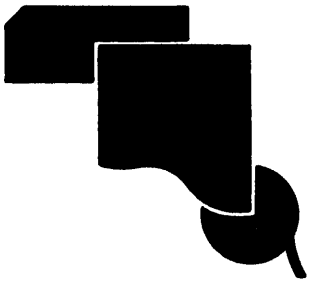
GENERAL ELECTRIC
COMPUTERS

GE-200 Series Time-Sharing Operating System



GENERAL ELECTRIC

CPB-1455

GE-200 SERIES TIME-SHARING OPERATING SYSTEM

REFERENCE MANUAL

September 1967

GENERAL ELECTRIC

INFORMATION SYSTEMS DIVISION

CPB-1455

PREFACE

This manual describes the GE-255 and GE-265 Time-Sharing Systems. The intent of the manual is to provide the reference information needed by the programmers and analysts who start up and maintain the Time-Sharing Systems.

A brief description of the hardware that comprises the GE-200 Series Time-Sharing System, and its supporting communications equipment is provided. However, the manual concentrates on the operating system--the programming concepts and techniques that cause the equipment to operate efficiently.

Suggestions and criticisms relative to form, content, purpose, or use of this manual are invited. Comments may be sent on the Document Review Sheet in the back of this manual or may be addressed directly to Documentation Standards and Publications, B-90, Computer Equipment Department, General Electric Company, 13430 North Black Canyon Highway, Phoenix, Arizona 85029.

© 1966, 1968 by General Electric Company

(2.5M 2-68)

CPB-1455

CONTENTS

1. INTRODUCTION 1

2. TIME-SHARING COMPUTER HARDWARE CONFIGURATION 3

3. SOFTWARE SYSTEMS DESCRIPTION 7

Preface 7
General Description of the Executive System 7
The DATANET-30 Executive 8
GE-235 Executive 12
Catalogs 15

4. SYSTEM OPERATIONS 35

Startup Procedures for a New System 35
GE-255 New System Startup 36
GE-265 New System Startup 40
Daily Startup 44
Daily Shutdown Procedure 45
Troubleshooting 45
Teletypewriter Messages 45
Console Typewriter Messages 47
System Library 49
Control Teletypewriter Commands 49
Input Commands 51
GE-225 Card Input Commands 51
GE-235 Console Typewriter Commands 60

5. USER VALIDATION 63

6. SYSTEM ACCOUNTING 67

Central Processor Time 67
Teletypewriter Time 67

7. BACKGROUND AND SERVICE PROGRAMS 69

Background Programs 69
Card Reading Overlay 69
Background Executive 70
Background Executive Service Subroutines 70

Preparing the Control Cards 71
Programming Conventions for Background Programs 79
Background Subroutines 80
Background Program Header Information 86
SYMMAINT-Symbolic Maintenance Program 87
General Description 87
Control Card Formats 87
Operation 88
Building Tapes 89
Control Cards 89
Subsequent Files 91
Maintaining Tape Files 92
Other Cards Used During Copy Process 96
Output Control Cards 97
Operations on Symbolic END Cards 98
Error Messages 99
Service Programs 100
Loaders 100
Background Assembly Programs 103
Condensed Operating Instructions 104
Card-to-Disc Program 106
Disc Edit Routine 109

8. COMPILER SYSTEMS 111

System Interface and Programming Conventions 111
Functions of the GE-225/235 Executive 111
Programming Conventions 112
Memory Allocation 113
Compiler System Header Information 114
System Overlay Call 115
Disc Usage 116
Compiler System Loader 117
Source Program Processing 117
Program Interrupt 118
Generated Output 118
Example of a System: BASIC 119
Input/Output Code Conversion 120
The Compiler Systems 121

9. SYSTEM ORGANIZATION 123

System Flowcharts 123
Memory Allocation Maps 134

10. COMMUNICATIONS HARDWARE 143

Interface Equipment 143
Summary of Data Services 144

Data Set 103A2 147
Data Set 103F2 154
Terminal Equipment 158
Model 33 Teletype Unit 161
Model 35 Teletype Unit 165

11. OFF-LINE REPORTING ROUTINES 171

General 171
Billing Master Pack 172
Terminal Time Retrieval 178
CPU Usage Sort 187
Disc Sort 190

APPENDIX

A. MAILBOX CONFIGURATION 195

B. INPUT/OUTPUT CODE CONVERSION 201

INDEX

ILLUSTRATIONS

1. GE-255 Time-Sharing System Cabling 4
2. GE-265 Time-Sharing System Cabling 5
3. Initial DATANET-30 Sequence Processing Diagram 19
4. Internal Processing of OLD 23
5. Internal Processing of LIST 24
6. Internal Processing of SAVE 25

7. Internal Processing of EDIT 26
8. Internal Processing of START 27
9. Internal Processing of RUN 29
10. Internal Processing of BATCHMODE 33
11. Sample SYMMAINT Control Deck 88
12. Input/Output Code Conversion 120

13. Interface Communications Hardware 143
14. Interface Connector Pin Assignment 148
15. Transmission Frequencies (CPS) 150
16. Channel Establishment 151
17. Data Set 103A Space Disconnect Sequence 153
18. Interface Connector Pins Assignment (103F2) 154

19. Data Set 103F Timing Sequence 157
20. Proposed Revised American Standard Code for Information Interchange 159
21. Model 33 Controls 162
22. Model 33 Keyboard Assignment 162
23. Model 35 Controls 166
24. Moded 35 Keyboard Arrangement 166

1. INTRODUCTION

The GE-200 Series Time-Sharing System allows many people to simultaneously use a centrally located computer from terminal devices for problem definition, problem solution, or program editing. The system consists of General Electric processors, discs, and other components adapted for use in a real-time conversational environment. The Time-Sharing System which uses the GE-225 computer is called the GE-255; the Time-Sharing System using the GE-235 computer is called the GE-265.

This reference manual briefly describes the hardware that comprises the GE-200 Series Time-Sharing System (GE-255 or 265) and the communications equipment that supports it. The manual concentrates, however, upon the Operating System--the programming concepts and techniques that cause the equipment to operate efficiently.

The intent of the manual is to provide the reference information needed by the programmers and analysts who start up and maintain the GE-200 Series Time-Sharing System. With this goal in mind, the writers have assumed that those who use the reference manual are well-versed in basic computer concepts, such as assemblers, compilers, and order codes, and are familiar with General Electric equipment.

The Operating System consists of the following elements:

The Executive Programs in the DATANET-30* and the GE-225/235 that manage and control the flow of information to and from remote devices, as well as supervising the transfer of instructions and data within the system.

- The DATANET-30 Executive is the master of the time-sharing system; it regulates communication with all remote terminals and schedules programs on the GE-225/235, using it to edit, compile, and calculate.
- The GE-225/235 Executive program consists mainly of routines to carry out commands from the DATANET-30. These routines move data internally, and shift compilers and programs back and forth from the disc.

The Validation Techniques that establish and control access by users and ensure them program security.

The System Accounting Programs that accumulate information for use in regulating and in billing customers.

* DATANET, Reg. Trademark of the General Electric Company.

The Background Programs that allow the GE-200 Series computer to do a variety of "spare-time" batch processing using conventional peripheral devices, such as printers, card readers, and card punches. The background processing is carried on concurrently with time-sharing programs.

The Compilers and other run-time programs that contain a repertoire of instructions for solving problems and manipulating data from the remote terminals.

The manual describes all of these elements of the system. The manual also includes a chapter that covers system startup, shutdowns, troubleshooting, and other important operator information.

Other manuals are available which are oriented primarily to the users of the time-sharing system. These are:

CPB-1476	GE-200 Series Time-Sharing Terminal User's Manual
CPB-1150	GE-200 Series Time-Sharing BASIC
CPB-441	GE-200 Series Time-Sharing Dartmouth ALGOL
CPB-1424	GE-255 Time-Sharing FORTRAN

In addition, manuals covering the DATANET-30, the GE-225 and GE-235, and other components of the system are available. Copies may be obtained from your local General Electric representatives.

2. TIME-SHARING COMPUTER HARDWARE CONFIGURATIONS

The GE-255 and GE-265 Time-Sharing Systems require the following minimum hardware configuration:

QUANTITY		TYPE NOS.		
GE-255	GE-265	GE-255	GE-265	DESCRIPTION
1		CC225A		GE-225 central processor with 16k memory, console, output typewriter, and 8-channel controller selector
	1		CA235	GE-235 central processor with console, and input/output typewriter
	1		MM235C	16k memory
	1		CSS235	Single Access Controller Selector
1	1	OPT036	OPT035	N-Register Option for Time-Sharing
1	1	J225A	BCD235	Decimal Package
1	1	J225B	API235	Automatic Program Interrupt
1	1	J225C	MVC235	Move Command
1	1	J225E	RTC235	Real-Time Clock
1	1	X225A	AAU235	Auxiliary Arithmetic Unit
1	1	M225BX	M225BX	Dual Access Disc Storage Unit Controller
1	1	DSF204	DSF204	Disc Storage Unit with 4 Discs
1	1	OPT203	OPT203	Twelve Additional Discs
1	1	OPT206	OPT206	96-Record Read/Write Option
1	1	D225B	CRC235	Console Card Reader and Control, 400 cpm
1	1	DCP932	DCP932	DATANET-30 Processor with 16k memory
1	1	CSU931	CSU931	Controller Selector Unit
1	1	CIU930	CIU930	Computer Interface Unit
3	4	BBU932	BBU932	Bit Buffer Unit
30	40	BBC932	BBC932	Bit Buffer Channel
3	4	TCP936	TCP936	Timing Plug, 110 bits per second
6	8			Cable Package for BBC932 Bit Buffer Channel
1	1	MTC680	MTC690	Tape Controller
2	2	MTH690	MTH690	Dual Tape Handler
1	1	P225A	P225A	On-Line Printer and Control, 900 lpm
1	1	E225K	CPA235	Card Punch and Control, 100 cpm

Cabling for the GE-255 and GE-265 Time-Sharing Systems is shown in Figures 1 and 2.

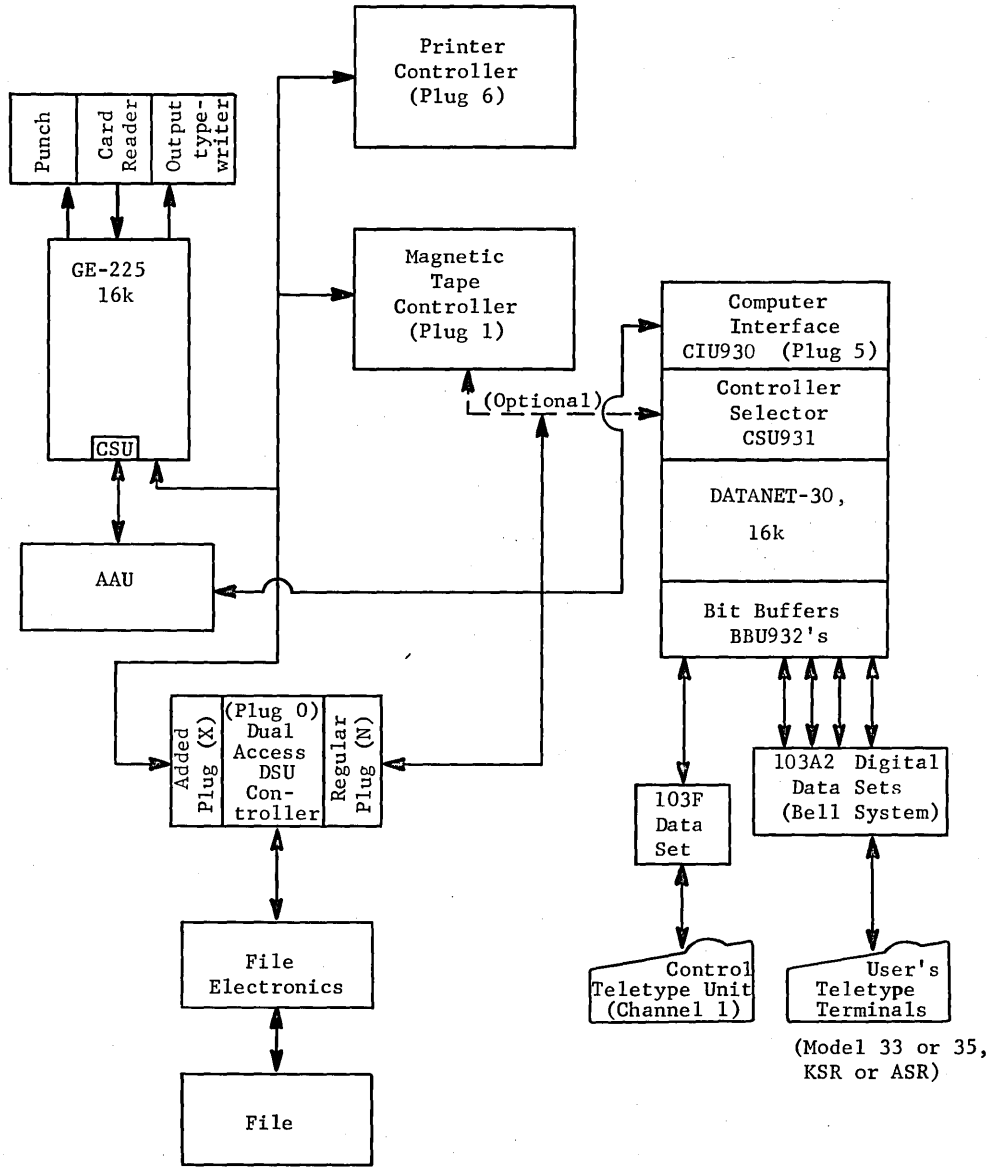


Figure 1. GE-255 Time-Sharing System Cabling

CPB-1455

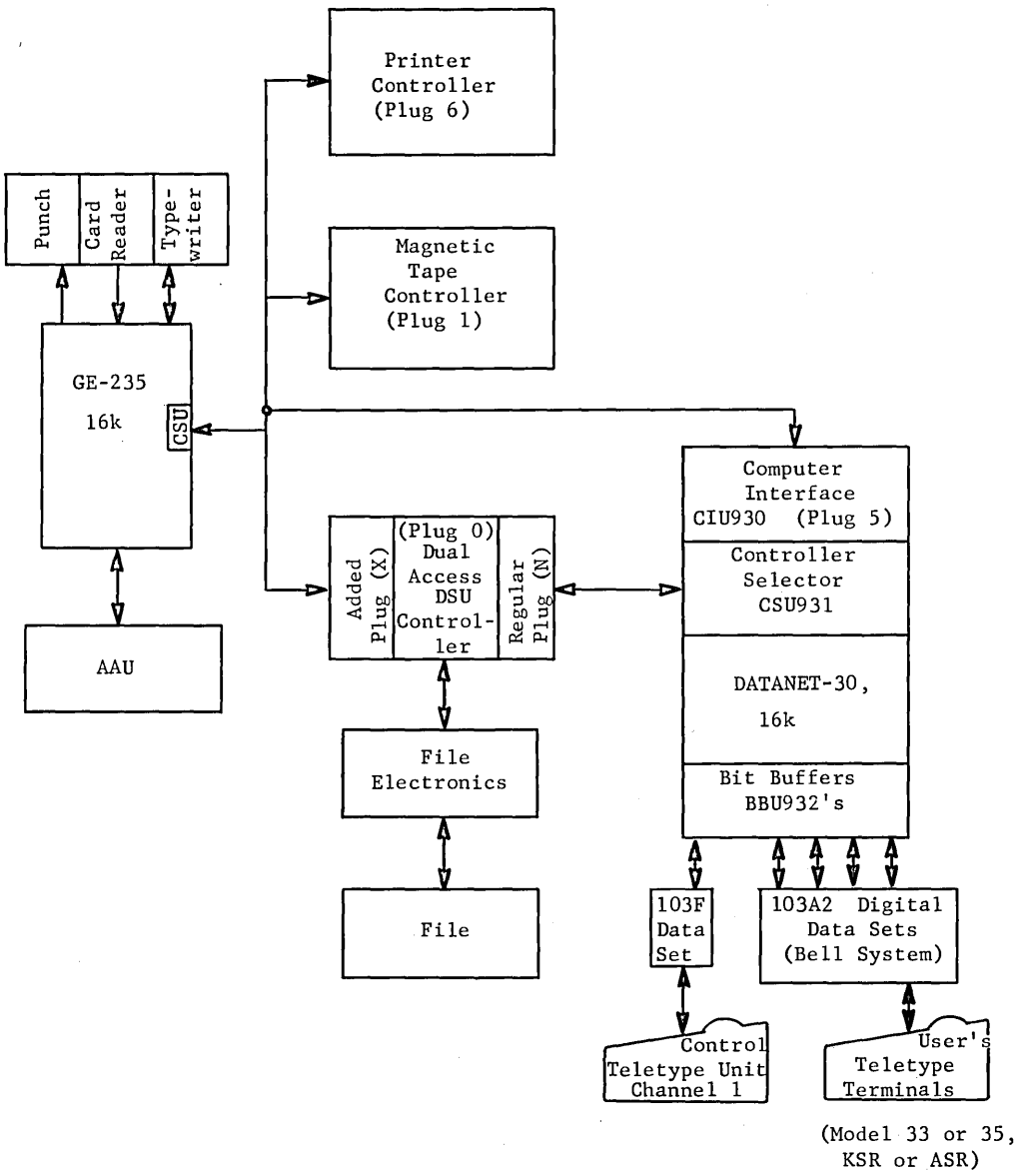


Figure 2. GE-265 Time-Sharing System Cabling

3. SOFTWARE SYSTEMS DESCRIPTION

PREFACE

The Executive system for GE-200 Series Time-Sharing is distributed between the DATANET-30 and the GE-225 or GE-235 computer. The DATANET-30 is the controlling part of the system. It interprets the system commands from remote terminal users and issues instructions to the GE-200 Series computer telling it to execute designated programs. Communication between the two processors is performed via the "Mailbox". This consists of certain locations in the GE-200 Series computer memory in which are stored coded messages sufficient to cause the proper action in either unit. The two units are necessarily in constant communication with each other, monitoring and announcing the progress of executing jobs, indicating status of disc units and other peripheral equipment, and establishing output buffer blocks in response to the remote terminal user.

GENERAL DESCRIPTION OF THE EXECUTIVE SYSTEM

Upon detection of the "carrier present" condition on one of the lines into the bit buffers, the DATANET-30 first answers the call, activates the answer-back drum, and then initiates the HELLO sequence. A user validation check is performed; this implies that the terminal from which a user is transmitting must be accredited and that his user number has been previously validated for that terminal. (The validation of terminal and users must have previously been performed via the control teletypewriter; refer to Chapter 5.) After the user has been granted access to the system, a specific area on the disc is assigned for his teletypewriter alone during the length of his connection.

When the user issues a RUN or EDIT system command to the time-sharing system, the DATANET-30 must turn the job over to the GE-225/235. In doing this, the DATANET-30 sends sufficient information to the GE-225/235 so that the program may be executed. The GE-225/235 storage area through which information is transferred is called the "Mailbox". It contains such information as the following:

- User Number
- Program Name
- Operating system name (BASIC, ALGOL, EDIT, etc.)
- Starting and ending disc address where the source program is located. (This is not the area on the disc where a program would have been SAVED, but a temporary area assigned on a teletypewriter number basis.)
- Code indicating the operation to be performed.

The DATANET-30 has the ability to interrupt the GE-225/235 so that the Executive may program, receive and process the message that has been placed in the Mailbox The GE-225/235 cannot interrupt the DATANET-30 when information must be returned to the DATANET-30. It merely places the message in the Mailbox and waits for the DATANET-30 to recognize it.

Upon command of the DATANET-30, the program that had previously been running in the GE-225/235 will be stored on the disc for later recall, and based on the information contained in the Mailbox, the execution of a new job will be initiated. The GE-225/235 is charged with the straightforward task of compiling and executing the user program. The GE-225/235 determines whether the correct operating system is currently in residence and if not, brings it in from the disc. If a new job has been initiated, compilation and execution will be begun. If an old (long-term running) job had been recalled, sufficient information exists on the disc to indicate from where the program should be resumed. In general, the DATANET-30 will issue a command to the GE-225 235 to dump the object program onto the disc in anticipation of another job. The job running in the GE-225/235 however, can initiate the termination of a program segment, as in the instance where it has generated a full output buffer or has requested real-time input. In either instance, the GE-225/235 Exec puts a message in the Mailbox indicating the desired action or recognition of a DATANET-30 command.

This system of swapping programs in and out of the GE-235 (time-division multiplex), will continue until a user signs off; it is the key to the time-sharing concept.

The DATANET-30 Executive

The DATANET-30 is a real-time computer that is designed to automatically receive and process information originated at locations remote to the computer. Because of its ability to communicate bi-directionally with remote equipment in real time, it is assigned the task of processing all information being received and transmitted by the entire time-sharing system.

