all hardware errors to aid in determining if components are going "soft." This very valuable feature is offered on B2 as well.

B2. The B2 operating system is intended primarily for Century 75, 101, and 150. 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 either a dedicated mode (on-line or batch) or a dual programming mode. In the latter, the foreground partition handles the on-line applications, the background partition the batch jobs. Foreground programs have priority for processor time over background jobs. The background partition must be at least 16K bytes; the foreground partition can be any size.

The optional JETS (Job Executive and Transport Satellite) package allows B2 to do limited multiprogramming: two pseudo off-line I/O conversions in the foreground partition with a batch processing stream in the background partition. I/O conversions are 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. The operator can cancel processing jobs if sufficient resources for the emergency job are unavailable. If programs are written to utilize checkpoint/restart, the operator can use this feature to suspend processing.

For on-line applications using multiple terminals, B2 permits chaining instructions to eliminate dedicating fixed size storage areas to collect multiple message segments. Memory can be dedicated to users dynamically, that is, memory regions (containing related segments) can be chained for 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 multi-tasking, dual programming, or dynamic storage allocation for I/O areas.

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 with the 101: Century 101 Basic Fortran requires 16K bytes of memory; Century 101 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 101: Stage I is a subset of basic Cobol implemented for Century 101 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 101 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 application packages are for the Century Series, a partial list of those available are:

- *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 accounting 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.

MAINTENANCE

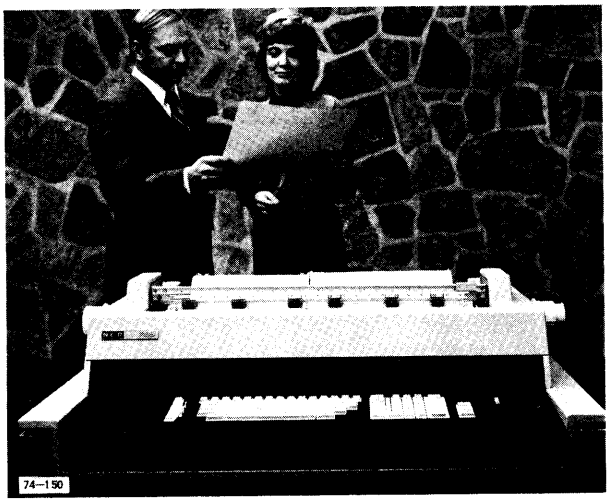
Maintenance is available through about 300 service offices in the United States and Canada, and 900 offices overseas. The 101 is easy to service because it has a high degree of circuit standardization: all logic appears on six basic cards. Thus, virtually all malfunctions can be connected with a handful of plug-in replacement circuit boards. System downtime therefore is kept to a minimum. The standard service contract offers maintenance during any selected eight-hour period between 8 a.m. and midnight. Special arrangements can be made for 24-hour service at higher rates.

HEADQUARTERS

NCR Corporation
Main & K Sts.
Dayton OH

NCR

299 Accounting Computer



OVERVIEW

The NCR 299 is a programmable, low-cost accounting system designed for businesses with fewer than 150 employees. It belongs to that hybrid class of equipment variously called "programmable accounting machines" or "visible record computers." It adds the automatic computation and control capabilities of small computers to the visible record-keeping processes of accounting machines. The NCR 299 features a low-cost, easy mark-sense method for entering programs, and a sizeable memory (for this type of system). Memory consists of 4K to 8K 64-bit words of core in addition to the microprogrammed MOS/LSI ROM used for system control. Installation and custom programming of the system are so easy that NCR plans to handle both with its sales force rather than with systems analysts and instructors.

The basic system combines an accounting machine keyboard, a golfball printer with split platen and special mark-sense read head and CPU, housed in a single desk-like unit. There are no extra peripherals available, but the instruction set has provisions for programming peripherals. Programs are read from a special mark-sense form that divides each 64-bit instruction word into a number of fields that define not only the operations to be performed, but also the format and checking restrictions, source and destination of data, and related mechanical operation (such as ribbon color and carriage return). Most of the subfields of the instruction word are coded with a single pencil or pen stroke on the preprinted mark-sense form and numerical values (the number of print positions, for instance) are entered in a binary format. The pre-defined format, variety of instructions, and mark-sense entry method allow control programs to be developed rapidly even by novice users. In addition, an operator can use the system effectively after considerably less training than that of the usual accounting machine operator.

NCR anticipates an extremely high volume of business with this system because of its low price, versatility, and ease of operation. Market surveys indicate that more than half a million businesses or other organizations in the United States alone have fewer than 150 employees. The following applications are suitable for the 299:

- 46,000 Transportation Companies: revenue analysis, compilation of freight bill statistics.
- 200,000 Retail Firms: cycle-billing, inventory control.
- 115,000 Wholesale Firms: order billing, sales analysis.
- 125,000 Manufacturing Companies: job-costing, work-in process, work center loading.
- 80,000 Building and other contractors: estimating, job costing, maintenance of equipment records, daily labor reporting.
- 22,000 Auto Dealers: monitoring parts sales, new and used car sales, dealer trades, service and repair accounting, vehicle inventory.

NCR will install 5,000 of the 299 Systems in 1974 and anticipates 50,000 installations by 1979. The first NCR 299 was delivered in February 1974.

PERFORMANCE AND COMPETITIVE POSITION

NCR planned the 299 for users who are novices not only in computer use but also in accounting machine use. The system's low price enables it to compete with both small business computers and electromechanical accounting machines such as NCR's own earlier 3000 Series. Larger businesses with small branches can also use the 299, but these applications lend themselves more readily to intelligent terminals in a distributed processing network. One of the biggest advantages NCR has in this small-business market is its existing market penetration, which consists of over 375,000 carriage-type accounting machines, probably more than any other manufacturer. Owners of the small businesses addressed by this product probably have only a vague idea of what the market has to automate their accounting, and they probably don't have the personnel for market research. They will tend to turn to large, well-known manufacturers like NCR and to suspect that smaller companies will not give them the support they need.

Because a larger sales organization is needed to contact a large number of small discrete businesses, the only significant competition must come from manufacturers with an established name in accounting machines. In the United States, the major competitors are IBM, Burroughs, Litton, and Singer-Friden; the Swedish-based Facit-Addo company has also made some inroads into this market. Only the low end of the well-established Burroughs L Series approaches NCR's beginning prices in the current United States market. The L Series uses a very small read/write memory (128-256 words) and utilizes more conventional and more complicated programming techniques, but a variety of peripherals are available for all models, including sizeable auxiliary

mass storage for the upper models of the series. The other large United States manufacturers offer electromechanical accounting machines and small business computers that fall into higher price classes. Facit-Addo is perhaps an exception; its small system uses a control memory that operates something like a key/tape device buffer.

The competitive position is somewhat different in Europe, where there are a large variety of visible record systems offered by such manufacturers as Nixdorf, Kienzle, Olivetti, and Philips, as well as many smaller companies. The all-important factor of price, however, is not available to make a valid comparison. Many European manufacturers use magnetic-stripe ledger cards, which, for some reason, have never gained wide popularity in the United States.

CONFIGURATION GUIDE

Only the basic 299 system is currently available: keyboard, printer, and optical scanning read-head combined in a single unit with the CPU and 4K words of read/write memory. This system can accumulate 10 totals and handle programs of up to 46 steps. Options include additional memory, more totals in increments of 20, programs of up to 63 steps long and multiply/divide. A continuous forms feeder will be available the second quarter of 1974.

Program coding forms include standard codes for paper tape/edge-punch card reader/punches, cassette transports, magnetic ledger card processing, and communications, so development along these lines is undoubtedly planned for the future. Standard system specifications are listed in Table 1.

Compatibility

The NCR 299 is not compatible with any other system.

MAINFRAME

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 totalling 4 to 23 inches; 10- and 12-inch platen sections are standard, but other splits are available. A 64-bit microprogrammed minicomputer with a cycle time of 448 microseconds (seven microseconds per bit) controls the printer and optical reader. An MOS/LSI ROM module stores control memory. Read/write core memory of 4K words expandable to 8K words is available for user data and programs. Each word is 64 bits long; it can store eight 8-bit bytes or 16 digits plus sign in ASCII-compatible or hexadecimal format. The system operates in Load/Check, Debug, or Entry mode as set by keyboard control keys.

Table 1. NCR 299: Product Specifications

CENTRAL PROCESSOR	
Word Size (bits)	64
Capacity (words)	8K
Cycle Time (μsec)	448
Working Storage	Core
AUX STORAGE	None
DATA OUTPUT	
Line Printer (lpm)	None
Serial Printer	Golfball (std), 15 cps
Card (cpm)	None
Paper Tape	None
DATA INPUT	
Keyboard	Standard
Card (cpm)	Mark-sense
Paper Tape (cps)	None
SOFTWARE	
Assembler	None
Operating System	Firmware
Compiler	None

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 instructions except I/O instructions use the primary format; I/O instructions use the secondary format. Table 2 presents both formats in tabular form. The first field at the top of Table 1 corresponds to the left-most field of the instruction word, the other fields follow in order of their position in the instruction word. Operations 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 allow 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 identification if they are not to be printed in columns that automatically identify the type of total. The symbol, ◇, is used to identify reverse conditions (such as a debit instead of a credit), because carbons cannot print in two colors. The operations performed by other instructions are self-evident.