The communications environment is full duplex, allowing simultaneous transmission and reception. The transmission rate is 110 bits per second. The Q-counter of the DATANET-30 is set to 8.606-millisecond interrupts by the DATANET-30 Exec; each time it counts down to zero, the program is interrupted and control is transferred to an interrupt routine. This routine initiates the hardware scan of the 20 or 40 Teletype lines in the GE-255 and GE-265, respectively.

Eight-level (ASCII) character code is used, with seven information bits per character. The receiving and transmitting is asynchronous in the sense that a character may be transmitted at any time with respect to all other characters. The line is normally standing by in a "1" state, called a "mark". To indicate the start of a character, the line is set to the "0" state, called a "space", for one bit time. To allow mechanical parts sufficient time, each character is concluded by at least two mark bits. Including the start and stop bits, eleven bit times are necessary to form a full character.

Since character recognition is the key to system operation, eleven interrupts must be processed before a character can be decoded. To optimize real-time processing, the work load is distributed over the eleven bit times; five teletypewriters are processed for each of eight bit times, with the other three being used to communicate with the GE-235 via the Computer Interface

Unit (CIU). Character recognition is done in real time via a conversion table. Lines are built until an end-of-line character (carriage return) is located, thus terminating the continuity of the accumulated character set. Other terminating characters are the "Control X", "escape", and "alternate mode", all used for the single purpose of line deletion. Other special characters are "rubout", "backspace", and "break."

The DATANET-30 Executive routine is divided into two areas; the real-time portion and the spare-time portion. As noted above, approximately every nine milliseconds a hardware interrupt breaks the processing of spare-time tasks.

The real-time routine is concerned with those processes that are necessarily synchronous; that is, the scan of teletype lines and the communication with the GE-235 via the CIU. The real-time routine devotes only the necessary amount of time to servicing those functions. For those functions that can be performed asynchronously, for example disc input/output, spare-time tasks are established which can be performed at an indefinite time. These tasks are set into a circular table and exhibit no priority properties; therefore, they are executed in a sequential manner.

In the spare-time task portion, once per second the state of the telephone lines is investigated and a status level is established for each line. This constant monitoring yields the recognition of new dial ups and sign offs and also provides the monitoring service which disconnects a user if his line has been idle for an extended period (e.g., ten minutes).

Within the real-time executive portion, processing is divided between teletypewriter and GE-225/235 communication.

Input and output characters are recognized as being on line by the status of the scan words. The output routine is entered by the detection of bit 18 set in scan word 2. This routine gets the next character to be transmitted and converts it from a machine oriented BCD character to teletypewriter (ASCII) format and transmits it.

Since communication is full duplex, it is also necessary to check scan word 3 for input recognition, even if output is being performed. The input routine decodes the character that is on line; and, in the case of nonspecial characters, places it in its appropriate location in the input buffer area. Certain characters need immediate response, such as backspace and line delete, but the carriage return causes the most work. The carriage return indicates the completion of a line of input which could either have been a program source statement (to be recognized by a digit or a space digit as the first character) or a system command. If a program source statement has been transmitted, it is placed in the input buffer for future use. System commands are immediately decoded and a spare-time task is established to initiate the action necessary for that command. These tasks are the low level portions of job execution and provide the impetus to get the job going. In the case of HELLO, it will set up the typeout: USER NUMBER.

Also handled during the teletypewriter communications sequence are the commands received via the command teletypewriter: WARN, DIAL, and MONITOR. (Refer to Chapter 4.) The loop under which the above-mentioned routines are executed is performed for each of five teletypewriters, depending on the bit cycle. When these teletypewriters have been serviced, real-time execution is abandoned and program control is returned to the instruction at which the last operating spare time task was interrupted. Sufficient information is retained (addresses and critical registers) so that continuous operation can be carried on. On the three cycles during which no teletypewriter communication is done, the DATANET-30 communicates with the GE-235 via the CIU.

The concept allowing the execution of time-sharing is that the DATANET-30 systematically monitors the progress of all jobs it has logged in and establishes a schedule of job execution based on the following algorithm. There are six priority levels:

- Level zero is reserved for retrieving OLD programs
- Level one for LIST
- Level two for SAVE
- Level three for real time input
- Level four for initial RUN
- Level five for continued RUN and Background

The first three levels are guaranteed full access to the GE-225/235. They will not be interrupted by any other job until full execution of the task has been performed. Level three, real time input, is established by the executive when the operating system has requested data. The promotion to priority to level three expedites response time to the user.

When a run is initiated the job is assigned to priority four. The first time the operating system creates output data, the run priority is bumped to level five, continued RUN. This provides faster reaction to new RUN jobs than to continued ones.

Level four and five jobs are broken into three queues:

- Two allotments through queue zero at three seconds apiece
- Five allotments through queue one at six seconds apiece
- An indefinite number of allotments through queue two at twelve seconds apiece.

This scheduling algorithm provides that for any set of jobs at a given time, assignment to the GE-225/235 will be at level one, first, level two, second, and level three, third. Jobs in level four and five will be assigned based on queue; queue 0 first, queue 1 second, queue 2 third. The schedule also accounts for allotments. During any given pass through the queue table, all jobs must be processed and none may be processed twice; therefore, a level four queue zero job (3 seconds) cannot be assigned twice before a level four queue two job (12 seconds). However, the insertion of a higher priority job at any time will cause it to be executed immediately. When a job is logged out of the GE-225/235 the entire job table is again scanned on a priority basis. If, during the execution of a priority five job, a LIST is called for, the Exec would drop down to level one before returning to the next proper level five job. Background jobs requested via the GE-225/235 are also assigned to priority level five and are allotted eighteen seconds per assignment.

Normally, based on the above scheduling system, the DATANET-30 determines when the resident program in the GE-225/235 has had its share of time, and it sets up a command to the GE-225/235 to dump the current program. There are some cases, however, where the GE-225/235 initiates this request, as in the case where a job has terminated or an output buffer is full and must be dumped, or where real-time input is necessary. Since the DATANET-30 has complete command of the disc and knows its status, the GE-225/235 must request the DATANET-30 to grant access to the disc for dumping. All these communications are made via the Mailbox in the CIU routine portion of the real-time executive program.

The key to the execution of the CIU routine is the Mailbox. This fourteen-word group of memory cells provides the sole means of message transmission between the DATANET-30 and the GE-225/235. The Mailbox is a two-way carrier and thus it is important that both the DATANET-30 and the GE-225/235 acknowledge the receipt of messages from the other unit. There are two sections in the Mailbox, the regular Mailbox which monitors the progress of the currently running job in the GE-225/235, and the special Mailbox which is concerned with tasks requiring communication with peripheral equipment. The status of the GE-225/235 disc operations is transmitted through this link. Since the DATANET-30 has complete control of disc operations, disc status reporting by the GE-225/235 is of significance.

The first word in the regular Mailbox is a message from the GE-225/235 indicating an action that it has performed either in response to an earlier DATANET-30 message or a request from its own operating system. The message from the GE-225/235 is one input which determines the next operation in the DATANET-30. The other input is the status of the job in the DATANET-30. There are six status levels.

Status 1 - OLD
Status 2 - LIST
Status 3 - SAVE
Status 4 - Initial RUN
Status 5 - Continued RUN
Status 6 - Batchmode (Background)

Progress through the first three levels can only be made by issuing system commands. The DATANET-30 Executive controls the progress from initial RUN (which is started by the system command RUN) to continued RUN. Batchmode status is achieved via a Start Batchmode message in the special Mailbox from the GE-225/235. During the period of time in which a job is resident in the GE-225/235 and no special action has taken place the message in use will be a zero. For all status levels, message zero from the GE-225/235 causes the DATANET-30 to check the amount of time the job has used. If the job has run out of time, a dump message is transmitted to the GE-225/235. After a return message is received from the GE-225/235 indicating that the dump has been performed, the scheduling algorithm will be invoked to determine the next assignee.

Of course, there will be periods of program execution during which nothing of note is occurring. In this instance, the GE-225/235 would send a null message and the DATANET-30 would investigate the time allotment status for the program. When the appropriate action has been taken, the return message is transmitted to the GE-225/235 indicating its future action. The result of the message translation might indicate that the resident program in the GE-225/235 has run out of time or has decided to give it up, and that, therefore, the next assignee must be determined. It is at this time that the scheduling algorithm is entered, after which control is returned to the interrupted spare-time task.

The spare-time task portion of the DATANET-30 Executive program scans the spare-time task list and transfers control to the appropriate subroutine. The task list has been built on a first come-first serve basis, and is closed loop end-around. All tasks are guaranteed that their execution will be attempted in the order in which the tasks were inserted. If a task cannot be executed, as, for example, because of nonavailability of the disc, then that task is left in the table for future execution.

A task that is completed is deleted from the table. The spare-time portion of the Executive will continue to execute each task in succession until the Q-counter counts to zero, at which time it will be interrupted, so that real-time tasks may be executed. Return will be made to the appropriate area, however, when the spare-time portion is next called upon.

As previously mentioned, one of the spare-time tasks is a routine that checks the status of the telephone lines every second. When a connection has been terminated, the amount of terminal time, that is the length of time the user has been connected to the time-sharing system, is put out on a billing record on the disc (a word in the validation program). This information, together with the accumulated CPU time that is accounted for by the GE-225/235, provides information for billing customers.

GE-225/235 Executive

The major function that is performed in the GE-225/235 is the compilation and execution of the DATANET-30 assigned programs. Adjunct functions are the execution of background and API programs.

The nature of the GE-225/235 Executive program is similar to that of the DATANET-30. There is a real-time portion and a spare-time portion, which like the DATANET-30, is made up of a list of functions that have previously been set up. (The number of tasks which may be entered in this task list is considerably less than in the DATANET-30.)

If no tasks exist in the task table, the GE-225/235 enters a wait routine displaying a systematic count in the A-register. Upon receiving an interrupt from the DATANET-30, peripheral equipment, or a GE-225/235 self-generated interrupt, control is transferred to the interrupt routine.

The GE-225/235 operates in the Automatic Priority Interrupt (API) mode. The API mode allows the GE-225/235 to recognize and process external interrupts. When the interrupt is received, the API mode is disabled and must be reset via program means. The GE-225/235 will not reset API until it is assured that it has performed a sufficient amount of the program under the protection of the lockout. When the proper functions have been accounted for, API can be reset and DATANET-30 and peripheral equipment interrupts will again be accepted. During the time that the GE-225/235 is not receptive to DATANET-30 or peripheral equipment interrupts, they are saved by hardware means, so that all succeeding interrupts will be recovered.

An interrupt may mean that the DATANET-30 has a message for the GE-225/235. It may also mean that a peripheral device needs servicing or that the GE-225/235 has interrupted itself to get an important function performed. In the case of a DATANET-30 interrupt, the message may be a null message requiring no significant action to be taken by the GE-225/235 program. The information contained in the Mailbox is the key to the operations in the GE-225/235. Since the GE-225/235 changes the contents of the Mailbox for return messages, the entire DATANET-30 Mailbox is saved and is used as the reference for tasks. When the DATANET-30 puts a message in the Mailbox, the GE-225/235 Executive sets Mailbox word zero to zero to acknowledge receipt of the message and then proceeds to decode the rest of the message.

The functions of the Mailbox words are described in Appendix A. Both the message transmission from the DATANET-30 to the GE-225/235 and the reverse is described. Also described are the messages sent from the GE-225/235 to the DATANET-30 via the special Mailbox. These messages are concerned with tasks requiring peripheral equipment.

Mailbox word zero contains a value (0 through 9) that is the direct informant as to the function to be performed. The remaining words in the Mailbox indicate such things as the system name, starting and ending disc location for the object program, and the user and problem number. Regardless of the command received from the DATANET-30, the procedure for each message is similar. The appropriate actions are initiated, based on the Mailbox contents, and the necessary responses to the DATANET-30 are put in the Mailbox by the GE-225/235.

The program action that follows this is a function of messages which are described below.

A summary of the messages follows:

Message 0: Edit (update) the source program.

Message 1: Start program compilation and execution in the GE-225/235.

Message 2: Resume compilation or execution.

Message 3: Dump a GE-225/235 job onto the disc.

Message 4: The GE-225/235 is to read a source program into 2k memory area.

Message 5: The GE-225/235 is to write the contents of 2k memory onto a standard teletype working area of the disc. The 2k area starts at 6000_8.

Message 6: Unused.

Message 7: Start or continue batchmode processing in the GE-225/235.

Message 8: Unused.

Message 9: Stop batchmode processing in the GE-225/235.

Descriptions of the messages and the activities that occur in the GE-225/235 as a result follow:

Message 0 causes an edit of the source program on a run, save, or list command which reorders statements according to line number. The source program is read from the standard disc teletypewriter area, edited in the GE-225/235, and rewritten onto the disc. The actual disc writing is accomplished by setting up a priority entry task in the task list and going to the wait routine to await the next interrupt. At the head of the task list is a priority entry. A task set at that level is guaranteed execution at the next interrupt. In some cases, after a priority task has been established, the GE-225/235 will set up an interrupt itself which will cause transfer of control to the interrupt routine when API mode is again reset.

Message 1 starts program compilation and execution in the GE-225/235. A check is made to see if the appropriate operating system is in the computer, and if it is not, the correct one is brought in. The starting time is noted for future billing purposes and control is transferred to the operating system. There is a standard convention concerning the heading of all operating systems and the second word always contains a branch to the first logical instruction in the system. Prior to transferring control to the operating system, the API mode is reset so that the system execution can be interrupted by a subsequent interrupt. At any time that either a system or a spare-time task is interrupted, sufficient information is stored so that normal execution can be picked up at the appropriate time.

Message 2 indicates to the GE-225/235 Executive that a program that had previously made progress in either compiling or execution is to be returned to continue operation. Since it is no longer in the GE-225/235 memory, it must be read in from the teletypewriter 6k disc area; and, if necessary, the operating system and/or overlays must be read in. Control is then returned to the location at which the program had been interrupted and operation continues in the API mode.

Message 3 initiates a dump onto the disc in the GE-225/235. There are three causes for disc dump: terminal exits, intermediate output, and real-time input. The terminal exit is a special case in which the DATANET-30 tells the GE-225/235 to summarize the current job. The final times for billing are established and the output area is transferred to the teletypewriter dump area for transmission to the user. The messages are put in the Mailbox for the DATANET-30 and control is transferred to the spare-time task list. If the dump was for either intermediate output or real-time input, the GE-225/235 Executive must save all appropriate registers, collect the running time for the last portion, and set appropriate trapping flags for the continue status. API mode is reset and a priority task is set up for a routine to perform the billing functions and write the working area onto the disc. The billing routines put out a twenty-four word record onto magnetic tape every time a dump is called for. This dump includes the DATANET-30 Mailbox and time words indicating the starting and ending time for a run. (This tape will be used later by the off-line billing package. Refer to Chapter 11.) After the appropriate messages are set up for the DATANET-30, control is transferred to the task list.

Message 4 indicates a command from the DATANET-30 to read a variable length source program from a specified address into the 2k area of GE-225/235 memory. The messages are set into the Mailbox for the DATANET-30 and control is transferred to the task list.

Message 5 is a command to write a variable length source program onto a specific teletypewriter standard disc area from the 2k area of GE-225/235 memory. After the DATANET-30 message is set up, control is transferred to the task list.

Message 6 is unused at the present time.

Message 7 causes batchmode processing to be initiated or continued in the GE-225/235. This requires that the Background Executive be loaded into the GE-225/235 if it was not in, and control transferred to it. Before this transfer, the API mode is reset.

Message 8 is unused at the present time.

Message 9 causes batchmode processing in the GE-225/235 to be terminated, either permanently, or until it is next reassigned. The entire background system is dumped onto the disc for future recall and a load of the GE-225/235 Executive system is executed. Control is then transferred to the wait routine.

As indicated in the discussion of the commands received from the DATANET-30, tasks that would delay the processing of interrupts and that are not immediately necessary to be performed are set into a task list to be executed at some subsequent time. There is another way in which this list can be processed other than the ones mentioned above. In the interrupt routine when it is recognized that the DATANET-30 has put no message on line, transfer is immediately made to the task list, with the priority item being executed first. As each task is performed it is erased from the list. At any time that the list execution has been exhausted, one more area must be checked before control can be transferred to the last interrupted program.

Several commands to the system can be made via the console typewriter which initiate background or API programs. Background programs are discussed in Chapter 7. Basically, they are assigned by the DATANET-30 and are operated on as a priority level six jobs. There is a background operating system that is called in when needed.

API programs are executed only during the protective lockout when no interrupts can be received by the GE-225 or GE-235. When the Executive is interrupted, the N-register is tested for a character on line. If input is coming from the card reader on the GE-225, the characters are collected and held for decoding. If the input is coming from the console typewriter on the GE-235, the characters are collected until an upper case period (ǂ) is found. The command is then decoded via a translation table. The appropriate GE-225 or GE-235 program overlay is called in, if necessary, and execution of the routine is begun.

Since API programs all require peripheral equipment, the status of the equipment must be checked for availability. When a peripheral unit is available, the function is performed. If the peripheral unit is unavailable, the routine is exited. Prior to exit, however, a spare-time task is set up to allow continuation of the API program at some later time. Because the peripheral equipment furnishes interrupts, these programs may be executed in the GE-225/235 while a DATANET-30 designated program is being executed.

There is no conflict of interests and little time is taken from the executing program. Only one API program may use the facilities at a time and no billing procedures are provided.

CATALOGS

Programs stored on the disc are not identified by user number, but by disc address, based on program length and available disc storage. There is no descriptive material such as user number or program name included with each program. The key to this storage scheme is the "catalog". Each user has a listing, the catalog, of his programs, and there is an entry for each one. Sufficient information is included in the catalog entry to locate the program on the disc. When a program is first created, a catalog entry is made and then the actual program is put on the disc. A program is removed from system operation by deleting the user number and problem name in its catalog entry and inserting fill characters.

The catalog entry for each program is eight words long:

Word No.	Use
1	User Number (most significant half)
2	User Number (least significant half)
3	Program Name (most significant half)
4	Program Name (least significant half)
5	Starting disc address
6	Ending disc address
7	Coded date
8	Length flag = 0 64 word program (or less) 1 128 " " 2 256 " " 3 512 " " 4 1024 " " 5 2048 " "

User numbers must be of the general form Nxxxxx or xxxxxx where N is any letter and x is any digit. The user number 000000 is illegal. The third and second digits (in that order) define the "equivalence class" to which the user belongs. The catalog for each equivalence class has a fixed location on the disc. (Refer to Chapter 9.)

Therefore, based on its equivalence class, the catalog for any user can be located. There are one hundred equivalence classes and each can contain 127 catalog entries within the specified area on the disc. If more than 127 programs are created in any equivalence class, the excess catalog entries will be located at some other location. In this case, the last entry in the standard catalog is a link to the area where the catalog is continued.* There is no limit to the number of programs that can be assigned to an equivalence class. In addition to the user-created entries in the catalog, a validation program for each user number in an equivalence class is created. This program has the unique program name of octal sevens (fill characters). On the daily catalog printout, the validation record for each user can be recognized by an entry with a blank program name.

Any program that is created is classified according to its length; a flag indicating this length is maintained as part of the catalog information for each program entry. The time-sharing environment is one in which programs are constantly being created and destroyed. If programs were only added to the system there would be little bookkeeping problem in assignment of new

*Word two of the 128th catalog entry is equal to 373737_8 and word one is the disc location where the catalog is continued.

program area. However, because of the finite size of the disc storage, it is necessary to remove unneeded programs from the system. It is also desirable to reserve for a program only the amount of storage it needs, therefore, the six sizes of program allocation. These two factors lead to a set of pointers indicating the location of the next available block for each size program. These pointers are part of a sixty-four word block of information that is written out on the disc each time one of the pointers change. The system can best be described by following the action caused by calling out an old program and then by saving one.

All action concerning catalog functions is performed in the DATANET-30. When an OLD program is called out, the DATANET-30 does a table look-up to find the disc address for the catalog corresponding to the equivalence class of the user number.

The catalog is searched for user number and program name match. If the program cannot be located, the system will type out PROGRAM NOT SAVED on the user's teletypewriter. If it is located, the standard disc address is calculated, the new coded date is inserted into the catalog, and it is rewritten onto the disc. Status level one is established so that on a subsequent CIU cycle, the procedure to move the program to the standard teletypewriter area will be processed.

When a program is to be saved, the procedure becomes more extensive. The appropriate catalog is searched for user number and program name. If the two-part match is made, a program with the new name already exists. The new program length is checked with the coded length of the existing program. If they are the same, the new program will eventually replace the old one at the same place on the disc, the coded date is updated, and the catalog and program are written on the disc. If the new program is of a different length, the existing program is unsaved and a search for storage goes on.

At this point, the action is the same whether a new program is being created or an old one is being updated. The catalog is searched for a hole, that is, an area where at one time there was an entry, which has since been "unsaved." The user number and problem name are destroyed on an UNSAVE, but disc storage availability information is retained. When a hole is found, the length associated with that hole is compared with the new program length. If they are equal, the program is entered into that catalog slot and the program saved in the existing area. If no holes exist, or all program sizes are inappropriate, then the catalog scan goes on until an end of file is found. At this point a new entry into the catalog must be made, followed by a new end of file.

The disc location for storage of a program will be determined according to the program length. Each of the six program lengths are assigned continuous blocks of two thousand words. For each length, there is a pointer indicating where the next program is to be stored. These pointers are incremented by the program length each time a program is stored. Checks are made for disc location discontinuity, catalog bands, and scratch areas. Where an entire 2k is used up for a particular length, a new area is assigned. This system allows for the most flexibility in filling in programs up to the above mentioned limits. The six size levels for programs also provide for a very efficient storage allocation system. After all this is done, the DATANET-30 instructs the GE-225/235 to edit the program (if necessary) and place it on the disc at the now-determined address.

Unsaving a program merely replaces its user number and program name in the catalog entry with fill characters (octal 77). All other catalog information remains and the program remains on the disc. This program area on the disc can be used again only if another user in that particular equivalence class wants to save a program of exactly the right size.

When a user is removed from the system (via the UNCREATE routine), his validation program entry in the catalog is removed. All of his program entries and programs, therefore, still exist.

The disc blocks to which the various length programs are initially assigned are as follows:

Size	Words	Disc Address
0	64	52000 - 52076
1	128	52100 - 52176
2	256	52200 - 52276
3	512	52400 - 52476
4	1024	52500 - 52576
5	2048	52600 - 52676

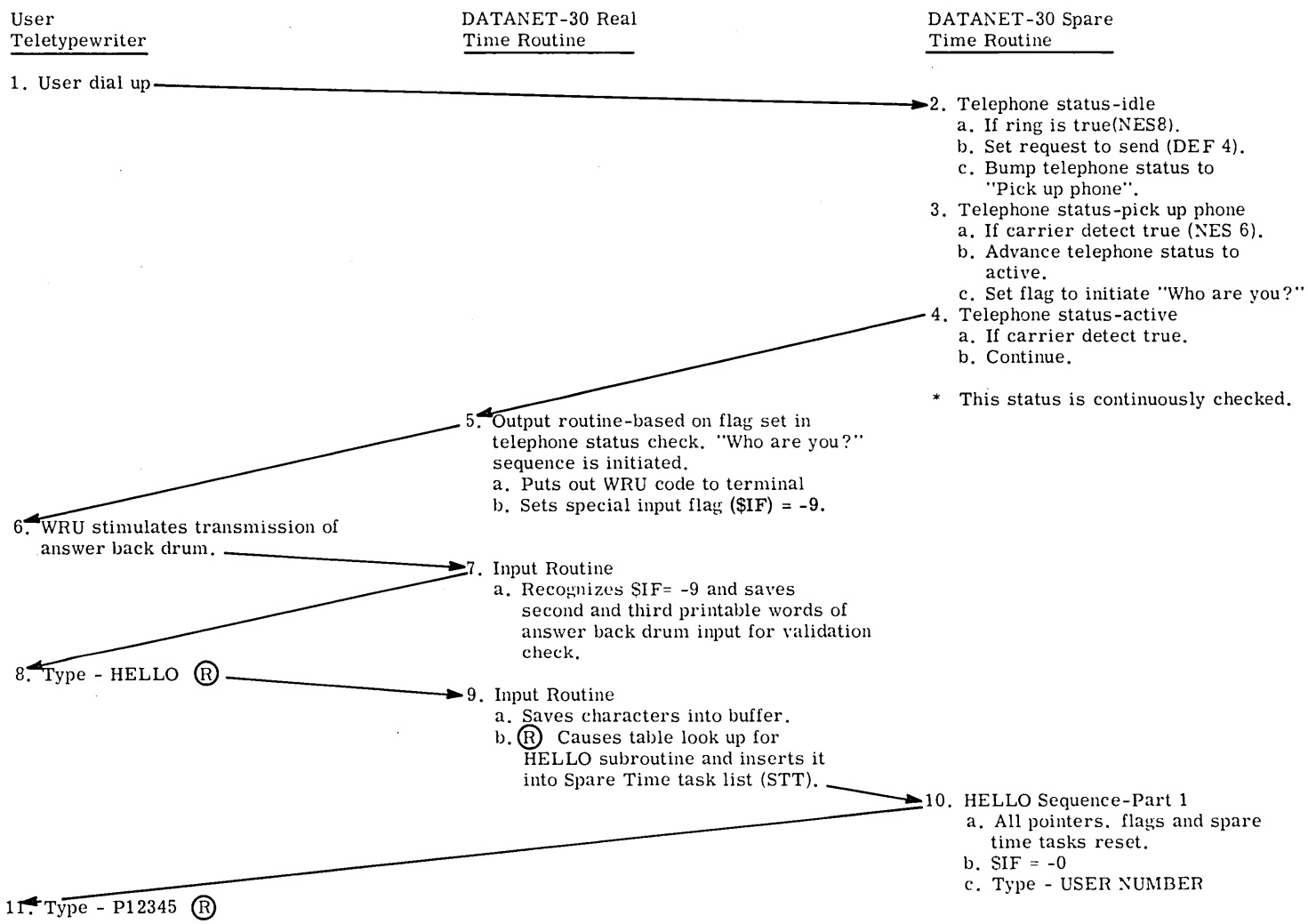
Figure 2 outlines the initial processing from user dial-up through the terminal processing which follows the internal processing of the system command. Figures 3 through 9 outline the internal progress of system commands: OLD, LIST, SAVE, EDIT and RUN through the DATANET-30 and the GE-225/235.

Abbreviations used in these diagrams are as follows:

TTY 3k area = area on disc to which a saved program is relocated when a user calls it into the system.

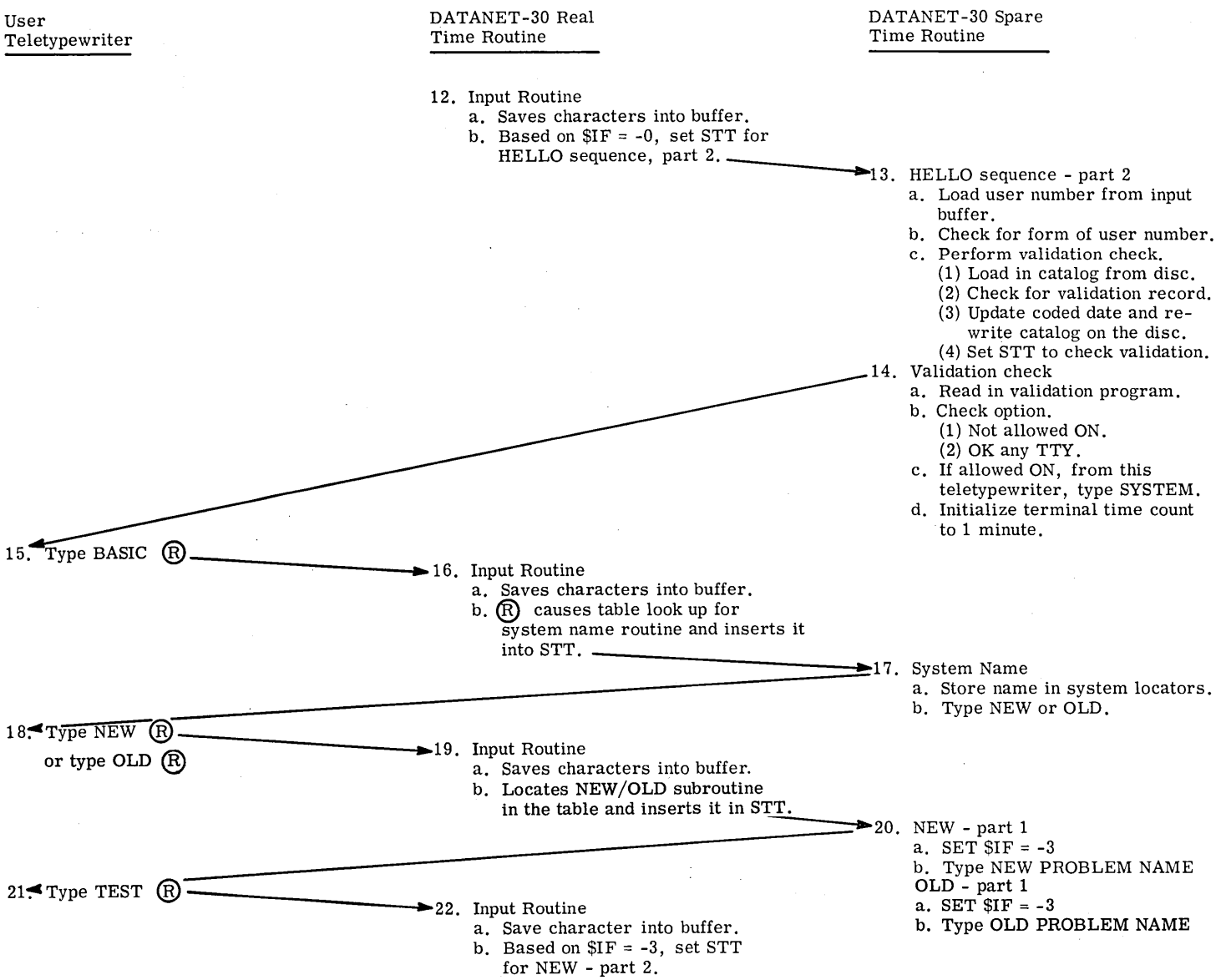
TTY 6k area = area on disc where operating system in GE-225/235 saves executing program and system information when it is swapped out.

SDA = starting disc address
EDA = ending disc address
MSH = most significant half
LSH = least significant half
I/O flag = intermediate output flag



Ⓡ indicates depression of the return key.

Figure 3. Initial DATANET-30 Sequence Processing Diagram


User Teletypewriter
DATANET-30 Real Time Routine
DATANET-30 Spare Time Routine
12. Input Routine
a. Saves characters into buffer.
b. Based on $IF = -0, set STT for HELLO sequence, part 2.
13. HELLO sequence - part 2
a. Load user number from input buffer.
b. Check for form of user number.
c. Perform validation check.
(1) Load in catalog from disc.
(2) Check for validation record.
(3) Update coded date and re-write catalog on the disc.
(4) Set STT to check validation.
14. Validation check
a. Read in validation program.
b. Check option.
(1) Not allowed ON.
(2) OK any TTY.
c. If allowed ON, from this teletypewriter, type SYSTEM.
d. Initialize terminal time count to 1 minute.
15. Type BASIC (R)
16. Input Routine
a. Saves characters into buffer.
b. (R) causes table look up for system name routine and inserts it into STT.
17. System Name
a. Store name in system locators.
b. Type NEW or OLD.
18. Type NEW (R)
or type OLD (R)
19. Input Routine
a. Saves characters into buffer.
b. Locates NEW/OLD subroutine in the table and inserts it in STT.
20. NEW - part 1
a. SET $IF = -3
b. Type NEW PROBLEM NAME
OLD - part 1
a. SET $IF = -3
b. Type OLD PROBLEM NAME
21. Type TEST (R)
22. Input Routine
a. Save character into buffer.
b. Based on $IF = -3, set STT for NEW - part 2.

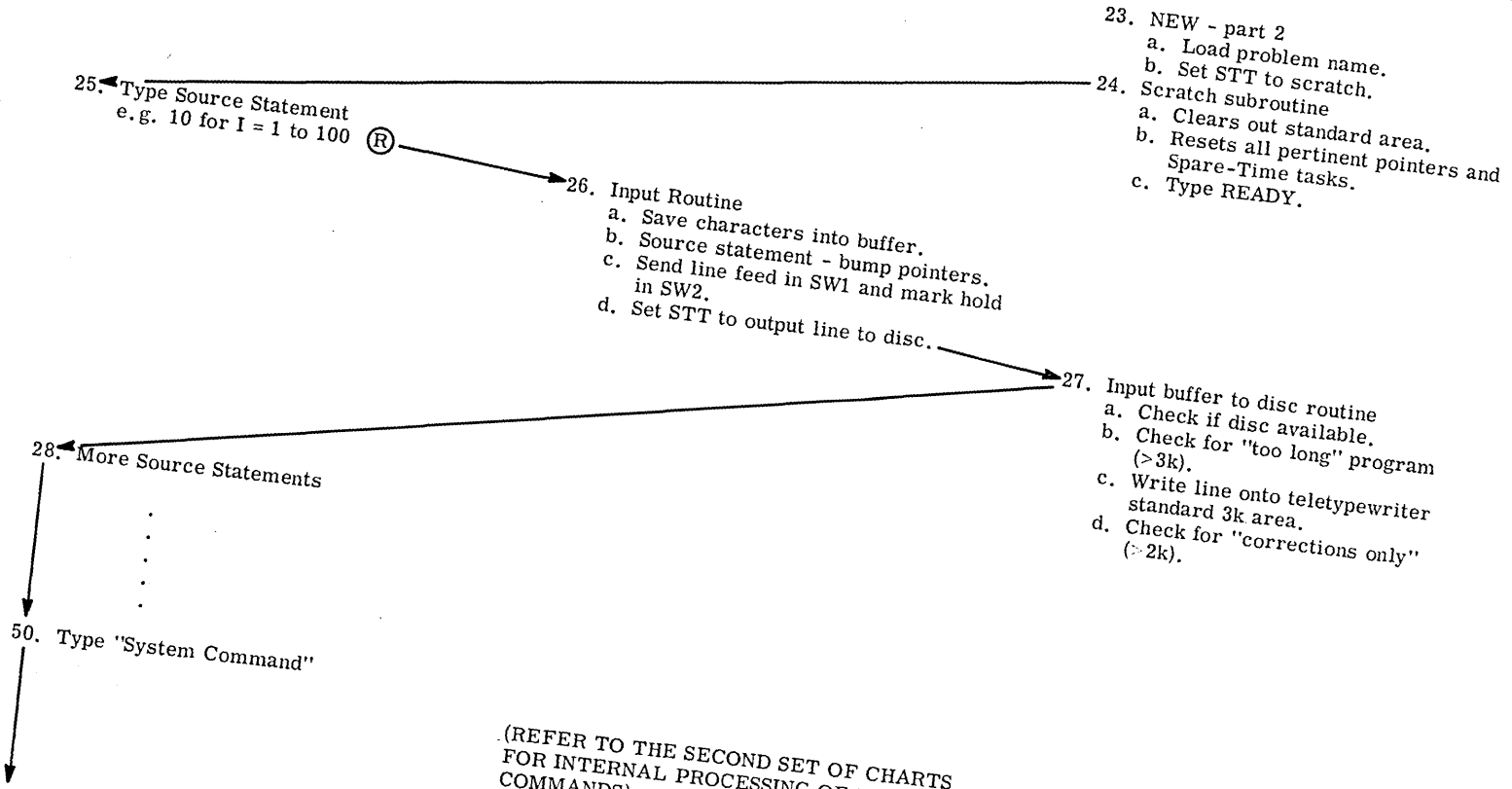
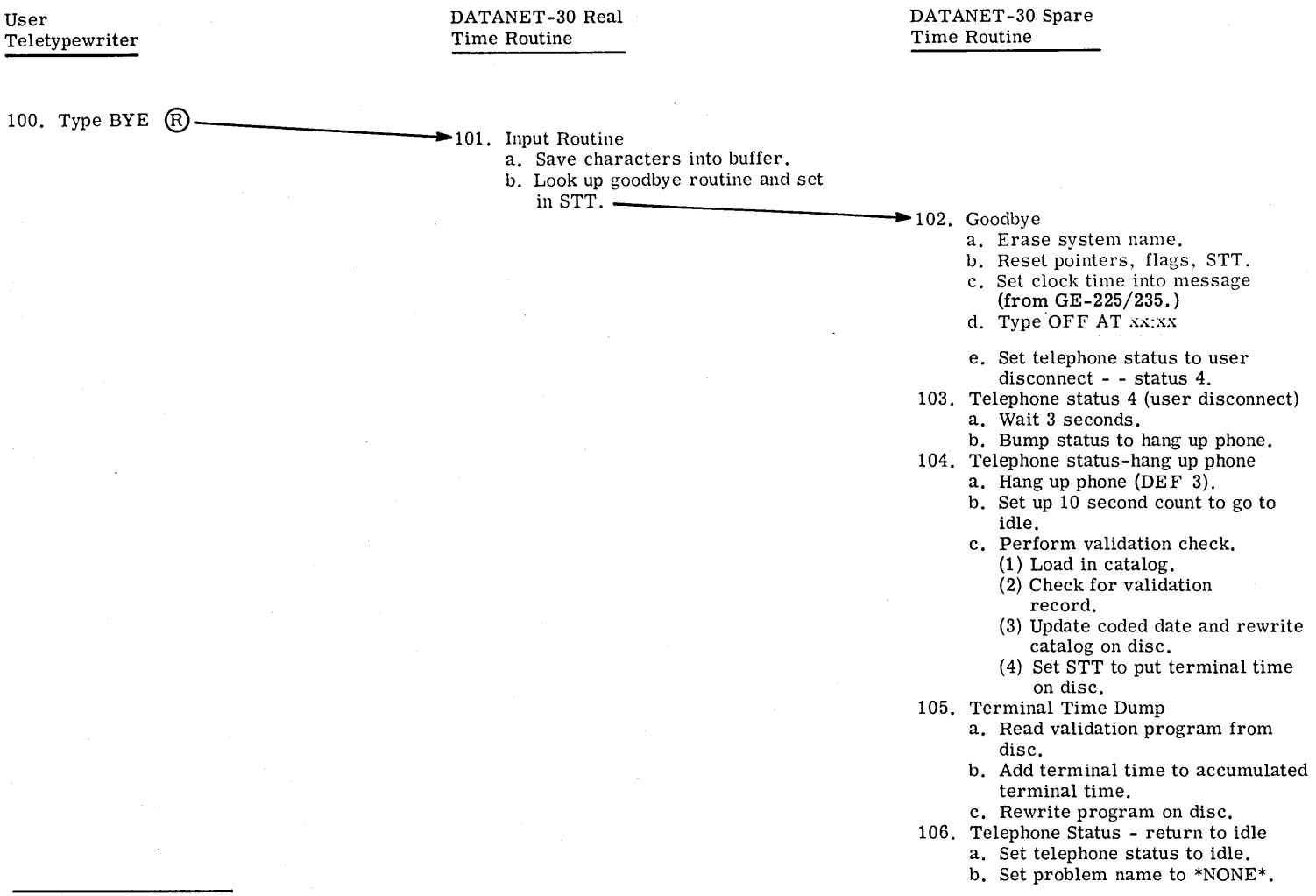


Figure 3. Initial DATANET-30 Sequence Processing Diagram (cont'd.)



Ⓡ indicates depression of the return key.

Figure 3. Initial DATANET-30 Sequence Processing Diagram (cont'd.)