SOFTWARE

All software is unbundled. NCR provides three kinds of programming support: standardized packages, slightly modified (less than 25 percent) standardized packages,

Table 2. NCR 299: Instruction Formats

Number of Bits in Field	Primary Statement Format	Secondary Statement Format
8	Print Positions	Same
2	◇, CR or No Sign	Same
1	Black or Red Ribbon	Same
5	Maximum Output Length	Same
1	Currency Symbol	Same
1	Edit/Omit	Same
2	Decimal Places (2, 3, 5, or None)	Same
4	Prime Operation, Non-I/O Instruction	Prime Operation Input, Output, or Output S
1	Format Flag (Primary/ Secondary Statement Format)	Same
7	Source (10-Key or Branch Key)	I/O Device
1	Clear Source	Clear A-B Operands
7	Operand A	Same
1	Add/Subtract	Numeric/ Alphanumeric
7	Operand B	Same
1	Add/Subtract or EOT	EOT
7	Operand C: 3-bit Output Device Code and 4-Bit Data Code Pointer	Same
8	Forms Handling Flags	Same (But "Additional Output" and "En Corr" Fields Omitted)
64	Total Number of Bits	

and custom packages. The standardized packages include Invoicing, Billing and Charge, Accounts Receivable, Accounts Payable, General Ledger, Payroll, Job Costing Estimates, Wage Accrual, etc. The standardized packages are the least expensive, of course, but the custom programs are also inexpensive because they are easy to develop. Frequently, the salesmen can gather the required data in the morning and return with the program in the afternoon. Costs are determined by the number of steps in a program: an accounts receivable program typically requires 46 steps while payroll preparation requires 63 steps. In addition, the customer can easily learn to program the machine himself.

HEADQUARTERS

National Cash Register Company
Dayton OH 45479

SINGER BUSINESS MACHINES

6800 General Accounting System

OVERVIEW

The Singer Business Machines 6800 is a turnkey small business computer oriented toward interactive processing. Keyboard entries are processed by manufacturer-supplied programs, with data files stored on small disc packs; output is to 1 or 2 CRTs or printers.

The 6800 bridges the gap between the 5800 system, a very small, programmable visible-record accounting system that is an outgrowth of the Friden accounting machine line and Singer's System Ten computer line. The processor used for the 6800 is actually Singer's smallest System Ten CPU capable of maintaining a disc, but the 6800 package is less expensive than the identical configuration on the System Ten. User programming is limited on the 6800. The only hardware expansion allowed is the addition of one more CRT and 10K bytes of core memory. Users who need to expand further can move up to a System Ten with no change in software.

Although Singer itself is only a recent entrant to the ranks of computer suppliers, its Business Machines Division, formerly Friden, which originally manufactured and sold System Ten, was founded in 1934 and is currently one of the largest manufacturers of desk calculators and accounting machines. As a result, Singer has an excellent understanding of the data processing needs of the business community, considerable expertise in manufacturing and servicing equipment to meet those needs, and detailed knowledge of the specific requirements of its accounting machine customers, many of whom may want to change to electronic data processing.

Performance and Competitive Analysis

The 6800 System is designed for the novice computer user; it is also a replacement for an accounting machine. As a strictly turnkey system with limited expansion capability and no communication facilities offered, it provides a beginner with a minimum of trouble. After files have been developed and a user wants to expand his capabilities or to develop his own software he can move up to System Ten. The 6800 does allow disc storage of master files, unlike the smallest computers in the Burroughs series, for instance. At first glance, its lack of expandability seems to place it at a disadvantage with other small business computers like the Eldorado 140, Litton 1200, Burroughs L Series, Qantel Q Series, and Ultimacc systems. This apparent lack is in name only, however, because the 6800 is a very small System Ten and many of its limitations are imposed by the manufacturer, not the hardware. Upgrading to the System Ten is like moving up to another member of the same computer family rather than to a completely different computer system. Users with applications that fit the 6800 may prefer it over a System Ten because of its lower price.

CONFIGURATION GUIDE

The 6800 comes in 3 configurations.

- Minimum Configuration — Model 70 Workstation, Model 42 Disc, 1 IOC channel.
- Midi Configuration — Model 80 CRT, Model 42 Disc, Model 52 Printer, 1 IOC channel.
- Maximum Configuration — Model 80 CRT, Model 70 Workstation or second Model 80 CRT, Model 42 Disc, Model 52 Printer, 2 IOC channels.

Both of the minimum configurations use a processor with one memory partition of 10K words plus 10K words of common core. The maximum configuration uses 2 partitions plus 10K words of common core for a total of 30K words of memory.

COMPATIBILITY

The 6800 is upward compatible with System Ten, but 5800 files must be reformatted to be used on the 6800.

MAINFRAME

Product specifications for the 6800 appear in Table 1.

Central Processor

The central processor for the 6800 is a System Ten Model 20 with either 2 or 3 memory partitions.

Table 1. Singer System 6800: Specifications

Characteristic	Singer 6800
PROCESSOR	
Main Memory (kc)	30
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	2 allowed
AUXILIARY STORAGE	
Storage Medium	Disc
Capacity (mc)	4.0
Transfer Rate (kc/sec)	229
DATA ENTRY	
Keyboard	Workstation; includes serial printer (15-25 cps)
CRT	Keyboard and 10-key numeric pad, 1,600 characters (1,500 cps)
Card Reader (cpm)	No
Paper Tape Reader (cps)	No
DATA OUTPUT	
Card Punch (cpm)	No
Paper Tape (cps)	No
Line Printer	132 col; 70 lpm
CRT Display	80 col by 20 lines
SOFTWARE	
Operating System	Multipartitioning via hardware
Assembler	No
Compiler	No

Data Structure. The System Ten processor on the 6800 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. The 6800 System Ten processor uses 13 basic types of machine instructions. The instruction word length is 10 characters (60 bits). Most instructions specify 2 operand addresses of 4 characters each. I/O instructions, however, use one operand for the address of the I/O area, and the other for the data count. If the addressed device is a disc, the second operand is treated as an indirect address. All disc transfers are in blocks of 100 characters.

Addressing Facilities. Every location in core memory can be addressed directly. A program instruction can directly address any location in its partition, and any location in the Common partition, each of which can be up to 10K characters. There is no indirect addressing. Indexed addressing is single-level, and it can be specified for either or both of the operands. Indexing of one operand address requires 31.1 microseconds, and indexing of both operand addresses requires 58.9 microseconds.

Interrupt Control

Interrupts occur as a result of program checks and initiation of I/O transfers. When a single character is ready for I/O transmission, an interrupt is signaled 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. Interrupt processing is built into the hardwired operating system and is transparent to the software.

There are 5 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, and bit 5 in any character of an instruction not being a 1.

Main Memory

The 6800 (System Ten) memory is divided into a hardwired partition called Common and 1 or 2 user partitions; each partition shares the Common partition. The Common area stores subroutines and data that can be shared to avoid duplication. Control of the processor by each of the user partitions is hardware monitored through a round-robin, time-slicing priority system. Each partition can receive up to a nominal 37.5 milliseconds for execution. 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.

In the 6800, Common is up to 10,000 characters long; the first 300 character locations are protected from program alteration although they can be examined.

In addition, minimum systems contain a single user partition with its associated IOC channel and up to 10,000 characters of storage. Because the round-robin time slicing does not apply to Common, there is no effective time slicing in minimum configurations. In the maximum 30K configuration, however, there are 2 user partitions of 10K characters each; here the time slices alternate between the 2 user partitions.

Input/Output Control. I/O control is established via the FAC (file access channel) for the high-speed magnetic disc, and via the IOC for all other 6800 peripherals. One dedicated IOC is associated with each user partition; usually the workstation or the CRT/line printer combination is associated with a partition, but not both. Data transfers via IOC are overlapped with processing on a cycle-stealing basis. Each IOC can support a data transfer rate up to 1.5K characters per second. In the maximum configuration with 2 user partitions, programs in Common can access either partition, and consequently can use all 3 peripherals.

FAC. Each user partition shares the single FAC to access the magnetic disc files. This architecture allows the same files to be used simultaneously by 1 or both partitions, although the software can allocate these resources selectively by partition; it also prevents overwriting of records in use. FAC supports data transfer rates up to 330K characters per second. Operations proceed sequentially and FAC transfers halt all processing activities, but operations can proceed on the IOCs.

PERIPHERALS

The 6800 has 4 possible peripherals: the Model 42 Disc Drive, the Model 70 Workstation, the Model 80 CRT Display, and the Model 52 Line Printer. There are no communication devices.

Model 52 Line Printer. The Model 52 Printer prints up to 70 lines per minute, with a maximum line length of 132 columns. A buffer stores data for 2 lines of print; buffering is necessary so that the output flow remains uninterrupted when the CPU is servicing another channel or peripheral device. Otherwise an interrupt would occur with every byte transferred.

Model 42 Disc Drive. A split-disc drive, Model 42, features 2 separate and removable disc packs — 1 mounted on top of the other in a single unit. The resident pack (Model 41A) is used for active manipulation and filing of data, which then can be duplicated onto the other pack (Model 41B), called the "removable pack," (although both packs are removable) and stored for file backup. Maximum capacity is 4 million characters per pack, 8 million characters per drive. Average access time is 73 milliseconds and transfer rate is 229,000 characters per second.