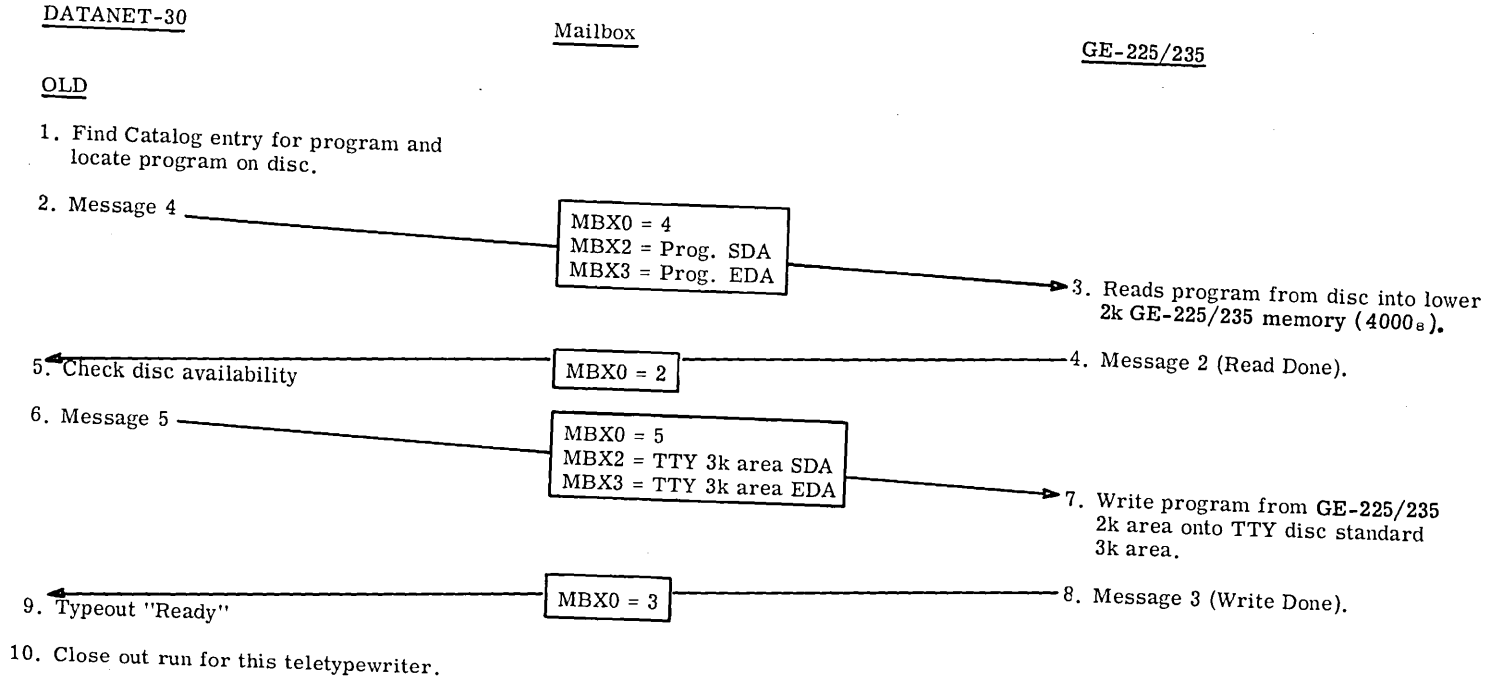


Figure 4. Internal Processing of OLD

DATANET-30 | Mailbox | GE-225/235

LIST

1. STT from command - LIST
   a. If no corrections, set STT to dump program from standard TTY 3k area on disc to TTY. Go to 6. (No communication with GE-225/235)
   b. STT from command - LIST If no corrections, set up List status.
2. If selective List, set line no. for EDIT and force an EDIT Message 0 → 3. (See EDIT)

MBX0 = 2
MBX1 = 2 x prog. length
MBX2 = TTY 3k area SDA

4. Message 2 (Read Done)

5. Setup STT to dump from standard TTY 3k area on disc to TTY.
6. Close out run for this TTY.

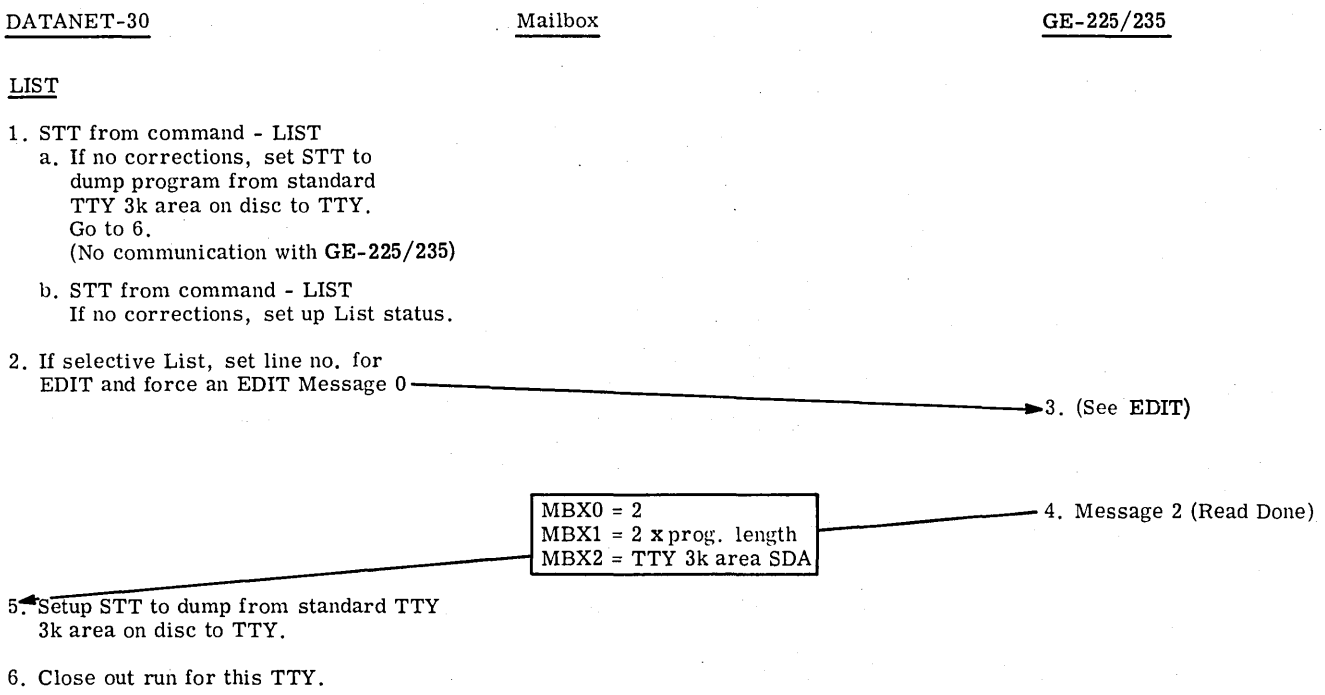


Figure 5. Internal Processing of LIST

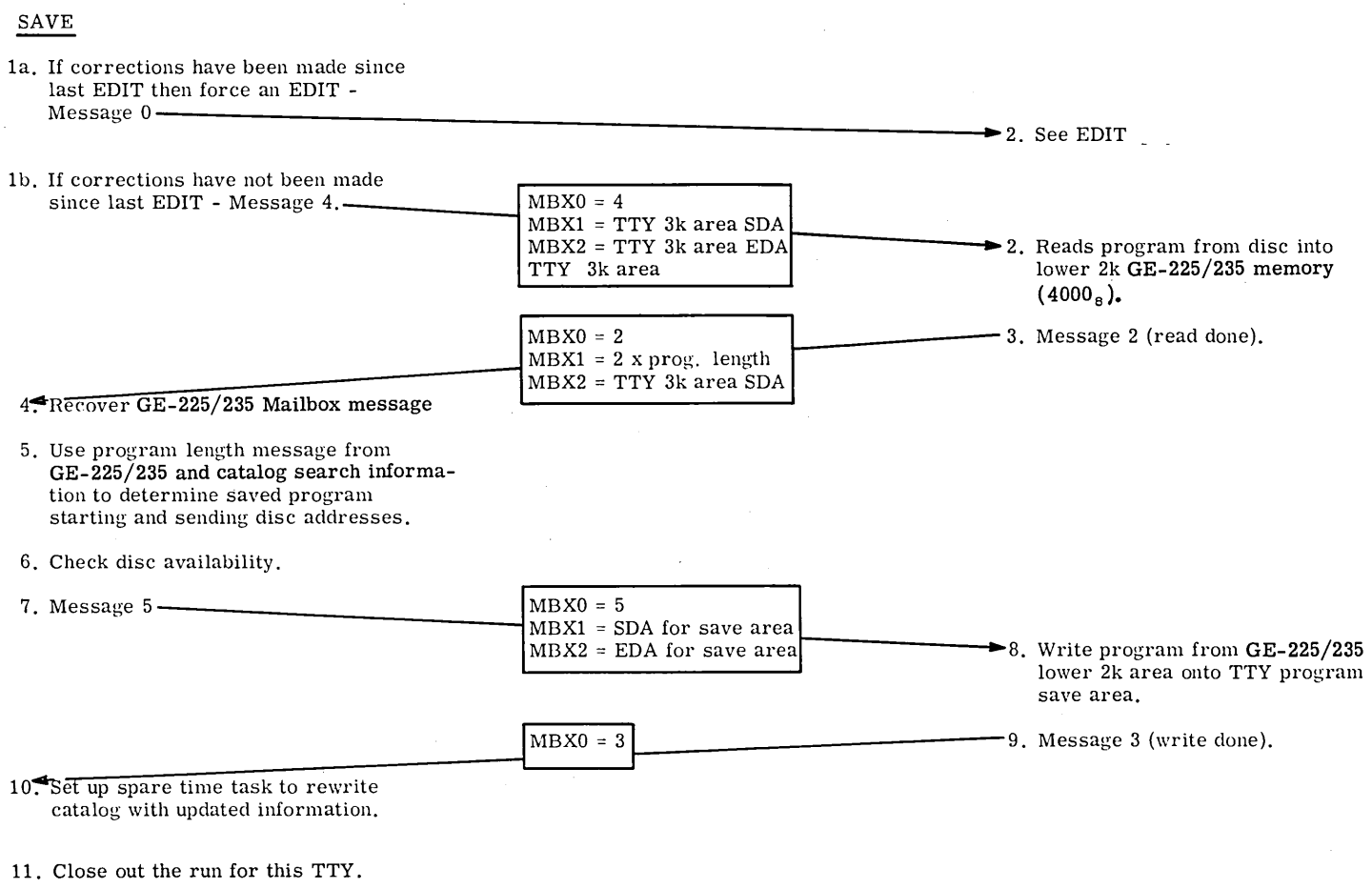
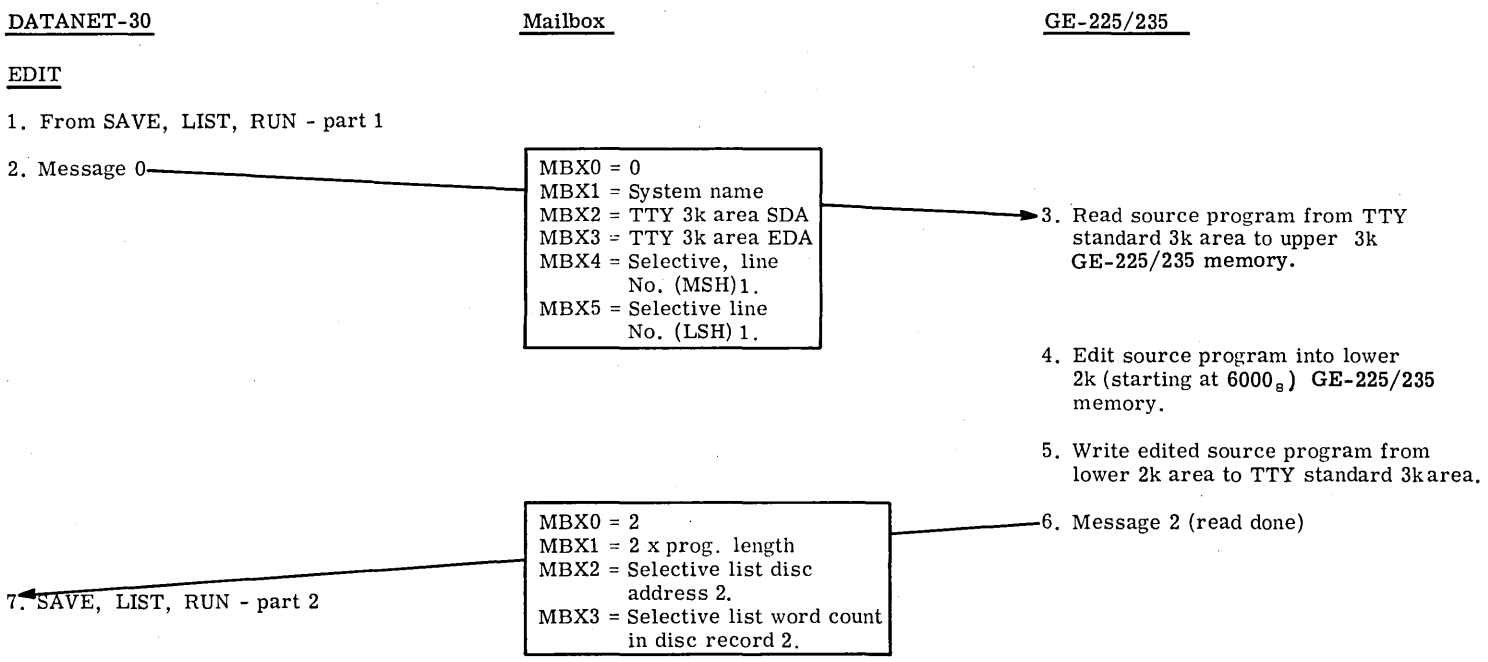


Figure 6. Internal Processing of SAVE



Note: 1. Selective line number is transmitted only if a selective LIST, e.g. LIST -- 200, request was made. On SAVE and RUN, MBX4 and MBX5 = 0.
2. Returned only on a selective LIST Edit; locates the correct area on the TTY 3k standard and area at which LIST should be initiated.

Figure 7. Internal Processing of EDIT

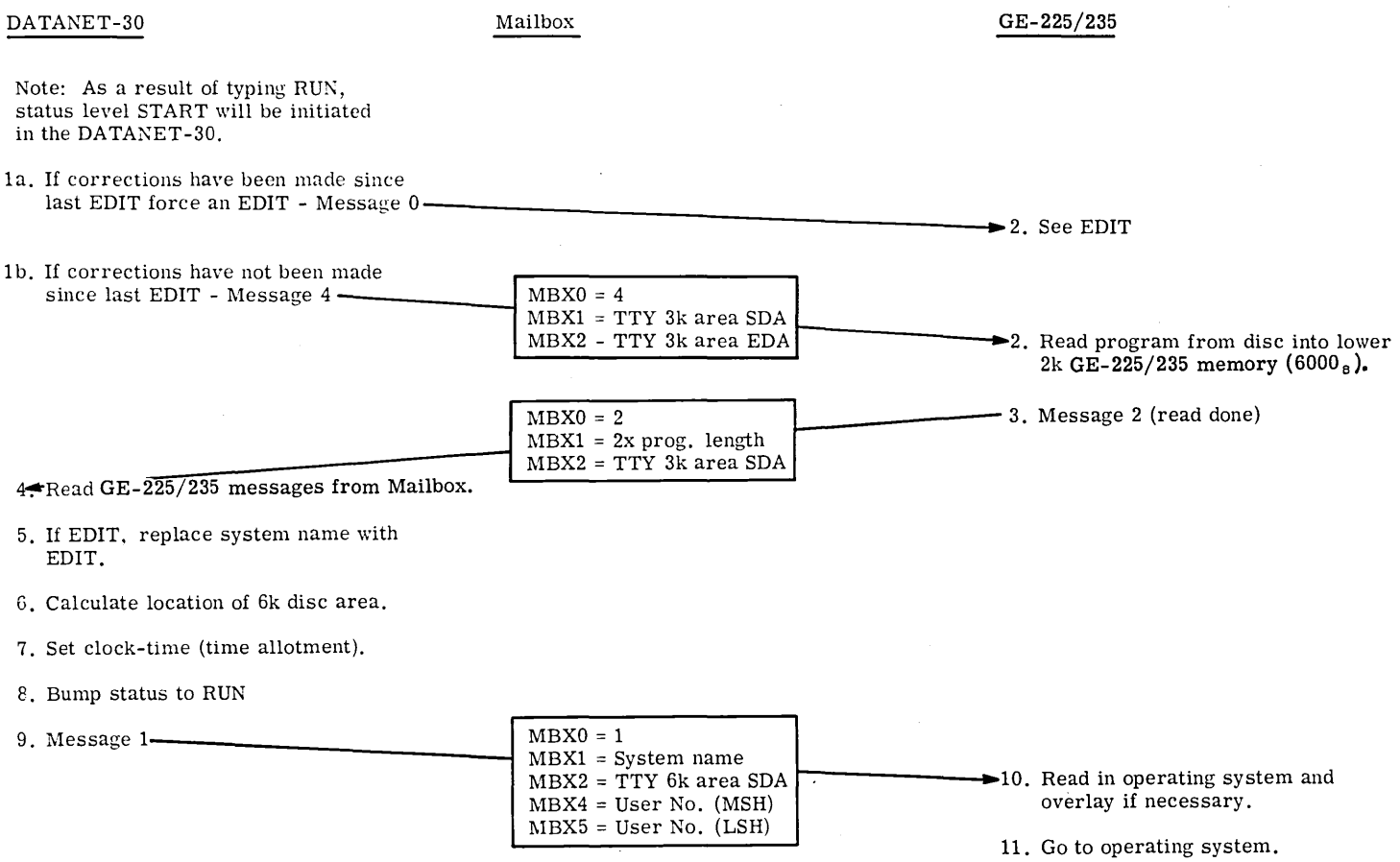
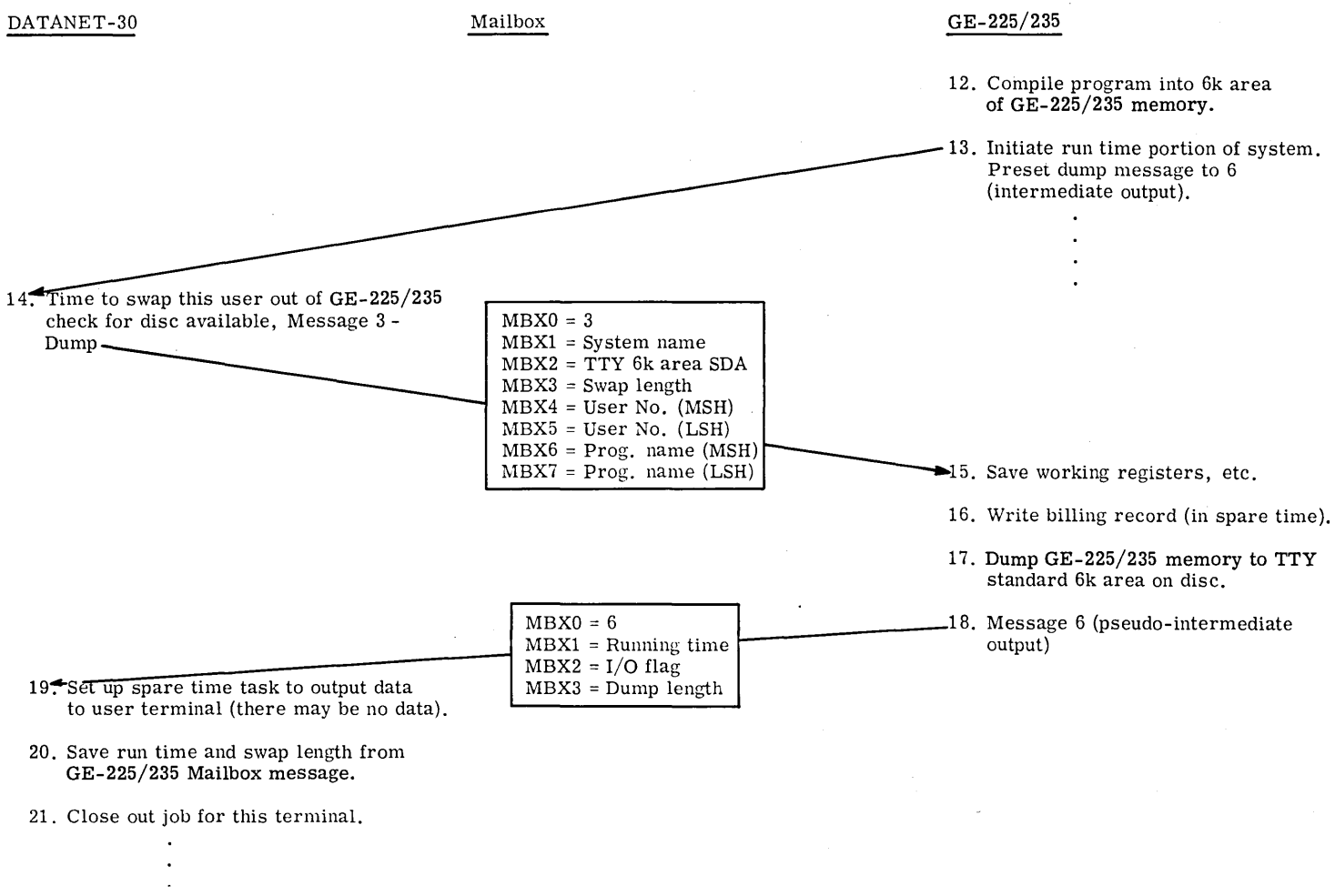


Figure 8. Internal Processing of START


DATANET-30
Mailbox
GE-225/235
12. Compile program into 6k area of GE-225/235 memory.
13. Initiate run time portion of system. Preset dump message to 6 (intermediate output).
14. Time to swap this user out of GE-225/235 check for disc available, Message 3 - Dump
MBX0 = 3
MBX1 = System name
MBX2 = TTY 6k area SDA
MBX3 = Swap length
MBX4 = User No. (MSH)
MBX5 = User No. (LSH)
MBX6 = Prog. name (MSH)
MBX7 = Prog. name (LSH)
15. Save working registers, etc.
16. Write billing record (in spare time).
17. Dump GE-225/235 memory to TTY standard 6k area on disc.
18. Message 6 (pseudo-intermediate output)
MBX0 = 6
MBX1 = Running time
MBX2 = I/O flag
MBX3 = Dump length
19. Set up spare time task to output data to user terminal (there may be no data).
20. Save run time and swap length from GE-225/235 Mailbox message.
21. Close out job for this terminal.