Model 70 Workstation. A desk-type data entry keyboard and serial printer output device, the Model 70 Workstation provides interactive communication with the CPU and prints output at 15 to 25 characters per second. The workstation features a standard alphanumeric keyboard and prints a 170-character line using a pressure-platen forms handler. Optional features include a pin-feed forms handler. An operator panel assists the operator with indicator lights displaying system status. The workstation can serve as a load device when given device address zero. The Model 70 can be located up to 2,000 feet from the processor.

Model 80 CRT Display. The Model 80 CRT is another interactive device for communicating with the CPU. It adds a 10-key numeric cluster similar to those on adding machines and unavailable on the workstation. Also, instead of the workstation's serial printer, it uses a CRT to generate a 1,600-character display in an 80-column by 20-line format. This display is fully buffered so that the CPU simply reads into the buffer the 1,600 characters of the display and then goes on to service another channel or I/O device.

The CRT display can be programmed to resemble a blank form onto which the operator "types" entries before feeding the entered data to the CPU. This is an advantage to a new operator because it shortens the question and response time between the computer and operator, and only the response need be transmitted to the 6800. The unit can be located up to 2,000 feet from the CPU.

SOFTWARE

The 6800 is basically a turnkey system with programming for Sales Accounting and General Accounting fully developed. The processor has no operating system as such; the hardware partitioning takes care of multiprogramming 2 simultaneous users by its time-slicing priority scheme in the maximum 30K-character system.

Other systems have only one user partition; thus one program operates at one time. Devices are buffered interrupts are hardware-generated, and each partition has its own dedicated I/O device.

In addition to the specific application software, all systems have a disc file management package. This allows operators to add, update, display, or delete records. File descriptors can be coded to protect certain fields, so they cannot be altered or deleted unless they meet certain conditions. For example, a second field may have to be in a zero or blank condition, or the new data may have to go through a checking routine or itself meet certain conditions.

Sales Accounting. The Sales Accounting package can run on all 3 configurations, since it accepts I/O from either the workstation or the CRT/printer combination. It includes programs for order entry and invoicing, accounts receivable, inventory, and sales analysis. The inventory and sales analysis programs are based on entries to the order entry and invoice programs and are basically computer-generated reports. The inventory program posts receipts and adjustments, (including stock transfers, purchase orders, stock issues, changes in customer back-order requirements), and lists inventory in several ways, ranging from a simple warehouse list with stock number, description, and so on, to lists broken out into out-of-stock items, purchase order status, or valuation reports. The sales analysis programs analyze salesmen's commissions, quotas, customer totals and profit percentages, product classes, and so on.

The Accounts Receivable and Order Entry and Invoicing programs are basically interactive, providing the ease and accuracy of computer-assisted entry for normal entries and an ease in handling exceptions that is more characteristic of manual systems than batch-processing computer systems. During the posting of cash under control of the Accounts Receivable programs, the operator enters payments and any corrections required to the customer's account, which is completely displayed (or printed). Reports from Accounts Receivable include an aged trial balance, finance charge computation, customer statements, sales tax reports, and an exception report for nonstandard situations.

Order Entry and Invoicing programs differ slightly depending on whether the Workstation or CRT/printer combination is used for I/O. The workstation uses the method commonly called "finished form invoicing", which produces an invoice as data is entered into the system. This could be at the point of sale for a small business, prior to the shipment of the merchandise, or after the shipment of the merchandise. The Order Entry method used with the CRT/printer configuration, on the other hand, prints invoices in a batch, not at the time of data entry into the system. In either case, the program notifies the operator of out-of-stock items, performs automatic credit check, and provides back-order information.

General Accounting. The General Accounting Package, which should operate in a configuration with a CRT and printer because of the extensive, varied reports, consists of programs for Accounts Payable, General Ledger, and Payroll. Accounts Payable captures vendor invoice data via the CRT keyboard and releases and prints checks on the printer. It also projects cash requirements and distributes expenses to the General Ledger system. Payroll establishes standard pay data per employee, it makes any adjustments for exception entries such as overtime and special deductions. General Ledger accepts operator entries, audits them for validity, and posts them to the general ledger accounts. A journal is produced. A number of financial reports can be defined for production, for instance, a report of percentage comparisons or budget comparisons could be printed.

HEADQUARTERS

Singer Business Machines
2350 Washington Ave.
San Leandro CA 94577

SINGER

System Ten

OVERVIEW

WANTED: A small- to medium-scale business computer, flexible in terms of available peripherals, extensive communications capabilities, available on turnkey, competition for IBM System/360, System/3 and must be low cost, must not have operating system.

No operating system? In a third-generation machine that competes with IBM's 360/40?

In a world where the relationship between operating system software and hardware is finally being understood and developed, Singer has produced an operating-system-less computer that not only is selling well but has an impressive array of very satisfied customers.

Singer's System Ten is small- to medium-scale business computer used both by small businesses that do not need or cannot afford larger computers, and by very large organizations with scattered work locations needing a network of on-site terminals to provide input to larger computers.

What characterizes users in almost all cases is that jobs being run on the System Ten are all of equal priority and are, for the most part, continuous (in-house data capture, such as retail sales and inventory monitoring).

What characterizes the system in most cases is its comparatively modest cost and its flexibility and ease of operation.

The simple message is: If you want to run programs of equal priority, or remote processing, or with a remote job entry terminal, there probably is no system better able to give equal weight to all jobs.

System Ten's ease of operation means that little training is required for its standard and special-purpose I/O terminals to be used by clerical personnel, sales persons, factory workers, hospital orderlies, and others. Users report as little as 2 hours are needed before a previously untrained person can comfortably use the system. Part of the ease of use comes from the fact that the System Ten does not have an operating system; therefore, there is no "operator," per se.

The System Ten is flexible. It provides time sharing and on-line information storage and retrieval with up to 20 simultaneous users and 200 I/O devices on one 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 time sharing operations and offers multiprogramming.

The System Ten is available on a turnkey basis, complete with either standard or some customized application packages. A comprehensive set of utility routines facilitates programming. This includes routines for program loading, card and paper tape reading, punching, verifying, and duplicating. In addition, common calculating routines are available, as are sorting and merging programs for both disc and magnetic tape, and computer-to-computer communications programs.

Languages available are RPG and Assembler.

The availability of special-purpose peripheral equipment, which replaces such devices as automated time clocks and semiautomatic merchandise checkout terminals also lends flexibility to System Ten. Special-purpose peripherals include employee badge readers and cash-register-type terminals with merchandise tag readers.

The System Ten's flexibility is due to the modular design of the system architecture. The multiprogramming is provided by a round-robin, time slicing priority system that is monitored by hardware without the use of an operating system. Plug-in 10K increments of core memory expand the system from the smallest configuration up to a total of 110K. Simple 2-wire connections hook up I/O terminals up to 2,000 wire-feet away from the central processor.

System Ten's field expandability means that operator stations or more storage modules can 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.

Although Singer itself is only a recent entrant to the ranks of computer suppliers, its Friden division, which originally manufactured and sold System Ten, was founded in 1934 and is currently one of the largest manufacturers of desk calculators and accounting machines. As a result, Singer has an excellent understanding of the data processing needs of the business community, considerable expertise in manufacturing equipment to meet those needs, and detailed knowledge of the specific requirements of its accounting machine customers, many of whom may be considering a change to electronic data processing.

CONFIGURATION GUIDE

Two basic processors, Model 20 and 21, and three basic configurations exist. Each of the configurations, the 101, 104, and 106, has been designed for a specific application and requires certain minimum equipment. In addition, each configuration can add optional equipment or increased quantities of the minimum required items.

The minimum and maximum hardware configurations for the Model 20 processor appear in Table 1.

The Model 21 processor differs from the Model 20 in that its common area can be as large as 65K; it supports indirect addressing, has a new instruction, and does not support the "privileged common" feature of the Model 20. Singer also advises that users convert to Assembler II and DMF II to fully utilize the Model 21.

One result of the new processor is that users can now execute a program up to 75K bytes in length (65K common and 10K in the partition).

Series 20-101. There are 2 versions of the Series 101 Configuration: Model 101-RJ and Model 101-TP. Both versions are oriented toward communications facilities, either synchronous or asynchronous. Both units in this series use the Model 80 CRT Display as an input device, and offer punch card or other processing equipment only in the maximum configurations. Disc storage (8 million characters) is available only in the largest configurations of this series.

Series 20-104. The Series 20-104 configuration handles larger volumes of data that can be handled by the 20-101 configuration, and has more extensive terminal capacity and greater expansion capability than the 20-101, including the use of punched-card equipment.

Because of its greater memory, this configuration can use the more powerful versions of Singer's file management software. Disc capacity can be from 20 million to 100 million characters; and for each additional hardware partition (maximum 20) another 10 I/O devices can be added. This gives a theoretical maximum of 200 terminals with up to 20 simultaneous data entries.

In addition, the 20-104 configuration can be used not only as a local computer, but also as a front-end computer to process and summarize data before transmission to a larger central computer system via wires, tapes, or disc. It does not handle data communications devices.

Table 1. Singer System Ten: Hardware Configurations for Model 20 Processor

SERIES 101

Model 101-RJ

Minimum

1 Model 20-101 processor with 10K core
2 I/O channels; SCA, ATA, or ACA
1 Model 53, 54, 55 or 56 Line Printer
1 Model 80 CRT Display

Max Additional

20K additional core
1 additional I/O channel
Additional Model 80 CRT, Model 31 Card Readers, Mdl 35 Card Punches or Line Printers, depending on I/O ports

Model 101-TP

Minimum

1 Model 20-101 processor with 20K core,
1 FAC; 1 disc controller; 2 I/O channels,
1 SCA, ATA, or ACA
1 Model 42 Disc Drive
1 Model 53, 54, 55, or 56 Line Printer
1 Model 80 CRT Display

Max Additional

10K additional core
1 additional I/O channel
Additional Model 31 Card Readers, Model 35 Card Punches, Model 80 CRTs, or line printers, depending on I/O ports available

SERIES 104

Minimum

1 Model 20-104 processor, with 20K core, 1 FAC, 1 disc controller, and 2 I/O channels

2 Model 70 workstations or 2 Model 80 CRT Display (CRT requires line printer)

2 Model 40 disc drives

Max Additional

Any device except Model 42 split disc and SCA or ATA communications adapter; includes additional core to max 110K, workstation, CRT, regular disc, line printer, mag tape, card reader or punch, paper tape reader or punch, JIS, attendance terminal, digital clock; total disc capacity: 20-100 mc

SERIES 106

Minimum

1 Model 20-106 processor, with 20K core, 1 FAC, 1 disc controller, 3 I/O channels (for nondisc communications systems, omit FAC and disc controller).

Max Additional

Additional core to max 110K; any System Ten peripheral including SCA or ATA communications adapter, workstation, CRT, split or regular disc, line printer, mag, card reader or punch, paper tape reader or punch, communications terminal, JIS, attendance terminal, or digital clock; total disc capacity: 20-100 mc (same as 20-104).

Series 20-106. Communications-based remote batch processing is the key concept for the 20-106. The 20-106 processor configuration can use a wide variety of terminals and communications devices to process source data off-line before its transmission to the host computer. Of the 3 configurations, the 20-106 is the most flexible in variety of applications, and is the most easily expandable because it can accommodate any Singer peripheral device without restriction. It can serve as an intelligent terminal (for example, 1 or more processors can appear to the host computer as an IBM 2780 remote job entry terminal) and has advantages in cost/performance over the other 2 configurations.

Special Capabilities

Singer System Ten is distinguished by certain hardware features that give it a personality all its own.

Modularity. Memory, additional I/O channels, and additional peripheral devices are simply plugged in. All components are upward compatible.

Hardwiring of Peripherals. Slow-speed devices such as CRT and typewriter (workstation) terminals, line printers, card and paper tape readers and punches, are connected by a simple 2-wire interface and can be located as far as 2,000 feet from the central processor. In most cases special-purpose peripherals, for instance, point-of-sale cash-register-type terminals and badge readers, can be connected by the same 2-wire interface as far as 8 miles from the central processor. Each user partition has one I/O channel (IOC) and each IOC accommodates up to 10 terminals, depending on the terminal mix.

Disc and Magnetic Tape Capabilities. The System Ten magnetic disc and tape drives interface with the processor through a high-speed file access channel (FAC), which can handle up to 4 tape drives and up to 10 disc drives. This allows a generous maximum of 100 million characters of disc storage. Magnetic tape drives can handle either 7- or 9-track format that is compatible with other manufacturers' drives.

Easy-to-Use Terminals. Various I/O terminals, including CRT, keyboard, and special-purpose, have helpful console lights to guide an inexperienced user, so that little training is needed.

Hardware Multiprogramming. The System Ten memory is divided into a partition called Common and from 1 to 20 user partitions, each of which shares the Common partition. The Common area stores subroutines and data that can be shared, to avoid duplication. Control of the processor by each of the user partitions is hardware monitored through a round-robin, time slicing priority system. Each partition receives 37.5 milliseconds for execution. Partition sizes are specified at installation, with a minimum of 1K increments.

The round-robin, time slicing priority system means that in the System Ten environment there can be no thing such as a rush job, or a priority queue of express jobs; the fact that an I/O interrupt prematurely terminates a partition's time slice means that an I/O-bound program's chances of being executed in a reasonable length of time, comparative to other competitive machines, are relatively slim. The only environment totally suitable for a System Ten is one with approximately equal programs with respect to I/O-processing balance and priority. This makes it an excellent remote processor.

Software. Singer System Ten software consists of 2 levels of assemblers with comprehensive sets of utility routines; the software also includes 2 report program generators, software packages for use when System Ten is employed as remote processor or input device for a large computer, and an extensive group of modules for business data processing. None of these language implementations or software packages is compatible with those of other computer manufacturers. The user has the option of obtaining the System Ten on a turnkey basis, complete with either standard or customized applications packages.

Performance and Competetive Position

Singer's System Ten computer is intended for business data processing such as sales order entry, invoicing, accounts receivable and accounts payable processing, inventory control, sales analysis reporting, general ledger processing, and payroll processing. Some work environments in which it has proved useful include the following: wholesale and retail merchandising for point-of-sale data collection, inventory control, and sales analysis; garment design and manufacturing business for analysis of styles, control of manufacturing and inventory; aerospace manufacturing organization for on-site scheduling of manpower and work priorities; a large hospital that uses it for 24-hour on-line control of supplies inventory and billing of services to patients; a large film-rental library in a state university for statewide film bookings; a large computer installation for locating and

scheduling the use of thousands of reels of magnetic tape.

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 experience.

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 1 or more small flexible computers in-house and dedicated to a specific project, rather than having to share a larger computer located elsewhere.

Some recent 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 2 computers with 8 CRT terminals and 2 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 to decrease losses on inventory items by more than $500,000 a year.

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 1 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 cut down 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 in-house telecommunications system (IBM) would cost $250,000 a year, while a modified version of this would cost $134,000 a year.

The Singer System Ten was estimated as $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 on-line 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 on-line terminals, for inventory control and shipping of more than 45,000 auto parts.

Aircraft. A large aircraft manufacturer with 8 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 3 System Ten's with 7 on-line CRT terminals and an array of data terminals for 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.

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.

Evolution and Maintenance

The first customer delivery of System Ten was made in 1970, and by the end of 1972 more than 800 installations had been completed. 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.

MAINFRAME

Product specifications for the System Ten appear in Table 2.

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 2 operand addresses; each operand address is 4 characters long.

Table 2. 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; 100
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 by 20 lines
SOFTWARE	
Operating System	Multipartitioning via hardware
Assembler	Yes
Compiler	RPG

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 max) and any location in Common (which is expandible 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 1 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 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 6 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 1 section of memory, called Common, of at least 1,000 locations, and from 1 to 20 user partitions. Thus, a minimum configuration of 10K might contain 1 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 1 of 2 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 3 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 1 tape controller with up to 4 tape drives, as well as 1 disc controller with up to 10 disc drives (an additional controller is needed for more than 4 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 2 regular I/O channels and each attach to 1 user partition. ATA replaces one I/O channel and is attached to 1 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 voice-grade 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 voice-grade 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 voice-grade 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. Both Models 50 and 52 printers are 132-column devices used for rapid data printout. They differ only in print speeds; the Model 50 prints up to 450 lines per minute, while the Model 52 only prints up to 110 lines per minute. A buffer stores data for 2 lines of print; buffering is necessary so that the output flow remains uninterrupted when the CPU is servicing another channel or peripheral device. Otherwise, an interrupt would occur with every byte transferred. Line printers are attached to the central processor through the I/O channels.

Model 53, 54, 55, 56 Line Printers. All 4 printers use a standard 64-character print set, 6 lines per inch, and 120 print positions. Their 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 per line, 8 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. Model 30 Card Reader is an 80-column, 300 card-per-minute reader that attaches to the CPU via an I/O channel. The 100 card-per-minute, on-line Model 35 punch connects to the CPU through a multiterminal I/O channel. Up to 10 readers or 9 punches can be serviced by a single partition.

Model 31 Card Reader. The Model 30 Card Reader reads 20, 51, 80, or 96-column cards at a speed of 300, 600, or 1,000 cards per minute (selectable at time or purchase.)

Model 60 Paper Tape Reader and Model 65 Punch. An on-line paper tape reader, Model 60 can read either continuous reels or strips of

punched paper or polyester tape at a rate of 275 characters per second. A Model 65 paper tape punch (companion unit to the reader) 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. The disc pack (Model 41) is removable and accommodates 10 million characters. Average data access time is 73 milliseconds, and data transfer rate is 229,000 characters per second. Up to 10 drives can be on-line to the central processor, which provides 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 4 drives are used, the fifth and successive disc drives require an auxiliary disc controller rather than the regular controller. Each disc read or write operation involves a 100-character transfer.