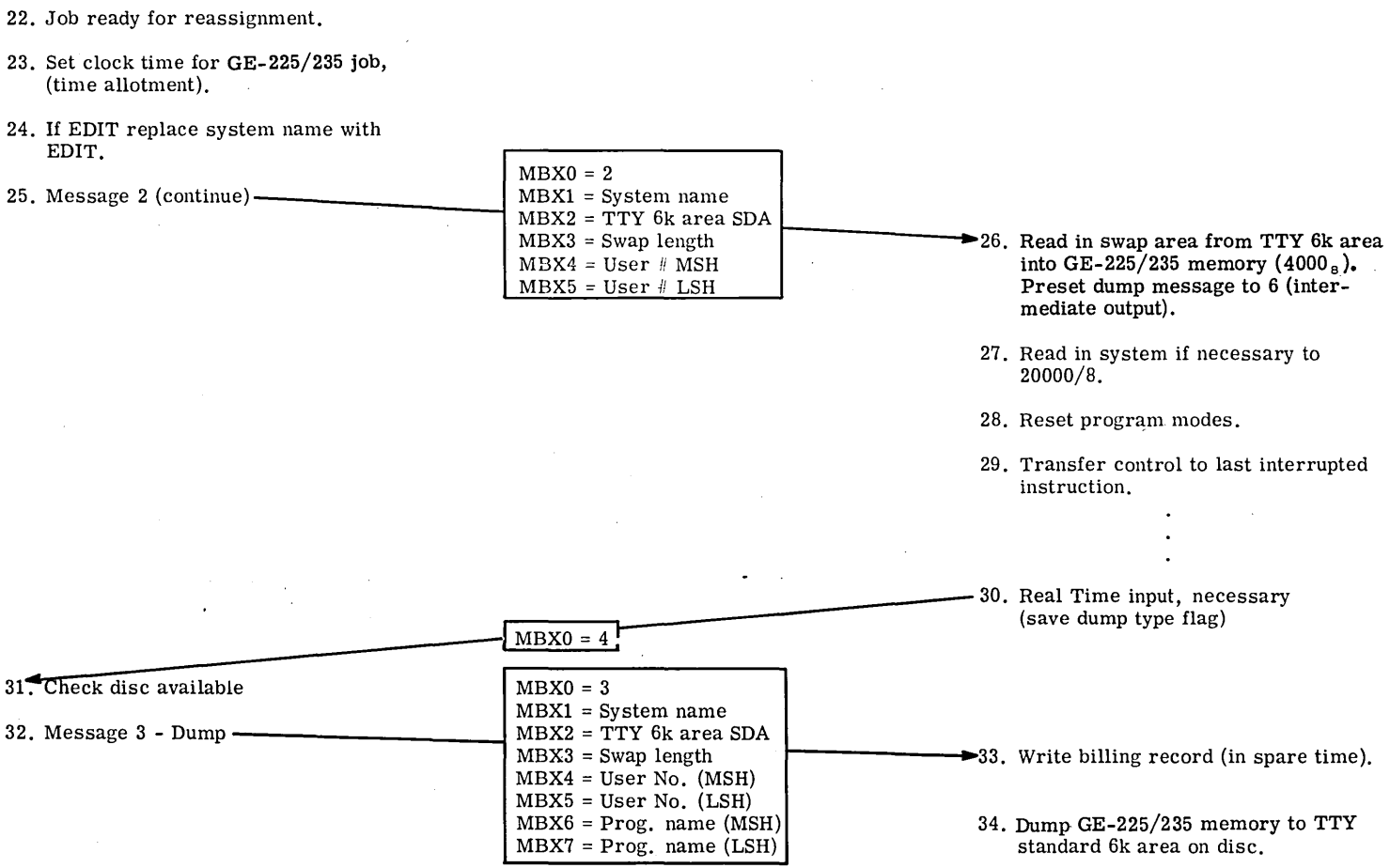
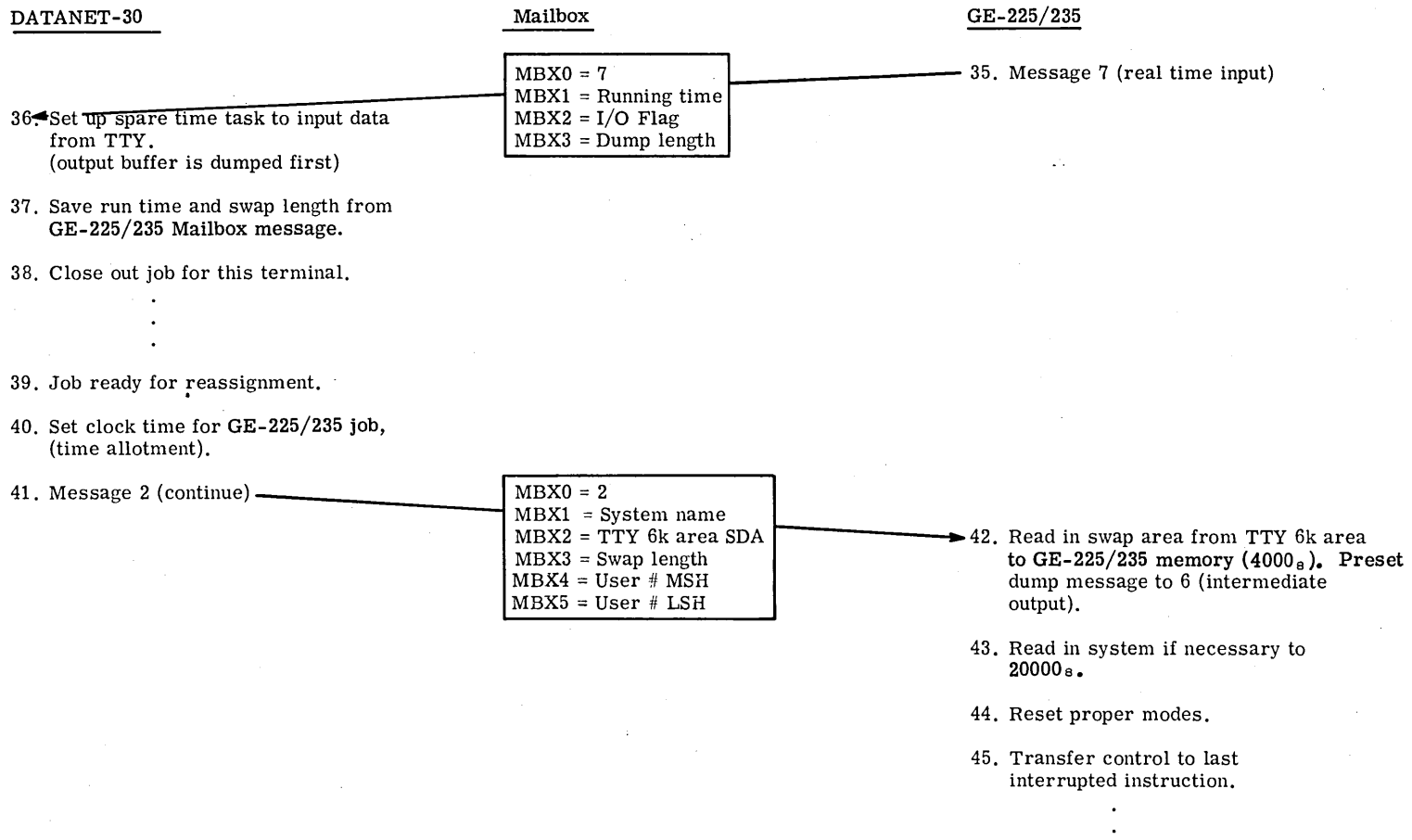


Figure 9. Internal Processing of RUN


DATANET-30
Mailbox
GE-225/235
MBX0 = 7
MBX1 = Running time
MBX2 = I/O Flag
MBX3 = Dump length
35. Message 7 (real time input)
36. Set up spare time task to input data from TTY. (output buffer is dumped first)
37. Save run time and swap length from GE-225/235 Mailbox message.
38. Close out job for this terminal.
39. Job ready for reassignment.
40. Set clock time for GE-225/235 job, (time allotment).
41. Message 2 (continue)
MBX0 = 2
MBX1 = System name
MBX2 = TTY 6k area SDA
MBX3 = Swap length
MBX4 = User # MSH
MBX5 = User # LSH
42. Read in swap area from TTY 6k area to GE-225/235 memory (4000₈). Preset dump message to 6 (intermediate output).
43. Read in system if necessary to 20000₈.
44. Reset proper modes.
45. Transfer control to last interrupted instruction.

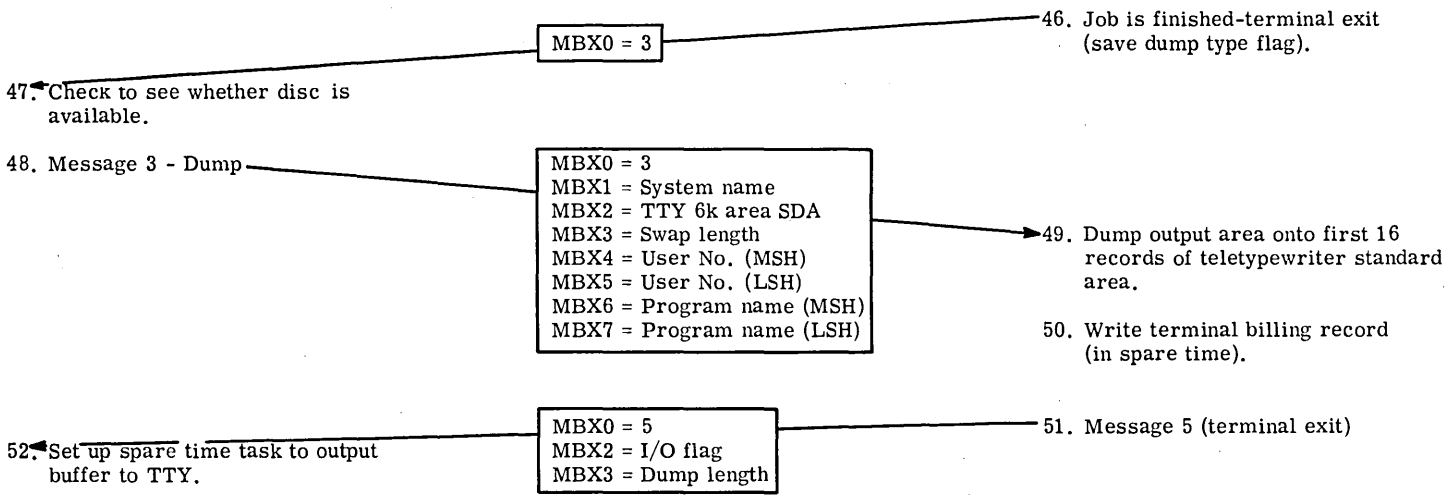
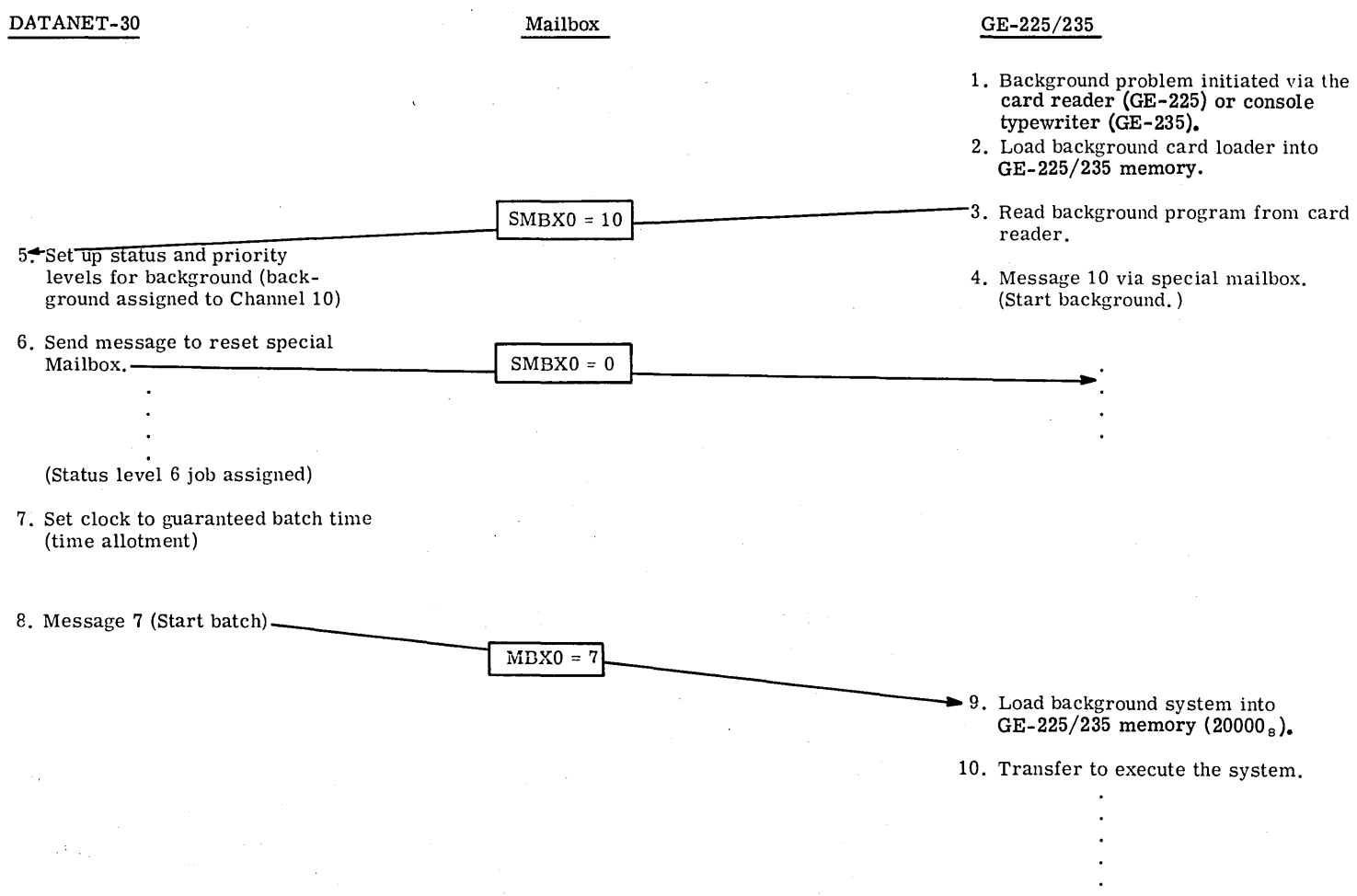


Figure 9. Internal Processing of RUN (cont'd.)


DATANET-30
Mailbox
GE-225/235
1. Background problem initiated via the card reader (GE-225) or console typewriter (GE-235).
2. Load background card loader into GE-225/235 memory.
SMBX0 = 10
3. Read background program from card reader.
5. Set up status and priority levels for background (background assigned to Channel 10)
4. Message 10 via special mailbox. (Start background.)
6. Send message to reset special Mailbox.
SMBX0 = 0
(Status level 6 job assigned)
7. Set clock to guaranteed batch time (time allotment)
8. Message 7 (Start batch)
MBX0 = 7
9. Load background system into GE-225/235 memory (20000_8).
10. Transfer to execute the system.

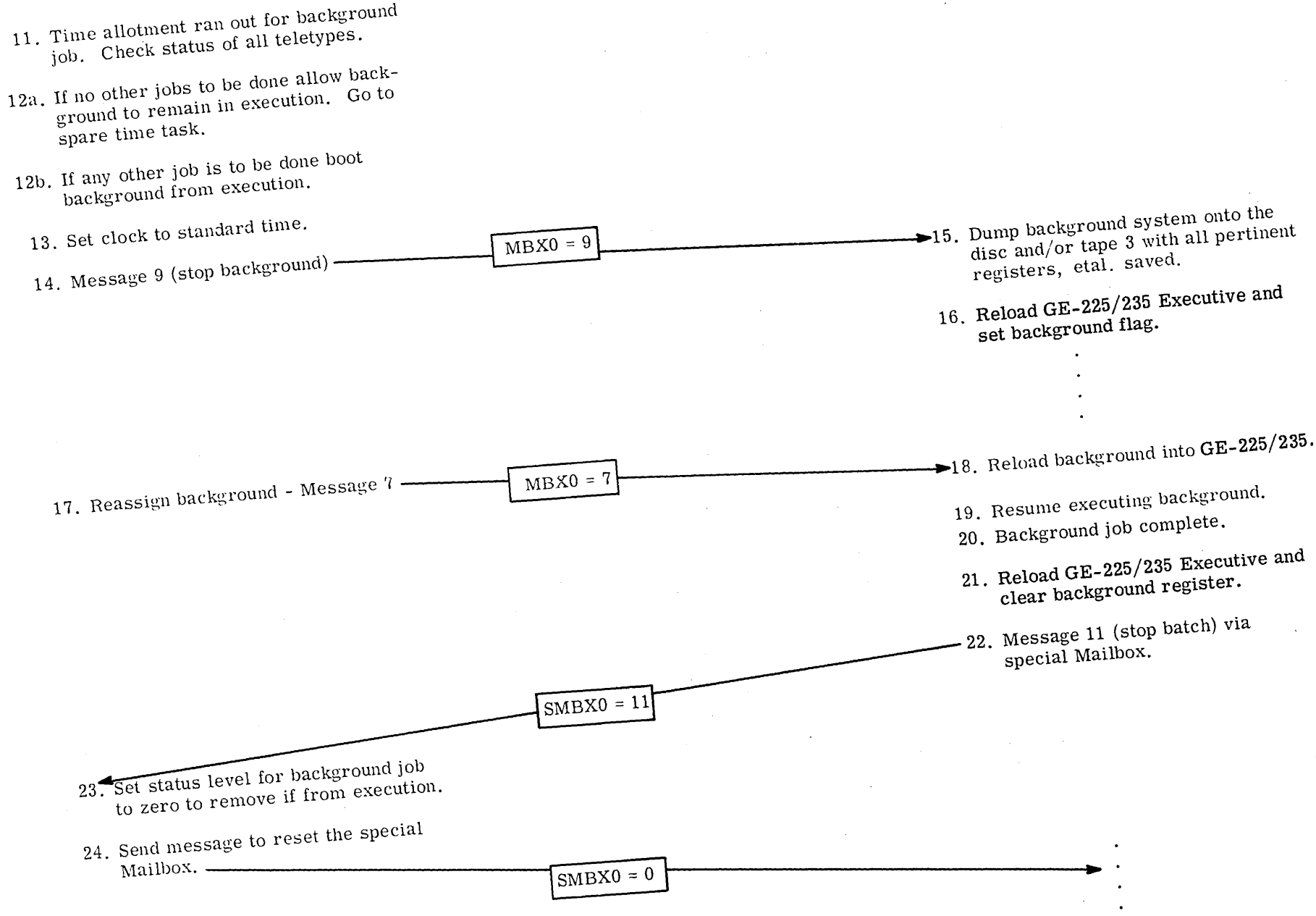


Figure 10. Internal Processing of BATCHMODE

4. SYSTEM OPERATIONS

The GE-200 Series Time-Sharing System requires little manual intervention once it has been properly initialized and is operating. Daily procedures are followed to set the proper date when the system is started up and to dump the disc when the system is shut down. Between these times the system is self-sufficient.

There may be occurrences when operations appear to break down and intervention is necessary. Also, it is necessary to debug certain problems or to provide further system development. For these situations, several system commands and functions exist which are initiated by way of the card reader, the console typewriter, or the control teletypewriter.

This chapter provides a description of the following necessary procedures for a time-sharing system:

Startup
Daily operations
Daily shutdown
Troubleshooting
System Library
Control teletypewriter commands
Input commands

In addition, a description of the existing routines that perform peripheral equipment functions is included.

STARTUP PROCEDURES FOR A NEW SYSTEM

To start up a new system, the assembled program decks for the operating system (described below) must be available. These decks are loaded into the GE-225/235 and then out onto disc storage. When these programs have been placed on the disc, an operating system is available.

For subsequent startups, the user may load the two Executives from the disc instead of from the program decks.

GE-255 NEW SYSTEM STARTUP

Follow this procedure for new system startup for the GE-255.

1. Prepare the equipment.

   - Set the following switches inside the door over the GE-225 console:

     RDR API to ON
     PNCH API to ON
     Cont. Sel. to 1
     SPB SW to G
     Card Read to Special
     MEM to 1-8/16/32
     2-4/8/16

     TIME-SHARE/BATCH to TIME-SHARE

   - Check the disc storage unit. Ensure that the four switches on the top module inside the front door of the controller are set to down position. The names of the switches and the function of the down position are listed below:

Switch	Down Position	Functions
65th WORD TO MEM	Inhibit	The 65th word (checkword) is inhibited from transfer to core memory.
STOP ON PARITY	No	Controller will not halt on detected parity or data-flow errors.
CONTR SELECT	Yes	Controller can be selected at any time regardless of its busy/not-busy state.
MAX RECORDS	96	Limits the maximum number of records that can be transferred for a given command to 96.

   - Set the SPECIAL/NORMAL switch (mounted by the wire wrap pins inside the DSU controller) to SPECIAL.
   - Set the Master Designation switches on the bottom module to Program Control.
   - Ready the printer and set the API switch ON.
   - Ready the tape controller with the API switch ON and mount the scratch tapes as follows:

Plug	Tape	Use
1	0	Time-sharing billing tape
1	2	Scratch tape for peripheral and background jobs
1	3	Disc dump/load and background
1	7	SYSOUT

   - Ready the card punch.

2. Clear the disc.

   - Every word on the disc must be set to 555555_8. (End-of-file marks.)
   - Manually clear the DSU controller and the DATANET-30 after the disc has been initialized.

3. Manually load each of the following decks in the order given. Each deck contains its own loader and disc write routine. (When loading of the Executives is complete, the indicated typewriter message occurs.)

	Typewriter Message
DATANET-30 Executive	END LOAD
GE-225/235 Executive	FLAG SET FOR BILL or FLAG SET FOR NO BILL
	BACKGROUND CARD CATALOG LOADED
	END LOAD
Disc Card Image Loader	
Batch Binary Card Loader	

   If the GE-225/235 Executive is loaded with switch 7 not set, billing on tape 0, plug 1 is expected. If the GE-225/235 Executive is loaded with switch 7 set, no billing is expected. To change the "no billing state," the GE-225/235 Executive must be reloaded with switch 7 not set.

4. Load the DATANET-30 and the GE-225/235 Executives into the proper processor.

   - Place the DATANET-30 paper tape bootstrap loader loop in the DATANET-30 paper tape reader. The MANUAL/PROGRAM switch on the DATANET-30 console should be set to MANUAL.
   - Load the DATANET-30 by pressing the MANUAL LOAD button on the DATANET-30 console. The following typeout occurs on the control teletypewriter: THERE HAS BEEN A MALFUNCTION; TYPE HELLO AND START AGAIN.
   - Set the MANUAL/PROGRAM switch to MANUAL.
   - Load the GE-225/235 by toggling switch 2 on the DATANET-30 console. This causes a bootstrap load of the GE-225/235. A typeout occurs on the console typewriter: END LOAD**etc.
   - If the control teletypewriter is not already on, turn it on by depressing the ORIG button and K (keyboard button).
   - Since the system is now theoretically in operation but not all routines are loaded, type OFF on the control teletypewriter. This prevents the system being accessed. The control teletypewriter types back: READY.

- Certain pointer locations in DATANET-30 memory must be manually initialized. This is done as follows:

  Type OCTAL 600 (R) on the control teletypewriter. System types "READY". Type in the numbers (all octal) in the following list in the order given.

  (The system should issue a line feed after each carriage return, but if it does not do so, press the LOC LF key on the control console.)

Octal Location	Contents	
600	053000 (R)	
601	000000 (R)	
602	777777 (R)	
603	000000 (R)	
604	000000 (R)	
605	000000 (R)	
606	000000 (R)	
607	000000 (R)	
610	377777 (R)	
611	377777 (R)	
612	000000 (R)	
.	.	
.	.	
.	.	All zeros
.	.	
654	000000 (R)	
655	052000 (R)	
656	052100 (R)	
657	052200 (R)	
660	052400 (R)	
661	052500 (R)	
662	052600 (R)	

  After the last number (052600) is typed in, an extra carriage return should be given, whereupon the system should type back READY. To check the correct insertion of these numbers, a DUMP 600 (R) should be typed on the control console. The DATANET-30 memory region beginning at location 600 will be typed on the control console. Typeout is terminated by depressing the BREAK key. The numbers typed back out in memory locations 610 and 611 should not correspond to those input (377777). These numbers are the number of cycles left after servicing the teletypewriter (610) and the CIU (611), and are updated every time the respective service routines are entered in the DATANET-30 Executive. These numbers should be between 200 and 2000 octal.

NOTE: (R) indicates depression of the return key.

- Type the command BOOTSTRAP on the control teletypewriter. The system will respond with:

  NEXT SAVED STORAGE IS DISC ADDRESS 53000

  CODED DATE IS 0000

  ENTER DATE --

  The current date should be entered as nnnnnnnmm/dd/yy (R) , n = day of week (7 characters), m = month (2 characters), d = date (2 characters), and y = year (2 characters).

5. Load the Card-to-Disc Deck:

   - S-card (S in column 1)
   - BAT card (BAT in cols. 1-3)
   - *FRONT (F in column 7)
   - User card (See "Preparing the Control Cards" in Chapter 7.)
   - Card-to-Disc Deck

   Place the first card of the deck on the read platform with the remainder of the deck in the card hopper.

6. Load the operating system(s) onto the disc preceded by an S-card and a SYS card, as follows:

   - S-card
   - SYS card
   - BASIC, ALGOL, FORTRAN or EDIT deck

7. Toggle Switch 18 to initiate loading. When the load onto the disc is complete, the console typewriter types the name of the system, followed by READY. When loading FORTRAN, put switch 0 down before toggling switch 18. When the typewriter carriage returns, put switch 0 up. Switch 19 must be down when loading FORTRAN and ALGOL.

8. Load any systems that are to be executed as background programs. The background programs to be loaded are:

   SYMMAINT

   GE-225 General Assembly Program

   DATANET-30 General Assembly Program.

NOTE: (R) indicates depression of the return key.

Each of these programs must be preceded by:

- S-card
- BAT card
- *FRONT card
- User card

Place the first card of each deck on the reader platform, with the remainder of the deck in the card hopper.

Toggle Switch 18 to initiate loading. Type ON on the control teletypewriter. Time-sharing is now in effect.

GE-265 NEW SYSTEM STARTUP

Follow this procedure for new system startup for the GE-265.

1. Prepare the equipment.

   - Set the following switches inside the door over the GE-235 console:

     RDR API to ON
     PNCH API to ON
     Cont. Sel. to 1
     SPB SW to G
     Card Read to Special
     MEM to 1-8/16/32
            2-4/8/16

     TIME-SHARE/BATCH to TIME-SHARE

   - Check the disc storage unit. Ensure that the four switches on the top module inside the front door of the controller are set to down position. The names of the switches and the function of the down position are listed below:

Switch	Down Position	Functions
65th WORD TO MEM	Inhibit	The 65th word (checkword) is inhibited from transfer to core memory.
STOP ON PARITY	No	Controller will not halt on detected parity or data-flow errors.
CONTR SELECT	Yes	Controller can be selected at any time regardless of its busy/not-busy state.
MAX RECORDS	96	Limits the maximum number of records that can be transferred for a given command to 96.

- Set the SPECIAL/NORMAL switch (mounted by the wire wrap pins inside the DSU controller) to SPECIAL.
- Set the Master Designation switches on the bottom module to Program Control.
- Ready the printer and set the API switch ON.
- Ready the tape controller with the API switch ON and mount the scratch tapes as follows:

Plug	Tape	Use
1	0	Time-sharing billing tape
1	2	Scratch tape for peripheral and background jobs
1	3	Disc dump/load and background
1	7	SYSOUT

- Ready the card punch.

2. Clear the disc.
   - Every word on the disc must be set to 555555_8. (End-of-file marks.)
   - Manually clear the DSU controller and the DATANET-30 after the disc has been initialized.
3. Manually load each of the following decks in the order given. Each deck contains its own loader and disc write routine. (When loading of the Executives is complete, the indicated typewriter message occurs.)

	Typewriter Message
DATANET-30 Executive	END LOAD
GE-225/235 Executive	FLAG SET FOR BILL or FLAG SET FOR NO BILL
	BACKGROUND CARD CATALOG LOADED
	END LOAD
Disc Card Image Loader	
Batch Binary Card Loader	

   If the GE-225/235 Executive is loaded with switch 7 not set, billing on tape 0, plug 1 is expected. If the GE-225/235 Executive is loaded with switch 7 set, no billing is expected. To change the "no billing state", the GE-225/235 Executive must be reloaded with switch 7 not set.
4. Load the DATANET-30 and the GE-225/235 Executives into the proper processor.
   - Place the DATANET-30 paper tape bootstrap loader loop in the DATANET-30 paper tape reader. The MANUAL/PROGRAM switch on the DATANET-30 console should be set to MANUAL.

- Load the DATANET-30 by pressing the MANUAL LOAD button on the DATANET-30 console. The following typeout occurs on the control teletypewriter: THERE HAS BEEN A MALFUNCTION; TYPE HELLO AND START AGAIN.

- Set the MANUAL/PROGRAM switch to MANUAL.

- Load the GE-225/235 by toggling switch 2 on the DATANET-30 console. This causes a bootstrap load of the GE-225/235. A typeout occurs on the console typewriter: END LOAD**etc.

- If the control teletypewriter is not already on, turn it on by depressing the ORIG button and K (keyboard button).

- Since the system is now theoretically in operation but not all routines are loaded, type OFF on the control teletypewriter. This prevents the system being accessed. The control teletypewriter types back: READY.

- Certain pointer locations in DATANET-30 memory must be manually initialized. This is done as follows:

  Type OCTAL 600 Ⓡ on the control teletypewriter. System types "READY". Type in the numbers (all octal) in the following list in the order given.

  (The system should issue a line feed after each carriage return, but if it does not do so, press the LOC LF key on the control console.)

Octal Location	Contents	
600	053000 Ⓡ	
601	000000 Ⓡ	
602	777777 Ⓡ	
603	000000 Ⓡ	
604	000000 Ⓡ	
605	000000 Ⓡ	
606	000000 Ⓡ	
607	000000 Ⓡ	
610	377777 Ⓡ	
611	377777 Ⓡ	
612	000000 Ⓡ	
.	.	
.	.	
.	.	All zeros
.	.	
654	000000 Ⓡ	
655	052000 Ⓡ	
656	052100 Ⓡ	
657	052200 Ⓡ	
660	052400 Ⓡ	
661	052500 Ⓡ	
662	052600 Ⓡ	

Note: Ⓡ indicates depression of the return key.

After the last number (052600) is typed in, an extra carriage return should be given, whereupon the system should type back READY. To check the correct insertion of these numbers, a DUMP 600 Ⓡ should be typed on the control console. The DATANET-30 memory region beginning at location 600 will be typed on the control console. Typeout is terminated by depressing the BREAK key. The numbers typed back out in memory locations 610 and 611 should not correspond to those input (377777). These numbers are the number of cycles left after servicing the teletypewriter (610) and the CIU (611), and are updated every time the respective service routines are entered in the DATANET-30 Executive. These numbers should be between 200 and 2000 octal.

- Type the command BOOTSTRAP on the control teletypewriter. The system will respond with:

  NEXT SAVED STORAGE IS DISC ADDRESS 53000

  CODED DATE IS 0000

  ENTER DATE --

  The current date should then be entered as nnnnnnnmm/dd/yy Ⓡ ,
  n = day of week (7 characters), m = month (2 characters),
  d = date (2 characters), and y = year (2 characters).

5. Load the Card-to-Disc deck:

   - Place the *FRONT card on the read platform and the remainder of the deck in the card hopper.
   - Type BATCH followed by an upper case period on the control teletypewriter. (Refer to Chapter 7.)
   - When loading is complete, the console typewriter will type:

     OFF AT xx:xx HRS.

6. Load the operating systems onto the disc. The systems to be loaded are:

   BASIC,
   ALGOL, or
   EDIT package

   Place the first card of each deck on the read platform with the remainder of the deck in the card hopper.

   Type SYS followed by an upper case period on the console typewriter. Loading is then initiated.

   When the load onto the disc is complete, the console typewriter types the name of the system (BASIC, ALGOL or EDIT), followed by READY.

7. Load any systems that are to be executed as background programs. The background programs to be loaded are:

   SYMMAINT
   GE-235 General Assembly Program
   DATANET-30 General Assembly Program.

   Place the first card of each deck on the read platform, with the remainder of the deck in the card hopper.

Note: Ⓡ indicates depression of the return key.

Type BATCH followed by an upper case period on the control teletypewriter. Loading is initiated.

8. Type ON on the control teletypewriter. Time-sharing is now on the air.

DAILY STARTUP

When the time-sharing system is shut down on a daily basis, a need exists to start it up on a daily basis. The startup procedure only requires that the Executives be loaded from disc storage into the GE-200 Series computer memory, and that the proper date and time be set for bookkeeping.

To start up the system on a daily basis:

1. Mount a blank tape on plug 1, tape unit 0. This tape is used for the central processor usage billing.

   If the previous day's dump tape is loaded, it should be mounted on tape unit 3.

   - For the GE-255, initiate this by entering an S-card, a LOA or LOAD card and 2 blank cards. Toggle Switch 18 to initiate reading of the cards.
   - For the GE-265, type LOAD on the input typewriter.

2. Clear the disc controller.

3. Manually load the DATANET-30.

4. Load the GE-225 or GE-235 by toggling Switch 2 on the DATANET-30 console.

5. Type OFF on the control teletypewriter.

6. To set the proper date in the system, type BOOTSTRAP on the control teletypewriter. The following typeout occurs:

   ```
   NEXT SAVED STORAGE IS DISC ADDRESS xxxxxx
   CODED DATE IS xxxx
   ENTER DATE
   ```

   Enter the date (via the control teletypewriter) in the following format. (This format must be adhered to.)

   wwwwwwwmm/dd/yy

   where: wwwwwww indicates the day of the week;
   mm indicates the month (a leading zero must be supplied if applicable); and
   dd indicates the day of the month (a leading zero must be supplied if applicable).

   (NOTE: The separator character is a slant (/) on the GE-235, and a dash (-) on the GE-225)

7. Type ON on the control teletypewriter. The system is then ready for operation.

8. The new time is then entered by means of DBGTIM mentioned later in this chapter.

DAILY SHUTDOWN PROCEDURE

To turn the time-sharing system off at the end of the day, follow this procedure:

1. Give warnings to the users with the WARN command, telling them that the system is going off.

2. Load a full reel of tape on plug 1, tape handler 3, and set it to high density. This tape is for the disc dump.

3. Type OFF on the control teletypewriter to terminate time-sharing processing.

4. To initiate a dump of all pertinent system information from the disc to tape 3, and to issue the catalog printout on the printer, do the following:

   GE-255

   Enter an S-card, a DUMP card and 2 blank cards through the card reader. (Toggle Switch 18 to initiate loading.)

   GE-265

   Type DUMP on the console typewriter.

5. Run the daily billing procedures. (Refer to Chapter 11.)

6. The equipment may now be turned off. If it is desired to remain in the time-sharing mode, users may be allowed back on the system by typing ON on the control teletypewriter. If billing has been done on the time-sharing system, the Executives should be reloaded from the disc.

TROUBLESHOOTING

Two types of messages warn the user that error conditions exist. The DATANET-30 types messages on the teletypewriter and the GE-225/235 types messages on the console typewriter.

Teletypewriter Messages

THERE HAS BEEN A MALFUNCTION;
TYPE HELLO AND START AGAIN

Meaning: The DATANET-30 has entered a hardware-load condition. Unless the operator deliberately caused this condition, a serious difficulty is indicated (probably in the DATANET-30).

Action: Shut down the system and determine cause of the trouble. Failure to do so may result in irrecoverable damage to the contents of disc storage.

BOOTSTRAP TELETYPE xx uuuuuu pppppp sss mmmmmm TIME hh:mm

Meaning: The DATANET-30 caused the GE-225/235 Executive to be reloaded from the disc, and

xx indicates the channel number or the teletypewriter which had access to the GE-225/235 when the bootstrap occurred;

uuuuuu indicates the user number associated with channel xx;

pppppp indicates the problem name being used by user number uuuuuu;

sss indicates the abbreviated system name specified by the user on channel xx;

mmmmmm indicates one of the following messages telling why the DATANET-30 may have booted this job:

- CLOCK — The GE-225/235 took too long to complete the task the DATANET-30 assigned it.
- MINUS — The GE-225/235 did not respond to a DATANET-30 generated interrupt within 220 milliseconds.
- MESSG — The GE-225/235 failed to place a valid message in the regular Mailbox for the DATANET-30.

hh:mm indicates the time of day when the bootstrap occurred. If the reason for bootstrap is either MINUS or MESSG, the time may be meaningless.

DISC ERROR

Meaning: The DATANET-30 has detected an error on five successive tries of the same disc operation. It stops trying and returns to the spare-time wait loop.

DSU xxxxxx

Meaning: The DATANET-30 has not received a ready indication from the disc controller after an approximately 7.5 second delay. The DATANET-30 issues a command overriding the busy condition and the operation causing it is retried. This typeout occurs approximately every 40 seconds if the DSU controller is permanently hung up. (xxxxxx denotes last disc address.)

ILLEGAL DISC ADDRESS

Meaning: An illegal disc address was detected in a RRF or WRF command.

NO ROOM IN SAVE STORAGE

Meaning: The disc storage files are completely full.

Action: Try a disc edit to squeeze out the holes in the catalogs.

Console Typewriter Messages

D30 KEPT DISC

Meaning: The DATANET-30 has retained control of the disc storage unit, thus preventing the GE-225/235 from gaining access to it, for more than about seven seconds.

DISC

Meaning: The GE-225/235 cannot access the disc although the DATANET-30 has granted access. If this typeout is repeated, it indicates that there is an equipment malfunction.

ILEGAL xxxxxx

Meaning: An illegal address, xxxxxx, has been requested of the disc.

FULL

Meaning: The GE-225/235 spare-time task table is full.

PARITY xxxxxx

Meaning: An irrecoverable parity error has been detected on disc storage. A GE-225/235 bootstrap is forced and the bad record is rewritten to the disc. xxxxxx denotes a memory cell.

MESSAGE

Meaning: An undecipherable message has been received from the DATANET-30.

BUSY

Meaning: The GE-225/235 types this message when an API or a Background program has made a request, but another API or Background program is currently in residence.

Action Required for GE-255 System: To terminate the old program, enter an S-card, followed by 2 blank cards, and toggle Switch 18. The system will type READY.

Action Required for GE-265 System: To terminate the old program, type the letter S followed by an upper case period (‡). The system will type READY.

HUH (For GE-255 System)
??? (For GE-265 System)

Meaning: An illegal command has been detected.

TAPE 0

Meaning: The tape controller was found not ready on a command to write on TAPE 0.

When a time-sharing system is running, certain occurrences may indicate a malfunctioning system. Symptoms of such conditions are listed below, followed by possible remedies. These are listed in order of increasing seriousness. It is recommended that only a minimum of corrective action be taken because every additional step may cause more problems for the users.

1. Symptom: System refuses to respond to the commands OLD, RUN, and LIST.

   Correction: GE-255: Insert S-card followed by 2 blank cards. Toggle Switch 18.

   GE-265: Type the letter S followed by an upper case period (ǂ). The console typewriter types READY and starts executing programs again.

2. Symptom: The GE-225/235 is typing DISC on the console typewriter, or the DATANET-30 is typing DSU on the control teletypewriter. The system refuses to respond to any commands.

   Correction: Put the CPU in MANUAL status. Then clear the disc, put the CPU back in AUTOMATIC status and press the START button.

3. Sympton: The DATANET-30 has typed BOOTSTRAP TELETYPE xx etc. on the control teletypewriter.

   Correction: The GE-225/235 should type END LOAD xxxxxx on the console typewriter. If so, normal operation is resumed. If not, one of the following may remedy the situation. NOTE: If none of these remedies work an equipment malfunction is indicated.

   - Check the disc controller to see whether the BUSY light is on continuously. If so, depress the MANUAL CLEAR switch.
   - Check to see whether the red HALT light on the DATANET-30 console is on. If so, depress in this order, the MANUAL RESET and MANUAL LOAD switches.
   - The message THERE HAS BEEN A MALFUNCTION should type out on the control teletypewriter.
   - Try reloading the system from cards starting with the DATANET-30 and the GE-225/235 executive programs.

4. Symptom: A typeout has occurred on the console typewriter of TAPE 0.

   Correction: Clear the tape controller.

5. Symptom: The catalog printout shows that validation programs, catalog entries, or any other area of the disc has been erroneously written on.

   Correction: Take system off the air and reload the disc from the previous day's disc dump, as this would initialize the system with the terminal time for the previous day. A pass at the Daily Terminal Time Retrieval Run of the billing routine should be run to clear out the terminal time.

SYSTEM LIBRARY

The system library allows users to retrieve and use routines and programs that have been created. This eliminates the need for recreating existing programs. Programs can be created at the control teletypewriter under the user number LIBxxx, where xxx can be anything (i.e., BAS, ALG, FOR). Such user numbers function as any other user numbers and any number of programs may be saved under each of them. The total of all programs saved at the control teletypewriter under user number LIBxxx is the library.

Individual users may retrieve a program from the library by typing its name, followed by three asterisks. For example: MATRIX***.

It has been the practice for the systems operator to create two programs in the library by which users can be informed of the contents of the library and of important information concerning the system.

Under a library program called CATALOG, a list and short description of all the system programs is maintained. By requesting an OLD program CATALOG***, under the BASIC system, and listing it, the user can determine all the available library routines.

Under a second program called INFORM, improvements to the system, new commands, changes in operating procedures can be presented to the user by having him follow the same procedure as for CATALOG but use a program named INFORM***.

The Library is under the sole control of the systems operator via the control teletypewriter. No addition can be made to the library by an outside user.

Control Teletypewriter Commands

Several commands that can be made through the control teletypewriter provide the following capabilities:

- To debug or develop the system
- To communicate with the users
- To provide additional system functions.

These commands are described below.