Model 42 Disc Drive. A split-disc drive, Model 42 features 2 separate and removable disc packs — 1 mounted on top of the other in a single unit. The resident pack (Model 41A) is 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. The Model 44 Disc Drive uses removable and interchangeable disc packs with a total capacity of 40 million bytes. Two of these disc drives can be attached to the central processor through the disc controller and the FAC. Each Model 44 looks like 4 Model 40 drives (that is, has 4 logical subdivisions) to the central processor; the Model 44 can also be intermixed with Model 40 or 42 Disc Drives as long as the total number of logical devices does not exceed ten. Each disc pack constitutes 4 logical volumes.

Model 45 Magnetic Tape Drive. Model 45 reads and writes in a format compatible with most other manufacturer's tape drives. Magnetic tape, used as auxiliary storage or as back-up for disc, is connected to the CPU via a tape controller attached to an FAC. Up to 4 units of the System Ten tape drives can be operated on-line.

Models are available for reading or writing on either 9-track or 7-track industry-compatible tape. Recording density on 7-track tapes can be either 556 or 800 bits per inch, and on the 9-track tapes is always 800 bits per inch. Both 7- and 9-track tape drives have maximum transfer rates of 20,000 characters per second. The 7-track drive normally reads and writes the System Ten 6-bit ASCII subset. The 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.

Special-Purpose Devices

Model 70 Workstation. A desk-type data entry keyboard and serial printer output device, the Model 70 Workstation provides interactive communication with the CPU and prints output at 15 to 25 characters per second. The workstation features a standard alphanumeric keyboard and prints a 170-character line using a pressure-platen forms handler. Optional features include a pin-feed forms handler. An operator panel assists the operator with indicator lights displaying system status. The workstation can serve as a load device when given device address zero.

Model 80 CRT Display. The Model 80 CRT is another interactive device for communicating with the CPU. It adds a 10-key numeric cluster similar to those on adding machines and unavailable on the workstation. Also, instead of the workstation's serial printer, it uses a CRT to generate a 1,600-character display in an 80-column by 20-line format. This display is fully buffered so that the CPU simply reads into the buffer the 1,600 characters of the display and then goes on to service another channel or I/O device.

The CRT display can be programmed to resemble a blank form onto which the operator "types" entries before feeding the entered data to the CPU. This is an advantage to a new operator because it shortens the question and response time between the computer and operator. The unit can be located up to 2,000 feet from the CPU, and 10 can be serviced by a single I/O channel.

MDTS Data Terminals (all models). Part of the Modular Data Transaction System (MDTS) for point-of-sale transactions, these cash-register-type terminals are used for remote data entry to the central processor. The MDTS terminals

also have the capabilities of a freestanding calculator, receipt printer, and totalizer. The compact units are particularly useful in a retail environment. They can be used with automatic tag readers for both detachable and non-detachable merchandise tags, as well as with credit card readers. Every transaction is recorded on an internally stored audit tape that can hold the details of approximately 400 transactions.

The CPU can, at any time, 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. Further, 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, Asychronous Communications Adapter (ACA); and Modular Data System (MDS) I/O Channel.

Model 100 Job Information Station. The JIS is an intelligent terminal that 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. This device 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, tool-room, 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. A special-purpose System Ten terminal, the 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 2 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 workstation or other input device rather than by executing assembler language instructions. A DMF system can use 1 to 10 disc packs and is divided into segments called pools. Each pools 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 can also communicate with another System Ten.

Assembler

The System Ten supports 2 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 voice-grade 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 6 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.

Modular Business Management System (MBMS).

The MBMS 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 these modules that he needs. Each module can be individually adapted at modest cost. Minimum hardware configuration includes 1 workstation (used for messages from the system and responses with requested data from the operator), 1 disc drive, and a 10,000-location Common partition with one 10,000-location user partition.

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.

HEADQUARTERS

Singer Business Machines
2350 Washington Avenue
San Leandro, CA 94577

UNIVAC
9200 System

OVERVIEW

The Univac 9200, 9200 II is the smallest of the 9000 Series systems and is a small-scale, general-purpose, business-oriented system. The 9200 is a logical upgrade from a punched card unit record system, and includes all of the necessary functions of computation, control, card reading and punching, and printing within the basic system.

Functionally the 9200 can be used as the total business data processor for a given installation. It is one of a series of systems used for I/O editing and validation when main processing might be accomplished by a larger system; or the 9200 can be employed as a communications front-end type of processor.

Both low-speed and high-speed I/O channels are available. This makes the system capable of considerable expansion in terms of I/O devices. However, memory size limitations preclude it from becoming more than a small-scale system. The 9200 does offer the user an opportunity of expanding within the series to meet his needs for some future time.

The Univac 9000 Series was introduced in 1966, and currently consists of the 9200, 9200 II, 9300, 9300 II, 9480, and 9700, of which the 9200 is the smallest.

PERFORMANCE AND COMPETITIVE POSITION

The 9200 has met the need as a small business data processing system especially since it offers upward compatibility within the 9000 Series. Hundreds of the Model 9200, 9200 II are now in field operation. Users seem to be quite satisfied with system performance and with Univac's support concerning manpower and software. Probably the most serious system limitation is the restriction to a 32K memory size. While a variety of peripherals is available, the memory limitation makes the inclusion of such peripherals and more sophisticated software somewhat academic.

The 9200 competes with the IBM System/360 Models 20, 22, and 25, the Honeywell 120 Series, and the IBM System/3. With all of these systems, there is a myriad of device mixes. However, the 9200 provides an excellent cost/performance ratio in most competitive situations. The System/360 Model 20, the H120, and the System/3 lack the compatibility with a larger range of systems within the same family that the 9200 has in the 9000 Series.

The use of the 9200/9200 II can be summarized in 2 general categories. First, the system can function as the main processor at an installation to perform any number of application functions for a small business organization, a government installation, or for various nonprofit organizations. The system could use the punched card as the prime unit of storage; but would more likely utilize the small disc files available with the system as master file storage. Second, the system is used as a slave communications front end or an I/O processor for a larger Univac system or one of another manufacturer, IBM, for example. This type of application uses various terminals in the inquiry/response mode or as a data I/O handling system.

To illustrate system usage the following 4 configurations are representative of present methods of system application.

Card Storage Configuration

- Hardware: 9200 Processor, 12K memory. I/O: card reader, card punch, printer (bar type), optional 1001 Card Controller.
- Software: Supervisor, job control, Assembly, RPG on cards; serial operation.

This configuration can process application systems such as payroll, accounts receivable, general ledger, and a small inventory system. File storage is on punched cards and the creation of updated files is accomplished by punching a new card master. A more powerful version of this system includes use of the 1001 Card Controller in an on-line manner. (The 1001 is an off-line, on-line card reading, punching, collating, and sorting device.) The user can eliminate the preprocessing of card collating because of the dual file input capability of the 1001. Not only is the collating operation eliminated, but both files are read at a combined speed of up to 2,000 cards per minute, considerably faster than a conventional card reader. This system is typical for a number of small wholesale organizations and financial firms.

Disc Storage Configuration

- Hardware: 9200 Processor, 16K memory. I/O: card reader, card punch, printer (bar type), multiplexor channel, 8410 disc subsystem — 6.4 million bytes of storage.
- Software: Disc operating system (NCOS), Assembly, RPG, utility routines.

The second configuration substitutes the disc for the punched card as the prime file storage medium. The card column format for data is much expanded since disc formats allow a significant increase in data capacity, and the number of files is reduced through consolidation of data. Operating times are greatly improved with file I/O which is now a function of disc operating times. Additionally, programs are stored on disc and total system operation improves. This is because the Job Control function loads new programs from disc and supplies a somewhat continuous job stream to the whole operation. This configuration is typical for a manufacturer, a distributor, or a municipal government operation.

Disc, Tape, Extended Memory Configuration

- Hardware: 9200 II Processor, 32KB memory. I/O: Card reader, card punch, multiplexor channel, 4-34K-byte magnetic tapes, printer (drum type), selector channel, 8411 Disc subsystem.
- Software: Disc operating system (COS), Assembly, Fortran; Multiprogramming — main program operates with symbionts.

The third configuration significantly increases system capacity in several ways. Memory is doubled, disc capacity is in modules of 29 million bytes, tapes are added, and printing speed is increased. The operating system provides the facility of running the main program while simultaneously performing data transcription programs (card-to-tape, tape-to-print). The user has the Cobol and Fortran languages available; the number and scope of applications processed have expanded. While this configuration serves a wider range of businesses, the limitation on memory size becomes significant.

Communications Front-end Processor Configuration

- Hardware: 9200 Processor, 16K-byte memory. I/O: card reader, card punch, printer (bar type), multiplexor channel, 8410 Disc subsystem, data communications subsystem, line terminal controller, line terminal, terminals, intercomputer control unit.
- Software: Disc operating system (NCOS), Assembly, RPG, OS-500 communications operating system.

The fourth configuration is an example of the 9200 used as a data I/O device and a communications front end for some larger system. OS 500 provides the software capability for the DCT 500 Terminal, while the normal IOCS routines can be applied to other terminals. In addition, an optical document reader can be attached for specific input documents. This system provides an I/O and terminal capability that serves as an interface for a larger system which is used by a public utility or an insurance company.

MAINFRAME

The 9200 uses the single stream processor concept that operates on an internally stored program. The system basically consists of program control, arithmetic, I/O control, and memory functions. The basic unit of information is an 8-bit byte that carries a ninth parity bit. The hardware provides for 2 states of operation: the processor program state control and the I/O program state control. These two states can operate concurrently, which means that the 9200 can execute 1 machine instruction with 1 of the following:

- Up to 3 slow-speed operations performed by the integrated devices. (The integrated devices, the card reader, punch and printer are connected to the direct I/O channel and are an integral part of the 9200 mainframe.)
- Up to 8 medium-speed data transfer operations taking place on the I/O multiplexor channel (optional on the 9200).
- One concurrent high-speed data transfer using the I/O selector channel (optional on the 9200 II).

Central Processors

Two processors are available in this series: the 9200 and the 9200 II. The basic difference is that the multiplexor is optional on the 9200, while the multiplexor is standard and 1 selector channel is optional on the 9200 II. The 9200 memory storage maximum is 16K, while 9200 II maximum is 32K.

The storage available in these processors ranges from 8,192 bytes to 32,768 bytes in increments of 4K or 8K bytes. Each byte is individually addressable, or can be addressed as a half-word — 2 bytes at a time; or addressed as a full-word — 4 bytes at a time. The processor houses integral controllers for card reading, card punching, and printing. The byte is made up of 8 information bits and 1 parity bit for validity of data.

The first 256 bytes of main memory are reserved for system use and include 2 sets of 2-byte

address registers. Eight of these registers are used for the processor normal state and another 8 for the I/O state. A benefit of this operation is that when the program state changes, which is based on an interrupt, the system simply switches from 1 set of registers to the other without the need to store the contents of each. This reduces the system overhead time consumed in the storing of register conditions, which would be necessary if there were only 1 set of registers.

Instruction Set. The 9200/9200 II processors have an instruction set of 35 instructions, of which 3 are optional: the edit, multiply, and divide. Included are instructions to translate, test under mask, decimal arithmetic and logical functions. Instructions for floating-point arithmetic are not available. Instructions are 4 or 6 bytes in length, and can address direct memory locations or indirectly address memory through the use of registers.

Interrupt Control. On the 9200/9200 II, interrupts are an integral part of all phases of computer operation that use the I/O devices. An interrupt request is generated when an I/O unit is ready for servicing (read cycle completed, punch ready, printer ready, and so forth). It allows a break in the program to attend to the I/O unit until its requirements are satisfied. The point of this program break is automatically recorded, and control is immediately returned to that point after the I/O device has been serviced. Thus, the speed limitation imposed on each unit is the inherent limitation of its normal electromechanical operation.

Main Storage

The 9200 has a plated wire main memory. The memory has a single access port, so that contention for memory access by the central processor and peripherals causes interference. The cycle time is 1.2 microseconds and each memory cycle accesses 1 byte.

Input/Output Control

A multiplexor channel is optional on the 9200 and standard on the 9200 II; a selector channel is also optional on the 9200 II. The multiplexor provides for the simultaneous operation of up to 8 peripheral devices. It can also operate in the burst mode wherein the channel is dedicated to 1 device and allows a higher data transfer rate. The selector channel is faster; however, it is dedicated to 1 device at a time.

Since there is only 1 access path to main memory, delays are introduced when different peripherals and the CPU attempt to access memory simultaneously. The processor initiates an I/O instruction by sending an execute I/O word to the appropriate I/O control unit; then the processor proceeds to execute the next instruction in sequence. In the I/O control unit, execution of the I/O operation occurs independently of the processor, but time-shares access to the memory with the processor and other I/O control units.

PERIPHERALS

The peripherals available with the 9200/9200 II are described as follows. The controllers for the 0711-00 and 0711-02 card readers, the 0603 card punch, and integrated bar printer are each a part of the processor unit itself.

Model 0611-00 Card Reader. 400 cards per minute; 1,200/1,500-card input hopper/output hopper capacity; 80-column cards standard; optional 51- or 66-column short card feeds. Its controller is standard with the CPU.

Model 0711-02 Card Reader. 600 cards per minute; 1,200/1,500-card input hopper/output hopper capacity; 80-column cards standard; optional 51- or 66-column short card feeds. Its controller is standard with the CPU.

Model 0716-02 Card Reader. 1,000 cards per minute; 2,400/2000-card input hopper/2 output hoppers (2,000 each); 80-column standard; optional 51- or 66-column short card feed. Its controller is part of CR Subsystem, available on a processor with a multiplexor.

Model 0603 Card Punch. 75 to 200 cards per minute; 1,200-card input hopper; 850 output normal stacker; 850 output select stacker; 80-column standard; optional read-before-punch at 200 card-per-minute rate; controller is standard with CPU.

Model 0604 Card Punch. 250 cards per minute; 1,000-card input hopper; 1,000 output normal stacker; 1,000 output select stacker; 80-column standard; optional read-before-punch at 250 card-per-minute rate. Controller is part of CP Subsystem; attaches to multiplexor.

Model 1001 Card Controller. 1,000 cards per minute — 1 feed; 2,000 cards per minute — 2 feeds; performs on-line or off-line collating, proving, editing, sorting; 256-position memory to add, subtract, and compare. Seven output stackers for selection. Input hopper — 1,200 to 3,700 cards, output hopper — 1,500 per stacker.

Model Integrated Bar Printer. 250 lines per minute; 96-print position; 63-character font; removable typebar; 6 lines per inch; other speeds; line widths as special features. Controller is standard with CPU.

Model 0768-00/01 Printer. 900 lines per minute with 63 contiguous characters; 1,100 lines per minute with 49 contiguous characters; 1,200 and 1,600 lines per minute available with special feature; 63-character font; 132 print position; 6 or 8 lines to inch; form width — 4 to 22 inches; length — 1 to 22 inches; 10 characters per inch; controller is part of printer subsystem.

Model 0768-02/03 Printer. 840 lines per minute with 94 contiguous characters; 1,000 lines per minute with 87 contiguous characters; 2,000 lines per minute with repeated subset of 14 characters; 94-character font; 132 print positions; 6 or 8 lines to inch; form width — 4 to 22 inches; length — 1 to 22 inches; 10 characters per inch; controller is part of printer subsystem.

Model 0920 Paper Tape Reader/Punch. Reads 300 cards per minute; punches 110 cards per minute; tape widths 11/16, 7/8, or 1 inch; tape channels — 5, 6, 7, or 8; 10 characters per inch; controller is part of paper tape subsystem.

Model 2703 Optical Document Reader. Reads 300 documents per minute (or 600 documents per minute upgrade); document size: height — 2.75 to 4.25 inches; length — 3.0 to 8.75 inches; 20 to 62-pound paper; reads single line of numeric data and special symbols; 3 stackers under program and hardware control; modulus 10 check digit; mark read; punched card read. Controller part of reader subsystem; attaches to multiplexor.

Uniservo VIC Magnetic Tape. This subsystem consists of a controller and from 2 to 8 magnetic tape drives. A master/slave concept is employed; thus, 1 master unit has the power and control circuitry for 1 master tape unit and 1 slave unit. Two additional slaves can be added. If more than 4 tapes are needed, a second master/slave must be added. Available in 7- or 9-track; 34,160 bytes per second at 800 bits per inch; gap time 14.1 milliseconds; 2,400-foot reel; 3-minute rewind; attaches to multiplexor; 9200 II only.

Uniservo 12 Magnetic Tape. This subsystem consists of a controller and from 1 to 16 Uniservo 12 Tape Drives. A master/slave concept is employed whereby 1 master unit has the power and control circuitry for 1 master tape drive and 3 additional slave tape drives. When more than 4 units are needed, a second master is necessary. Available in 7- or 9-track; 68, 320K-bytes per second for phase-encoded (1,600 bits per inch); 34,160K-bytes per second for 800 bits per inch; 14.1-millisecond gap time; 2,400-foot reel; rewind 3 minutes; attaches to selector channel; 9200 II only.

The 9410 Disc employs, as a recording medium, a nickel-cobalt-coated disc in an interchangeable cartridge. Each single disc cartridge can store up to 3.2 million bytes; but only 1.6 million bytes of each cartridge can be accessed on-line at a given time. By physically removing each disc cartridge, turning it over, and replacing it on the drive, the remaining 1.6 million bytes of data become accessible.

Two independently operated disc drives are housed in a single cabinet; each drive services a single disc cartridge. Up to 4 dual-disc drives are allowed in a maximum 9200 Series system configuration to provide a total on-line data capacity of 12.8 million bytes. The controller attaches to the multiplexor channel.

8411 Disc Subsystem provides a disc system that is compatible with the IBM 2311 Random Access System. The disc pack has the same number of recording surfaces, the same number of tracks, and the same byte capacity as the 2311. The drive accessor mechanism has the same 10 read/write heads for proper track and cylinder selection. The controller is part of the subsystem and attaches to the selector channel.

8414 Disc Subsystem expands to 29.18 million bytes per pack and is compatible with IBM 2314 disc system. The controller is part of the subsystem and attaches to the selector channel.

Besides the standard teletypewriters, Univac offers a wide variety of terminals for use with the 9200/9200 II. The DCT 500 inquiry terminal consists of a keyboard and 30 character-per-second serial printer; while the DCT 1000 is a version of the DCT 500 to which card and paper tape I/O capabilities can be added to provide remote batch operation. Faster and more comprehensive remote batch capabilities are provided by the DCT 2000 terminals.