DEBUGGING OR DEVELOPMENT COMMANDS

DUMP xxxxx - allows that portion of the DATANET-30 memory starting at octal location xxxxx to be typed onto the control teletypewriter. The mode is terminated by depressing the S key or the BREAK button.

OCTAL xxxxx - allows octal patches to be inserted into the DATANET-30 memory starting at octal address xxxxx. The READY typeout occurs. Insert the octal patch, one word at a time, by typing the patch yyyyyy followed by a carriage return, until the patch is completed. Terminate the OCTAL mode by giving one extra carriage return.

RRF xxxxxx (Read random file) - allows one 64-word record to be read from disc address xxxxxx into DATANET-30 memory starting at octal location 500. This data may be examined by using system command DUMP 500.

WRF xxxxxx (Write random file) - allows the 64-word block of DATANET-30 memory beginning at octal location 500 to be written onto the disc starting at octal address xxxxxx. This command should be used with extreme caution and should be preceded by an RRF (Read Random File command).

TTY xx - allows the control teletypewriter to print out the status of the octal channel xx. The message indicates the user number, program name, operating system, and program status.

TTYALL - is the same as TTY xx, but will only print information regarding active users and will scan all teletypewriters.

SERVICE - directs the telephone line service routines to answer only the first xx octal telephone lines.

COMMUNICATIONS COMMANDS

DIAL xx - allows the control console to communicate directly with any other teletypewriter which is currently connected to the system. A program cannot be run by either teletypewriter while in this mode. The xx indicates the octal channel address of the teletypewriter with which conversation is desired. Terminate the DIAL mode by depressing the RUBOUT key on either the control or user teletypewriter.

WARN - allows the control teletypewriter to send output to all other teletypewriters that are connected to the system at the time this mode is entered. This command is useful for informing the users that the system will be shut down. The input of the WARN (R) command should be followed immediately by an X-OFF, carriage return, and line feed. This serves to stop any paper tape output which someone may be trying to punch. The last characters typed before terminating the WARN mode should likewise be carriage return and line feed. Terminate this mode by depressing the RUBOUT key.

MONITOR xx - is similar to DIAL. It allows the control teletypewriter to receive all input and output of the teletypewriter specified by the octal channel number xx, without interrupting the run. The control teletypewriter cannot communicate with any other teletypewriter while in this mode. Terminate this mode by depressing the RUBOUT key.

MESSAGE - allows insertion of a message after HELLO is typed on the user's console. For example, the following message might be entered:

MES ΔΔΔTHE SYSTEM WILL GO OFF AT 1800 TODAY.

Note the three spaces after MES. The maximum length of the message is 72 characters. It is terminated by a carriage return. To provide no message, recreate the sequence with the message being a carriage return.

SYSTEM FUNCTIONS

NUMBER - allows the user number to be changed without going through the HELLO sequence. This allows the shifting of a program from one user to another.

OFF - turns off the system to all users except the control teletypewriter. Telephone line service is terminated also.

ON - allows the users back on the system and resumes telephone line communication.

RELOAD - reloads the GE-225/235 Executive from disc storage.

RELOADD30 - reloads the DATANET-30 Executive from disc storage.

CREATE - initiates the user's validation function for the system. (Refer to Chapter 5, "User Validation" for a description of this command.)

UNCREATE - initiates the invalidation function of a user for the system. (Refer to Chapter 5 for a description of this command.)

USERS - provides a typeout of the number of users currently on the system.

TIME - provides a statistical typeout of the distribution of labor in the time-sharing system.

INPUT COMMANDS

There are several commands which can be made in order to provide the following capabilities:

- to perform system operation
- to debug a system
- to perform peripheral tasks.

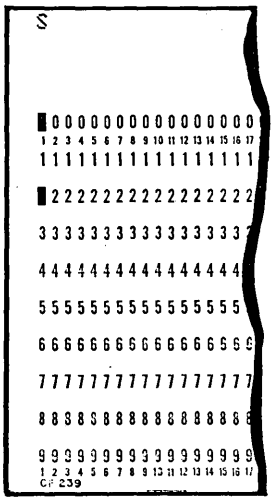
These commands, described below, are made through the GE-225 card reader and through the GE-235 console typewriter, for the GE-255 and GE-265 Time-Sharing Systems, respectively.

GE-225 Card Input Commands

SYSTEM OPERATION COMMANDS (Punched starting in column 1)

S

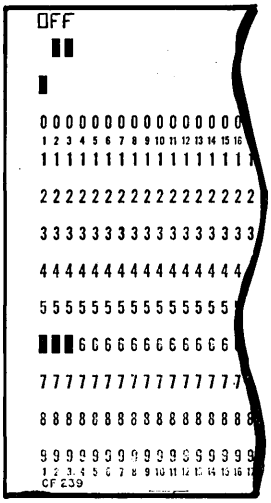
Format:



Use: Halts the GE-225 and makes the card reader available for program input. The S-card must precede other commands. Toggle Switch 18 to initiate reading of the S-card. (Also stops the currently running background program in the GE-225.)

OFF

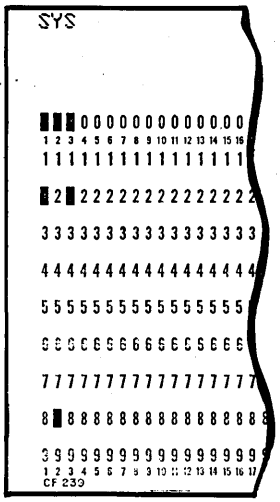
Format:



Use: Causes the GE-225 to tell the DATANET-30 to stop counting time. This command brings time-sharing to a halt until an S-card is entered through the card reader.

SYS

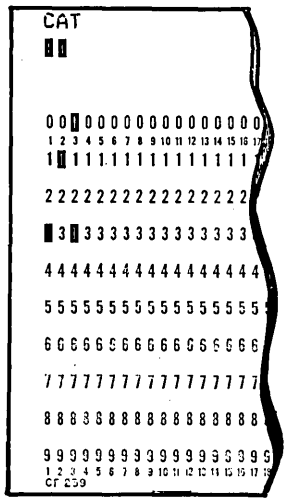
Format:



Use: Initiates the reading of a time-sharing system onto the disc while time-sharing is running. The card deck for the system must be in the card reader, assembled in the appropriate format.

CAT

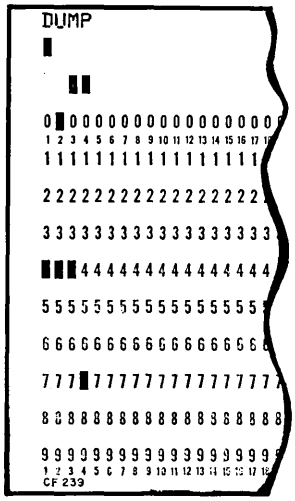
Format:



Use: Causes a listing of the user catalogs to be printed on the printer. This causes a DATANET-30 OFF condition, effectively turning off the time-sharing system. Usually this command is issued when the system has gone off the air at the end of the day. To allow users back on, type ON on the control teletypewriter.

DUMP

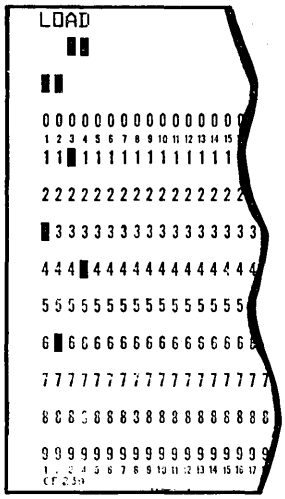
Format:



Use: Initiates a dump of all the information pertinent to time-sharing onto a tape on tape unit 3. Enter an S-card, a DUMP card, and 2 blank cards. Toggle Switch 18. This command also causes a CATALOG listing to be produced on the printer.

LOAD

Format:



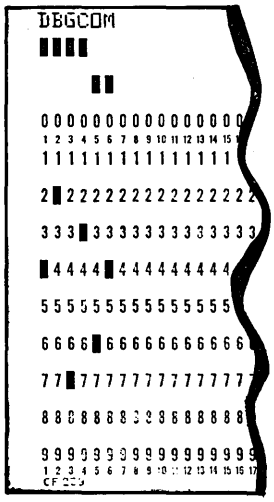
Use: Initiates a tape-to-disc operation. A tape on tape unit 3 which had previously been created by a DUMP command is loaded onto the disc. This allows the system to be loaded in the condition in which it existed at any given time for which a DUMP tape exists. Always hardware-load the DATANET-30 after a LOAD.

DEBUGGING COMMANDS

Debugging command cards are preceded by an S-card and followed by two blank cards. Punching begins in column 1.

DBGCOM

Format:

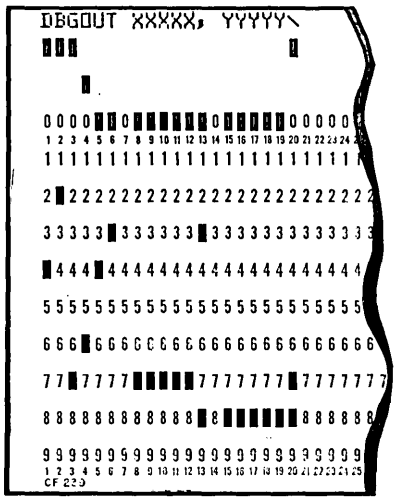


Use: Causes the Mailbox area of the GE-225 Executive to be dumped on reception of each message from the DATANET-30. The dump is made on the printer and on tape, when billing is being done.

DBGOUT xxxxx, yyyyy

(Followed by a 12-7-8 punch.)

Format:

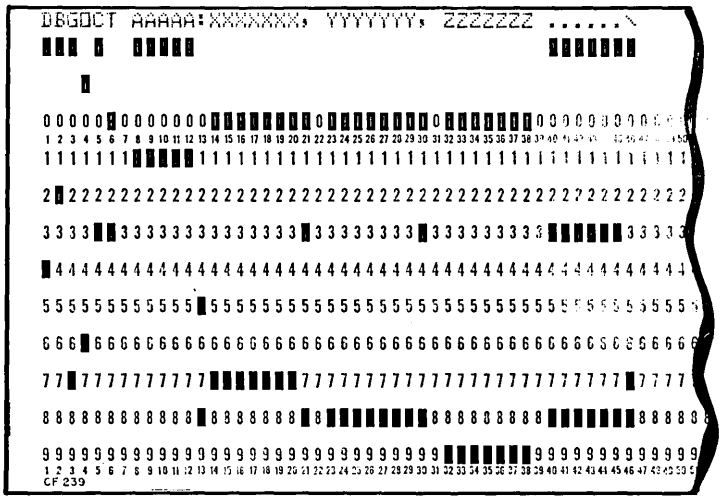


Use: Causes a dump on the high-speed printer of the portion of GE-225 memory specified by beginning octal address xxxxx and ending octal address yyyyy.

DBGOCT aaaaa:xxxxxxx, yyyyyyy, zzzzzzz .....

(Followed by a 12-7-8 punch.)

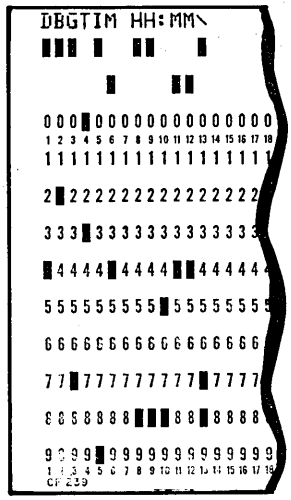
Format:



Use: Causes the octal correction xxxxxx to be placed in the GE-225 octal memory location aaaaa, correction yyyyyyy to aaaaa+1, correction zzzzzzz to aaaaa+2, etc.

DBGTIM hh:mm

Format:



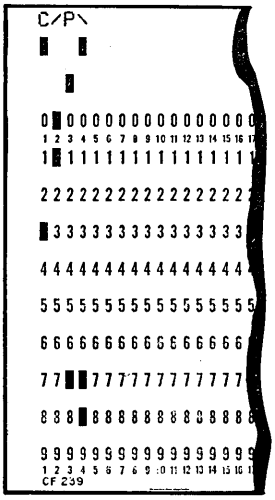
Use: To correct the real-time clock (C-register) in the GE-225. The hh and mm indicate the 24-hour time (in BCD) in hours and minutes, respectively. Toggle Switch 18 to initiate the new time in the system. Then the console typewriter types READY.

PERIPHERAL TASK COMMANDS

C/P

(Followed by 12-7-8 punch.)

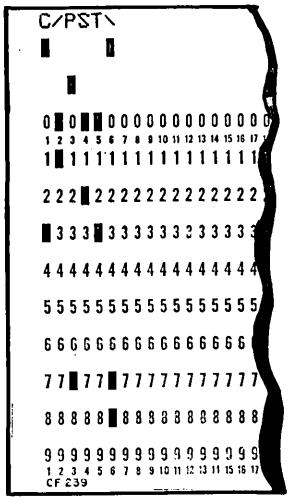
Format:



Use: Causes a deck from the card reader to be listed on the printer. The deck must be in decimal format. Listing terminates when a hopper empty condition is detected. Available options allow double-spacing of the listing and/or translating the cards to the standard FORTRAN character set.

C/PST

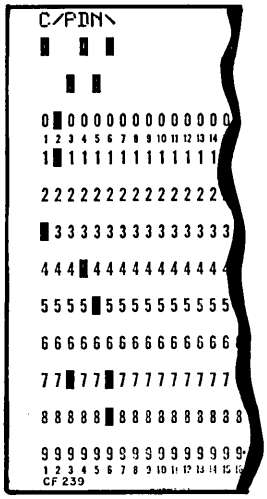
Format:



Use: For a single-spaced, translated listing, the card should be punched C/PST, followed by a 12-7-8 punch.

C/PDN

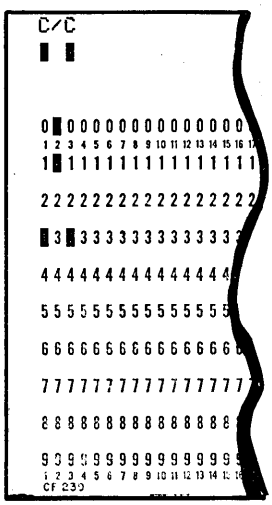
Format:



Use: For a double-spaced, untranslated listing, the card should be punched C/PDN, followed by a 12-7-8 punch.

C/C

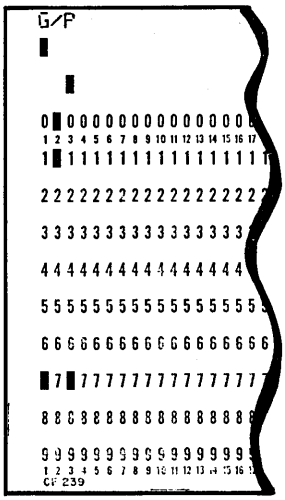
Format:



Use: Results in the exact reproduction of a deck from the card reader to the card punch. Punching terminates on a hopper-empty condition.

G/P

Format:

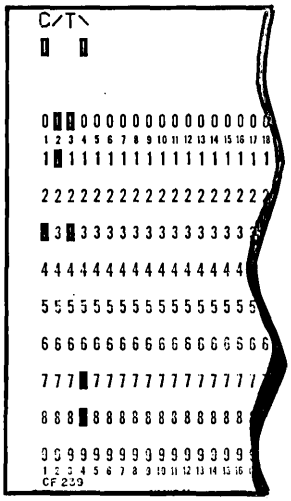


Use: Causes the listing of a General Assembly Program tape which is mounted on tape unit 3. The tape if first rewound. More than one assembly listing may be on the tape.

C/T

(Followed by a 12-7-8 punch.)

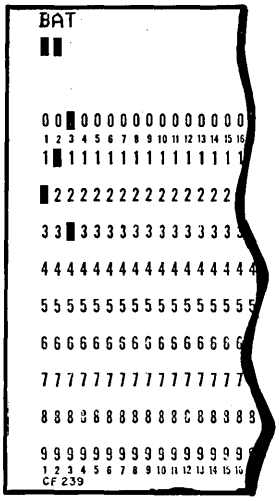
Format:



Use: Causes the decimal card deck in the card reader to be written as 27-word card images in the binary mode onto tape 4. Card-to-tape operation terminates on detection of a "quote" card or a hopper empty condition. "Quote" cards have 0-7-8 punches in columns 1-6. Upon termination, the program writes an end-of-file mark on tape 4 and rewinds it.

BAT

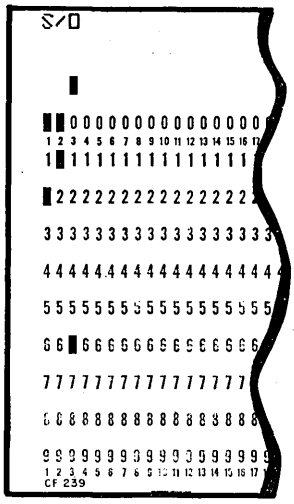
Format:



Use: Calls in the batch-processing monitor which proceeds to read the control cards in the card reader and executes them. This operation terminates on detection of a hopper-empty condition. (Refer to Chapter 7 for the details of batch processing.)

S/O

Format:



Use: Causes the SYSOUT tape produced by background jobs on tape unit 7 to be listed and/or punched. The tape will not be rewound before beginning the listing process.

To stop a peripheral task which has been started by the GE-225 because of a command from the card reader, do one of the following:

Stop it temporarily by depressing console switch 0.
Stop it permanently by loading an S-card followed by 2 blank cards into the card reader and toggling Switch 18.

GE-235 Console Typewriter Commands

The console typewriter commands are described below. The input of each command must be followed by an upper case period (≠).

SYSTEM OPERATION COMMANDS

OFF — Causes the GE-235 to tell the DATANET-30 to stop counting time. This command brings time-sharing to a halt until an S, followed by an upper case period, is typed on the console typewriter.

SYS — Initiates the reading of a time-sharing system onto the disc while time-sharing is running. The card deck for the system must be in the card reader, assembled in the appropriate format.

CAT — Causes a listing of the user catalogs to be printed on the printer. This causes a DATANET-30 OFF condition, effectively turning off the time-sharing system. Usually this command is issued when the system has gone off the air at the end of the day. To allow users back on, type ON on the control teletypewriter.

DUMP — Initiates a dump of all the information pertinent to time-sharing onto a tape on tape unit 3. When more than one tape is needed, a message to that effect is typed on the console typewriter. This command causes a CATALOG listing to be produced on the printer.

LOAD Initiates a tape-to-disc operation. A tape on tape unit 3 which had previously been created by a DUMP command is loaded onto the disc. This allows the system to be loaded in the condition in which it existed at any given time for which a DUMP tape exists. Always hardware-load the DATANET-30 after a LOAD.

DEBUGGING COMMANDS

DBGCOM Causes the Mailbox area of the GE-235 Executive to be dumped on the reception of each message from the DATANET-30. The dump is made on the printer and on tape, when billing is being done.

DBGOUT xxxxx, yyyyy Causes a dump on the high-speed printer of the portion of the GE-235 memory specified by beginning octal address xxxxx and ending octal address yyyyy.

DBGOCT aaaaa:xxxxxxx, yyyyyyy, zzzzzzz ..... Causes the octal correction xxxxxx to be placed in GE-235 octal memory location aaaaa, correction yyyyyyy to aaaaa+1, correction zzzzzzz to aaaaa+2, etc. The correction list is terminated by an upper case period.

DBGTIM hh:mm Is used to correct the real-time clock (C-register) in the GE-235. The hh and mm indicate the 24-hour time (in BCD) in hours and minutes respectively. This command is special in that, after typing in DBGTIM plus the time of day and an upper case period, the system types READY. The time is not placed directly into the C-register until after the character $ is typed on the typewriter. For example: DBGTIM 07:30 = READY $

PERIPHERAL TASK COMMANDS

C/P Causes a deck from the card reader to be listed on the printer. The deck must be in decimal format. Listing terminates when a hopper-empty condition is detected. Available options allow double-spacing of the listing and/or translating the cards to the standard FORTRAN character set. For a single-spaced, translated listing, type C/PST. For a double-spaced, untranslated listing, type C/PDN.

C/C followed by an upper case period - Results in the exact reproduction of a deck from the card reader to the card punch. Punching terminates on a hopper-empty condition.

G/P Causes the listing of a General Assembly Program tape which is mounted on tape unit 3. The tape is first rewound. More than one assembly listing may be on the tape.

C/T Causes the decimal card deck in the card reader to be written as 27-word card images in the binary mode onto tape 4. Card-to-tape operation terminates on detection of a "quote" card or a hopper-empty condition. "Quote" cards have 0-7-8 punches in columns 1-6. Upon termination, the program writes an end-of-file mark on tape 4 and rewinds the tape.

BAT Calls in the batch-processing monitor which proceeds to read the control cards in the card reader and executes them. This operation terminates on detection of a hopper-empty condition. (Refer to Chapter 7 for the details of batch processing.)

S/O Causes the SYSOUT tape produced by background jobs on tape unit 7 to be listed and/or punched. The tape will not be rewound before beginning the listing process.