Univac also provides 2 alphanumeric displays — Uniscope 100 and Uniscope 300. Although Uniscope 100 is a newer, less expensive version of Uniscope 300 with the same comprehensive editing facilities, Uniscope 300 has not been entirely superseded by the Uniscope 100. Uniscope 300 is better suited for high-traffic applications where terminals are connected in large clusters, while

Uniscope 100 is intended for low-traffic situations in which there are small clusters of terminals.

SOFTWARE

As a member of the 9000 Series, the 9200 has upward compatibility with other systems in the series, and the Univac supplied software is written to meet the needs of the entire series. The 9200 benefits from this relationship. The choice of the vendor-supplied software is very dependent upon the selection of hardware that is made by the user.

Operating System

With the minimum system configuration of the 9200, a basic Supervisor program is supplied to provide the control for communications between the operator, the user program, and I/O software; it also provides program restart. The Supervisor handles the I/O interrupts passing control between the IOCS routines (a subset of the assembler) and the main program. Programs, as well as various control cards, are entered via punched cards as the system executes jobs in a serial fashion. Included are an assembler with macro facilities and a report program generator.

The Minimum Operating System is available for use with 8K-byte main storage and larger tape-oriented 9200 systems. The operating system consists of a group of processing programs and control programs which are capable of operating in a semiautomatic environment. The basic supervisory program control functions are performed on-line in conjunction with, and in service to, the problem program. The minimum configuration includes an 8K memory, 3 Uniservo VIC magnetic tapes, the card reader, card punch, and multiplexor channel.

The Non-Concurrent Operating System requires a minimum 16K memory and at least 4 magnetic tapes. The supervisor and the job control program oversee system operation; the user now has a Cobol and a Fortran compiler available. System programs are disc-resident if a minimum 2-disc system is used. At this software level, only 1 program would be operable at a time. Both the MOS and the NCOS require the use of the multiplexor to interface tapes or disc.

The Concurrent Operating System which provides multiprogramming operations is basically oriented toward the larger systems in the 9000 Series. Technically, it can be used on the 9200/9200 II, but usually it would be run on a larger system.

Language Processors

The basic card assembler is a 2-pass program that will operate on the minimum configuration of the 9200. It is a simplified, and a somewhat restricted version of the larger tape assembler although the card assembler does include many of the macro facilities found in the larger version.

During the first pass, the card assembler reads information from the source program deck and produces a symbol table. During the second pass, the assembler generates object code from each source card to produce an object card. The assembler can translate all Model 9200 machine instructions and uses up to 8 assembler control instructions. Assembly-language symbolic labels can reference relocatable or absolute data; self-defined constants can also be included in many instructions.

The tape assembler is constructed at an 11K-byte design level. The assembler will function with any system that has at least 16K bytes of memory, 4 tape units, a card reader, line printer, and the I/O multiplexor. The assembler provides for the following:

- Use of system library and macro routines, and user-prepared macroinstruction definitions.
- Use of separately-prepared program segments that can be linked together as 1 object program. Thus, many cumbersome overlay control manipulations are removed from the concern of the programmer.
- Use of system control facilities of the supervisor program.

The report program generator is available in both card and tape versions; it provides a source language facility which is oriented toward the production of reports. The report program generator is subdivided into 3 parts: input, calculation, and output; each has a corresponding entry form. From the user coding on these forms, RPG produces an object program that will read the described input, do the specified calculations, and produce the printed reports and summary punched cards or object tape.

This RPG closely parallels the report program generator that is used with the IBM System/360. RPG requires an 8K memory, a card reader, punch, and bar printer as a minimum configuration.

The Cobol compiler is available only for the 9200 II due to the requirement of 4 magnetic tape

units on a selector channel (none available on the 9200). Also required are a 16K memory, a card reader, and printer. This compiler meets the specifications proposed by the USA Standards Institute for a minimum USA Standard Cobol.

The Fortran compiler requires the same minimum equipment configuration as Cobol. The Fortran language contains features of both ANSI Basic Fortran and ANSI Fortran.

Other System Software

Gangpunch-reproduce program generator — (card only) this permits functions normally associated with tabulating equipment to be described in problem-oriented terms. It generates a program to perform straight reproducing; controlled reproducing; master card, interspersed master card; and offset gangpunching; sequence checking; and consecutive punching.

Debugging aids that are available include a memory dump routine, and the Squeeze program for alteration of object programs. The memory dump routine can be incorporated in a program under test or loaded under operator control. The Squeeze program provides for patching binary programs.

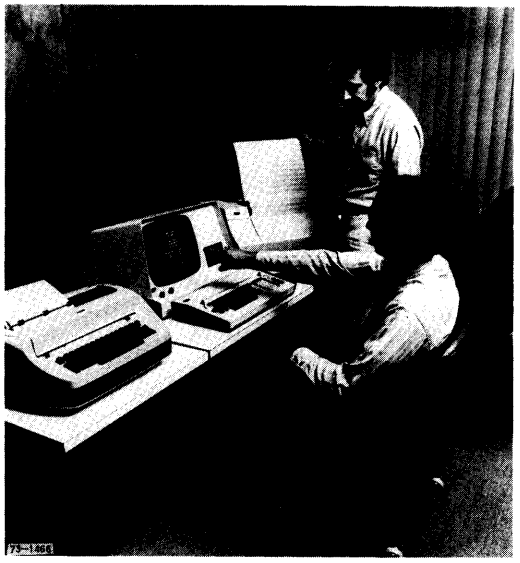
Sort routines, both tape and disc-based, provide the facility to sort either punched card input records or fixed or variable length tape records in ascending or descending sequence.

Application Packages

A broad range of application packages are available; these packages include: general payroll, typesetting, linear programming, medical accounting, mortgage accounting, CPM-PERT, accounts payable, bill of materials, basic inventory control, television scheduling, and others.

WANG LABORATORIES

System 2200 Advanced Programmable Calculator



OVERVIEW

The Wang System 2200 is a small business computer that is an outgrowth of the large Wang calculator line. The basic System 2200 consists of a CPU with a 4K byte read/write MOS memory, a special Basic statement keyboard or a regular alphanumeric keyboard, a CRT, one cassette drive and I/O slots for 6 peripherals. An extended Basic language interpreter is hardwired into memory, as is the control logic for the standard peripherals. This means the system does not require a software compiler. Arithmetic and trigonometric functions of interest to scientists and educators or businesses with unusual calculation requirements are standard in the instruction set. Extended I/O capabilities needed to configure small interactive business systems, including several types of printers, plotters, marked sense and punched card readers, communications interfaces and discs, can be added to the basic system.

The processor operates in 2 modes, program and immediate. In program mode, a 1- to 4-digit line number precedes each line, and this number signals the mode. The CPU checks the line for grammatical syntax, stores it and awaits further instructions. In the immediate mode, however, the absence of the line number causes the system to check the line and execute it immediately without saving the line. Furthermore, in the immediate mode, several statements separated by colons can be placed on a line to enhance the system's use as a calculating tool.

If a syntax error is found, the error code with an "up arrow" pointing to the error is displayed. Regardless of mode, the system returns control to the user, who can make the necessary changes by retyping the line.

Wang is a leading manufacturer of programmable calculators and word processing systems. The System 2200 is aimed partly at their traditional markets, which include various types of scientific applications but primarily surveying and civil engineering, medical and clinical work, statistical and mathematical calculations for universities, automobile dealers, and banks (loan installments, for example). In addition, Wang markets the System 2200 for users first entering the general purpose commercial computer market. Wang is developing Invoicing, Accounts Receivable, Accounts Payable, Sales Analysis, Payroll, Inventory, and General Ledger software packages for that market.

One feature of particular interest to novice nontyping users is the standard keyboard for the basic System 2200. This keyboard arranges uppercase alphabetics in straight A-Z alphabetical order, supplemented with a 10-key numeric pad. The lowercase characters are used to enter whole Basic statements and system commands with a single keystroke thus circumventing errors and increasing programming speed.

The first Wang System 2200 was delivered in June, 1973; about 500 systems were delivered in the next 3 months. System specifications are listed in Table 1.

CONFIGURATION GUIDE

Both the System 2200A and 2200B CPUs contain 4K bytes of read/write memory, a hardwired interpreter, 6 I/O slots, control electronics, and expansion capacity in the main chassis. They differ in that the System 2200B can be configured with discs and other peripherals unavailable for the System 2200A. The System 2200A model can be upgraded in the field to a System 2200B. To make a minimum fully operational system, a keyboard and CRT must be added to the basic configuration. A single magnetic tape cassette drive, which can be housed as a separate unit or combined with the CRT into a single module, rounds out the main chassis possibilities.

Some peripherals, in addition to those already mentioned as standard, can be added to either processor model, whereas some require the "B" model. The 2201 Output Writer, additional 2217 Tape Cassette Reader/Recorders, 2221 High Speed Printer (132 columns), 2222 Alphanumeric

Table 1. Wang System 2200: Specifications

Characteristic	Wang System 2200
PROCESSOR	
Main Memory (bytes)	4K-32K
Char Size (bits)	8
Addressable Registers	—
Cycle Time (μsec)	1.6
No of I/O Channels	6 Std; 5 opt
Max Devices/ Channel	1
AUXILIARY STORAGE	
Storage Medium	Disc/Tape Cassette
Capacity (bytes)	1.2M, 2.4M or 4.9M/ 78K
Transfer Rate (bytes/sec)	200K/326
DATA ENTRY	
Keyboard	Special Basic Keyboard std; alphanumeric typewriter keyboard
Card Reader (cpm)	Mark-sense (hand-fed); punched (300)
Paper Tape Reader (cps)	300
DATA OUTPUT	
Card Punch (cpm)	NA
Paper Tape (cps)	NA except as option for Teletype (10)
Line Printer	132 cols — 60 to 200 lpm 80 cols — 60 to 150 lpm
CRT Display	16 lines by 64 cols
SOFTWARE	
Operating System	No
Assembler	No
Compiler	Basic (hardwired interpreter)

Keyboard, 2227 Telecommunications Option and 2231 High-Speed Printer (80 columns) can be used with either model. The 2202 Plotting Output Writer, 2203 Punched Paper Tape Reader, 2207 Teletype Interface Controller, 2212 Flatbed Plotter, 2232 Digital Flatbed Plotter, 2234 Stack-Feed Card Reader, 2214 Marked Sense Card Reader, and the three 2230 Disc Models all require a System 2100B. Each of the 6 I/O slots can handle 1 device; an optional extended chassis adds 5 I/O slots for a maximum number of 11 peripherals per system.

A "matrix ROM" option extends the processor power by performing calculations on matrices rather than individual numbers. With one key depression, for instance, the user can add one matrix to another matrix. An ROM character editor option is also available to edit program source code.

PERFORMANCE AND COMPETITIVE ANALYSIS

With its first commercial system, Wang has created a product that is a cross between a calculator and a computer; it provides Wang's present calculator customers with a system to "move up" to and provides the business community with a small interactive system that is attractive to novice users because it is easy to use, it is low priced, and it is reliable. Users of previous Wang calculators will find advanced calculator functions as standard parts of the system, plus program storage, printing, and plotting capability, at very reasonable prices. Small businesses will find certain features unique for a small business computer, such as the nonstandard keyboard and the extensive calculating ability, combined with features that are becoming standard with many small interactive systems now on the market, such as a low cost CRT display-cassette-printer combination, microprogramming, and MOS circuitry (for small size and reliability). Wang has solved the problem of software support for users who have no EDP staff — which is the case for most potential customers for this type of system — by contracting with various small software houses around the country for custom programs. Users contacted were quite happy with the performance of their systems; they did not experience problems as a result of the split hardware and software support. Wang is in the process of developing standard business packages of several types.

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 and 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, which adds to the dealer's profit on an individual sale. 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 he has had excellent service, both on his hardware from Wang and his software from the "Creative Software" house in nearby Atlanta.

A software service bureau in the South bought a Wang System 2200 in order 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 want to do their own programming. An engineer, on the other hand, will probably program his computer. Wang does not yet have the programming staff to customize all its user programs, and users rarely use manufacturer-supplied software without some alteration. This software company does a booming business programming for the System 2200. Their main customers have been automobile dealers, but they have 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 that he knows which extras can be shaved off to lower payments and still maximize the dealer's or the institution's profit on the transaction. This software house believes there is a very large market for systems like the Wang, particularly because of the low hardware cost.

Another software house that has a Wang System 2200 in order to develop customized programs for other users also has an IBM System/3, an HIS 58, a DEC 340, and a Basic Four system for the same purpose. The firm has programmed a variety of applications for the System 2200, including programs for clinical laboratories, book distributors, a travel agency, a paper manufacturer (billing and materials), an engineering consulting firm (client billing), a furniture manufacturer (perpetual inventory), a small college (various financial applications), a construction firm (payroll and job-cost analysis), and a bank (mortgage, loan, and savings). This firm felt that the DEC 340, the Basic Four, Cascade Data and Quantel were Wang's major competitors, and Wang had a definite competitive advantage because of the tremendous price/performance of the System 2200. System/3, of course, is aimed at larger users than those that would buy a System 2200. In fact, this contact expressed the opinion that within one year after Wang began marketing the System 2200 heavily, Wang will have more installations than any other SBC manufacturer except IBM. This user felt the system was so inexpensive even very small businesses could afford it (the minimum business system they recommend includes 8K bytes of memory, 3 cassette drives and a Centronics printer and costs around $13,800), and the system performs well. The combination of the hardwired Basic interpreter and the lack of an operating system means that the system responds very quickly, and it is easy to use. Users noticed right away that keyed data appears "instantly" on the System 2200, whereas there is a discernable delay between entry and display on the DEC 340. The communications facility is quite fast. Even more important for business users, Wang has extended the Basic language with very good file handling capabilities (not a common feature of Basic extensions) which helped the software house provide efficient business programs. As for installation, all the user has to do is open the box, read the directions, put in a few plugs and press the switch.

MAINFRAME

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 39 single-byte program instructions, 2 double byte instructions (DATA LOAD and DATA SAVE), plus 15 mathematical functions. To this standard set can be added 32 user-defined functions that can be entered by a single programming keyboard stroke. 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
$Loge^x$	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
Arc tangent	72.5

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, and consequently, they do not impact the amount of read/write memory available to the user.

INPUT/OUTPUT

Six I/O slots for the attachment of up to 6 peripherals are standard to both processors. The expansion option adds 5 slots to attach up to 5 peripherals for a maximum of 11 per system. The peripheral handling routines are all hardwired ROM modules that come with the device. The exception is the disc management routine, which is an integral part of the Model 2200B processor, regardless of whether or not the system includes a disc. Certain peripherals can be attached only to the B 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 not possible.

PERIPHERALS

A wide variety of peripherals can be added to the System 2200: discs, printers, cassette drives, Teletypes, plotters, and both mark-sense and punched card readers. The standard system usually includes a CRT and cassette drive within the CPU chassis and a portable keyboard. More peripherals, including industry-compatible magnetic tape, will be announced shortly.

CRT. Up to 1,024 characters are displayed on an 8- by 10.5-inch screen in 16 lines of 64 characters each.

Keyboards. The standard keyboard has 80 keys: 44 alphanumeric keys, 10 numeric keys and several groups of editing and special function keys. Uppercase alphabetic keys are arranged in order A-Z; the lowercase keys are used for the mnemonics for Basic statements, which can be entered with a single key stroke. An alternate keyboard with a key arrangement like a Teletype ASR 33 is also available.

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 to I/O slots.

Printers. Two high speed printers, an output writer and a plotting output writer provide a range of printing capabilities. Models 2221 and 2231 Printers print 132 and 80 columns respectively on pin-fed forms at 150 and 100 characters per second respectively, using a dot-matrix impact printing technique; the OEM manufacturer for both printers is Centronics. Both output writers are IBM Selectric type units with the Model 2201 printing pin- or friction-fed forms at 12 characters per inch and the 2202 adding plotting capability at approximately 400 steps per second (X or Y axis) using 0.01-inch steps.

Plotters. In addition to the plotting capability provided by the plotting output writer mentioned above, Wang supplies a digital flatbed plotter with a 31- by 42-inch bed. An analog flatbed plotter with a 11- by 16.5-inch bed is also available. Both are for the 2200B processor only.

Conventional Peripherals. Several types of slow-speed input devices are available. These include a hand-feed mark-sense card reader, a stack-feed punched card reader (300 cards per minute), and a paper tape reader (300 characters per second).

Discs. All 3 disc models offered consist of one fixed and one removable disc. The Model 2230-1 stores 1.2 million bytes, Model 2230-2 stores 2.4 million bytes, and Model 2230-3 stores 4.9 million bytes. The disc management routines are part of the control memory that comes with the 2200B processor. The peak transfer rate is 200,000 bytes per second, yielding an effective transfer rate of 75,000 bytes per second.

DATA COMMUNICATIONS

An asynchronous adapter for half-duplex transmission of ASCII code allows the System 2200 to communicate with another System 2200 or any computer system that can handle ASCII transmissions. The adapter allows transmission rates of 110, 150 or 300 baud over voice grade lines and 600 or 1,200 baud over dedicated lines. The transmission rate is switch-selectable, and the input character code for carriage returns is also selectable.

A Teletype interface for asynchronous transmission at 110 baud allows the user to plug a Teletype into the System 2200.

SOFTWARE

Wang has responded to the software needs of its commercial users by arranging with local software houses to customize user programs in addition to the programs Wang is developing. Consequently, although Wang is now developing Accounts Receivable, Accounts Payable, Invoicing, Sales Analysis General Ledger, Inventory and Payroll packages, Wang 2200 systems are already being used for these applications.

Wang has a mathematics general program library, a statistics/engineering library and a finance/utilities/games library currently composed of 44, 40 and 35 programs respectively for the System 2200. Programs range from those of general values (such as Chi-square testing, distribution and analysis, Poisson distributions, nominal interest rates, depreciation changes, and Fourier analysis) to those of more specific interest, such as a routine that "computes the headwater depth of culverts flowing full" or another that "calculates the number of years that an oil well will produce." Games include artillery, craps, Tic-Tac-Toe, one-armed bandit, and blackjack — but no chess.

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