To stop a peripheral task which has been started by the GE-235 because of a command from the console typewriter, do one of the following:

Stop it temporarily by depressing console switch 0.
Stop it permanently by typing S followed by an upper case period.

To delete the characters entered since the last carriage return, type an upper case comma (ǂ).

To determine whether a new job may be entered on the console typewriter, type S≠. If the console typewriter types BUSY, a peripheral job is in process. If the console typewriter types READY, the user may insert the next job via the console typewriter.

If any operation initiation on the typewriter is performed and the system is busy, it will say BUSY.

5. USER VALIDATION

The user validation routines make it possible to identify all valid time-sharing users whenever they access the system. These routines are to prevent unauthorized users from using the time-sharing system.

Validation files are entered into the system only through the control teletypewriter. They are placed in the customer's catalog. A validation file must be entered for each valid user number which is assigned to a customer.

To enter a validation file in a system use the normal HELLO sequence. Answer the requests as indicated:

USER NUMBER	Enter the user number to be validated.
SYSTEM	BASIC
PROGRAM	NEW
NEW PROGRAM NAME	x (or any other character)

The validation file is a set of parameters rather than an actual program. The DATANET-30 expects these parameters in specified locations. Thus, the format for entering a validation file is fixed and must not be modified.

Enter the validation file parameters as follows:

Line No.	Entry	Meaning
1	01 x	Where x is 0, let the user on the system. Where x is 1, do not let the user on the system. Normally, this code will be set to 0. It is set to 1 only when it is desired to keep this user off the system temporarily.
2	02 x	Where x is 1, this user number may gain access to the system through any teletypewriter. Where x is 0, check lines 6 and beyond for the list of teletypewriters through which this user may gain access to the system. The user may not gain access from any other teletypewriter.

Line No.	Entry	Meaning
3	03mmddyy	Where mmddyy indicates the date that this user validation routine is entered into the system.
4	04 000000000	Where 9 zeros are reserved for the accumulation of this user's teletype time.
5	05 mmmmmmmmmmmmmmmmmm	Where 18 m's indicate an 18-character message that will be typed when he accesses the system. The content of this message is left up to the discretion of the user. The message must contain 18 characters. If the user does not wish a message to be typed, the line will be entered as 05 xxx NO MESSAGE YET.
6	06 aaaaaa	Where 6 a's indicate the 6th through the 11th characters after the first carriage return on the answer-back drum of the teletypewriter on which the user wishes to be allowed access to the system.* If the user wishes to be validated on more than one teletypewriter, lines 7, 8, etc. are used for entering the contents of the answer-back drums of the other teletypewriter. A maximum of 10 teletypewriters may be validated for any one user. This table of valid teletypewriters must be terminated with a literal "END". For example, if a user were validated on three terminals, the contents of the answer-back drums would have been entered on lines 6, 7, and 8. In this case, line 9 would be entered as 09Δ END.

After entering the entire validation routine, type the instruction CREATE on the control teletypewriter. This acts in much the same way as the SAVE instruction except that:

- It is a valid instruction only through the control teletypewriter.
- It changes the program name of the routine to all fill characters.

The reason for changing the name to fill characters is that the validation routine is placed in the user's catalog, but the user is not allowed to access the routine. Since fill characters are not keyboard characters on a teletypewriter, the user cannot access the routine. The routine can only be accessed by the DATANET-30 Executive program.

Example

This example shows how a validation routine would be entered for a user who desired to gain access to the time-sharing system from any teletypewriter and who did not want a message typed out. After going through the normal HELLO sequence, he could enter:

```
01 0
02 1
03 050465
04 000000000
05 xxx NO MESSAGE YET
CREATE
```

*Note: The answer-back drums must have the Bell System standard coding (i.e., CR, LF, RO, 12 characters ID, CR, LF, X-ON, SUP, SUP.)

A validation routine for a user who wanted to gain access to the time-sharing system on four different teletypewriters and have the message "Fill In Time Card" typed out every time he gained access to the system would be entered as follows.

```
01△0
02△0
03△121565
04△000000000
05△FILL IN TIME CARD
06△33-355
07△OMPANY
08△ERAL△E
09△123△XY
10△END
CREATE
```

To remove a validation routine from the system, type NUM on the control teletypewriter. After it types USER NUMBER, type in proper user number. It will then type READY. Then type UNCREATE.

The UNCREATE routine acts the same as the UNSAVE routine except that:

- It is a valid instruction only through the control teletypewriter.
- It changes the program name to all fill characters.

6. SYSTEM ACCOUNTING

During a normal day's operation, the time-sharing system records the information needed to prepare customer invoices on magnetic tape and on the disc storage unit. With this information customers may be charged for their use of the time-sharing system.

The amount of each user's central processor time is written on a magnetic tape called the daily CPU Usage Tape. The amount of time each teletypewriter spends in accessing the time-sharing system is recorded on the disc storage unit.

CENTRAL PROCESSOR TIME

The customer invoice includes a charge for each user's amount of central processor time. This is the time the user spends in actually running his program. Each time a user's program gains access to the time-sharing central processor, a record is written on magnetic tape. This record contains the time at which the program gains access and also the time at which the central processor relinquishes access. (Refer to the end of this chapter for a layout of the daily CPU usage record.)

The off line reporting programs will calculate the difference between these on and off times to determine the total access time.

The sum of all these individual records provides the total amount of central processor time used by each user.

TELETYPEWRITER TIME

The customer invoice also includes a charge for the time a user's terminal is connected to the system. When a user gains access to the time-sharing system, a teletypewriter accumulation register in the DATANET-30 Executive ($ ONTIM) is set aside for that user. It is initialized to one minute. Using the real-time clock contained in the central processor, the accumulation area is incremented for each minute used. Therefore, at any given time, the accumulation area contains the amount of time in minutes that a particular user has spent in accessing the time-sharing system.

When the user types GOODBYE or hangs up the teletypewriter, three things happen:

1. The user's validation record is read in from the disc.
2. The accumulation of minutes ($ ONTIM) is added to the total sum of teletypewriter time contained in the user's validation record.
3. The updated record is written back out onto the disc.

The magnetic tape and disc layouts used for system accounting follow.

RUN: _____ GENERAL ELECTRIC RECORD LENGTH: 24 WORDS
FILE: DAILY CPU USAGE BLOCKING FACTOR: 1/RECORD
RECORD TYPE: BIN GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET PAGE: 1 OF: 3

0	1	2	3	4	5	6	7
SYSTEM NAME			USER NUMBER				

8	9	10	11	12	13	14	15
		DATE			ON TIME		OFF TIME
		Δ MOMO / DADA / YRYR					

RUN: _____ GENERAL ELECTRIC RECORD LENGTH: 8 WORDS
FILE: CATALOG RECORD BLOCK LENGTH: 1024 WORDS
RECORD TYPE: BIN GE 200 SERIES DISC SECTOR LAYOUT SHEET PAGE: 2 OF: 3

0	1	2	3	4	5	6	7
USER NUMBER (SCD)		PROGRAM NAME (BCD)		BEGINNING DISC ADDRESS (BIN)	ENDING DISC ADDRESS (BIN)	CODED DATE (BIN)	PROGRAM LENGTH (BIN)

RUN: _____ GENERAL ELECTRIC RECORD LENGTH: VARIABLE LENGTH: UP TO 128 WORDS
FILE: VALIDATION RECORD BLOCK LENGTH: 1/RECORD
RECORD TYPE: BIN GE 200 SERIES DISC SECTOR LAYOUT SHEET PAGE: 3 OF: 3

0	1	2	3	4	5	6	7
0 1 Δ	OK CODE 7737	0 2 Δ	TTY CODE 7737	0 3 Δ	DATE OF VALIDATION MOMO DADA YRYR		7737

8	9	10	11	12	13	14	15
0 4 Δ	"A" RATE TERMINAL TIME (MINUTES)	"B" RATE TERMINAL TIME (MINUTES)	"C" RATE TERMINAL TIME (MINUTES)	7777 7777 3701			MESSAGE 05 Δ

16	17	18	19	20	21	22	23
	MESSAGE (CONT.)				7737 0604 Δ		VALID TER-

24	25	26	27	28	29	30	31
MINAL ANSWER BACK DRUM		7777 7737 0705 Δ			VALID TERMINAL ANSWER BACK		

32	33	34	35	36	37	38	39
DRUM				etc.			
7777 7737 0804 Δ							

CPB-1455

7. BACKGROUND AND SERVICE PROGRAMS

BACKGROUND PROGRAMS

Three separate program segments control background program operation and monitoring.

1. Card-reading overlay
2. Background Executive
3. Background Executive service subroutines

The background mode of operation is entered as follows:

GE-255: Enter S-card, BAT card, Background Job cards, and 2 blank cards through the card reader. (Toggle Switch 18.)

GE-265: Type BATCH, followed by an upper case period (≠) on the GE-235 console typewriter.

Card Reading Overlay

The purpose of the first program segment is to read and process control cards from the card reader on an automatic priority interrupt (API) basis. This segment is called in by the GE-225/235 Executive as follows:

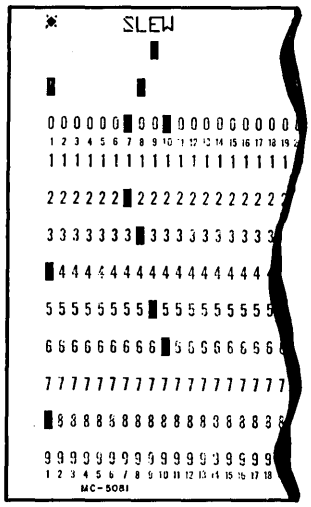
GE-255: Called in when an S-card, a BAT card, Batch Job cards and 2 blank cards are entered through the card reader.

GE-265: Called in when BATCH is typed on the console typewriter.

There are two kinds of control cards:

1. Cards which can be serviced directly from within the Executive.

Example Control card asking for an advancement to top of page.

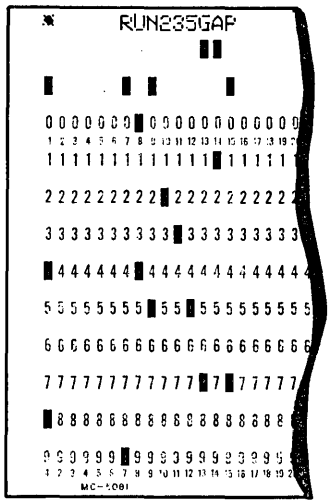


Use: This card causes the printer to advance the page immediately. The overlay then goes on reading more cards.

CPB-1455

2. Cards calling upon previously stored background programs.

Example Control card calling for a General Assembly Program assembly.



This card brings a further chain of events into action.

Background Executive

The second program segment is another overlay consisting of the Background Executive (to be distinguished from the GE-225/235 time-sharing Executive). This overlay is brought into memory by a command from the DATANET-30 to the time-sharing Executive instructing it to load this segment from disc storage. This second program segment replaces the card-reading overlay. When loaded, the Background Executive requests that the DATANET-30 begin background operation. Normal time-sharing continues until this request is granted.

Background Executive Service Subroutines

When the request is granted, the Background Executive brings in the third program segment consisting of the run-time service subroutines for background programs. This program segment overlays part of the GE-225/235 time-sharing Executive. The Background Executive then brings in the specified background program from disc, cards, or tape and transfers control to that program.

After the quantum of time allowed for the current job has elapsed, the DATANET-30 notifies the Background Executive to dump the existing background program from memory to a reserved area on the disc, or part to disc and part to magnetic tape 7 (if requested by a "T" in column 7 on the "Name" card). The Background Executive then brings the time-sharing Executive back into memory and transfers control to it. The time-sharing Executive waits for the DATANET-30 to again permit it to start background operation.

At this point, the Background Executive reloads the running background program from disc or tape, restores the registers, and returns control to the running program.

When the running background program has concluded, the Background Executive notifies the DATANET-30 to stop batch-mode operation, recalls the card-reading overlay, brings the time-sharing Executive back, and steals away into the night.

The card-reading overlay then reads cards, detecting the control cards, until the card hopper is empty.

Preparing the Control Cards

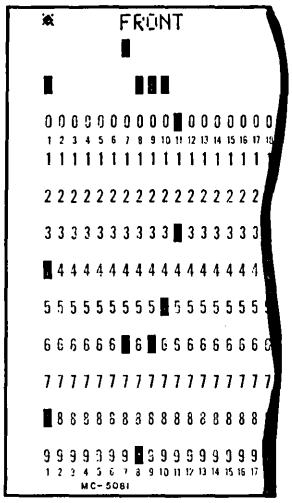
All control cards except the "NAME" card must have an asterisk (*, 11-4-8 punch, 54 octal), in column 1, or a literal "SCC" in columns 1-3. Noncontrol cards are ignored by the Background Executive. The name of the desired function must begin in column 7, unless otherwise noted.

An * FRONT card must be the first card in the card deck for a background job. The second card should be a "Name" card. The last three cards in the control deck must be an * BACK card followed by two blanks. Formats for these three cards follow.

Control cards serviced directly by the Background Executive are as follows:

* FRONT card

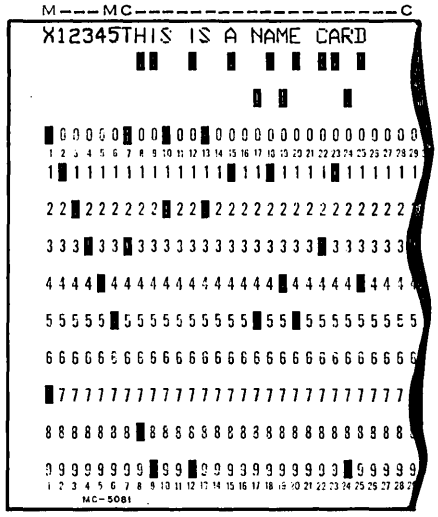
Format:



Use: This control card causes the Background Executive to sign on the user.

Name Card

Format:

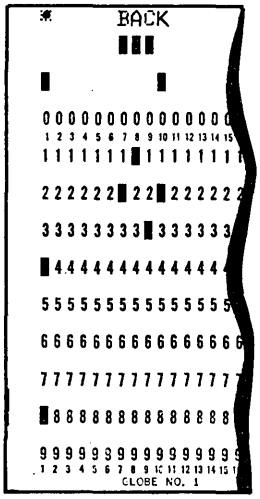


Where mmmmmm indicates the six-character user number of the person running a background program. cc indicates any comment he wishes to make about the job.

Use: This card identifies the user. An image of this card with the on-time in columns 13-18 will be typed out on the console typewriter.

* BACK

Format:



Use: After the FRONT and NAME cards have been accepted, the monitor accepts any of its normal control cards until one of three events occur:

1. A BACK card is discovered in the hopper.
2. A running background program is stopped by the operator as follows:

   GE-255 - Entering an S-card, 2 blank cards, and toggling Switch 18.

   GE-265 - Typing an S followed by an upper case period (‡) on the console typewriter.
3. The hopper goes empty while the monitor is scanning for control cards.

If the normal scan is terminated by typing S, cards will be passed through the reader until a BACK card is found. If the hopper goes empty between the time the monitor has signed a user on and the time it finds a BACK card, it takes all the same action it takes when it discovers a BACK card.

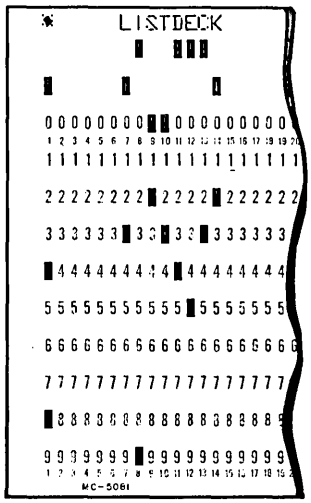
The action generated by a BACK card is: 1. Sign the user off. 2. Type a message indicating the off time on the console typewriter. 3. Punch a card on the punch with the following format:

Cols	1-9:	Image of name card
Cols	13-18:	Sign on time
Cols	19-24:	Sign off time
Cols	26-30:	Total background run plus swap time (i.e., all the time that normal time-sharing is not in progress).
Cols	32-57:	Image of name card
Cols	57-80:	Distinctive pattern

These cards are collected by the operator for use as input to a billing program.

* LISTDECK

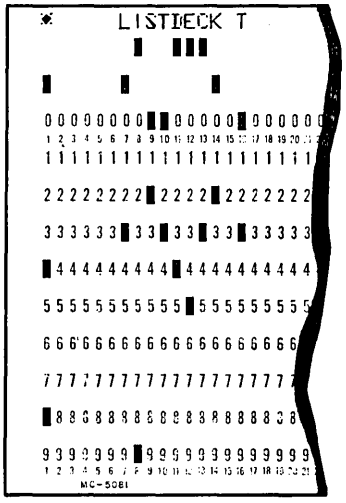
Format:



Use: This card causes the deck in the card reader to be listed on the on-line printer. Listing is terminated by a hopper empty condition. Parentheses and other special characters will not be translated for printer compatibility. The deck must be followed by two blank cards.

* LISTDECK T

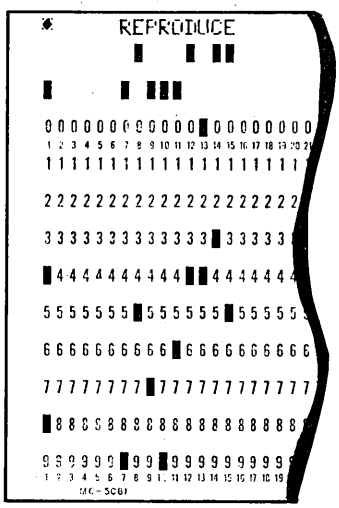
Format:



Use: This card causes the deck in the card reader to be listed on the on-line printer with parentheses and other special characters converted for printer compatibility. Listing will be terminated on a hopper empty condition. The deck must be followed by two blank cards.

* REPRODUCE

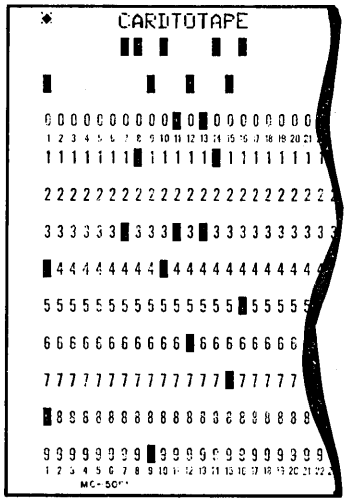
Format:



Use: This card causes the deck in the card reader to be reproduced in the card punch. Reproduction is terminated on a hopper empty condition. The deck to be reproduced should be followed by two blank cards.

* CARDTOTAPE

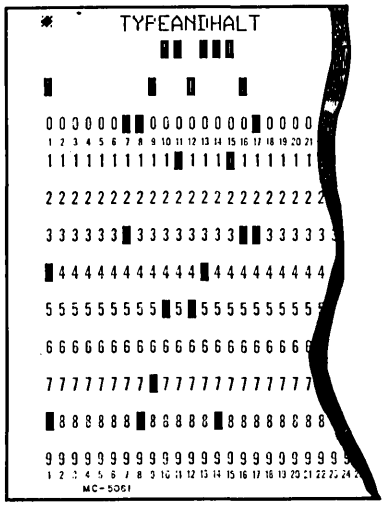
Format:



Use: This card causes the decimal card deck in the reader to be written as 27-word card images onto tape 4, in the binary mode. Card-to-tape operation will terminate on finding a "quote" card, or on a hopper empty condition. "Quote" cards have 0-7-8 punches in columns 1-6. On terminating, the program writes an end-of-file on tape 4 and rewinds it.

* TYPEANDHALT

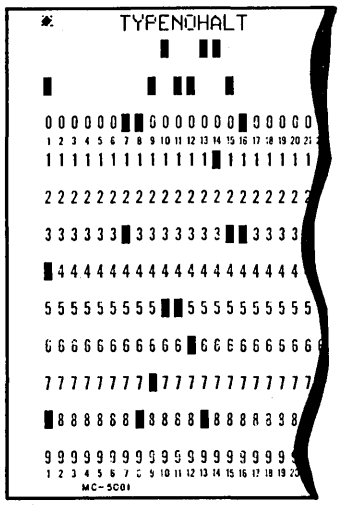
Format:



Use: This card causes the contents of the next card to be typed on the console typewriter, and waits in a loop for console switch 19 to be toggled. When switch 19 is toggled, the following card is read.

* TYPENOHALT

Format:

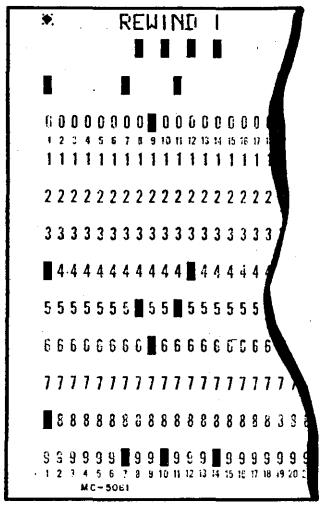


Use: This card causes the contents of the next card to be typed on the console typewriter, then reads the following card.

* TYPE - Same as TYPEANDHALT

* REWINDI

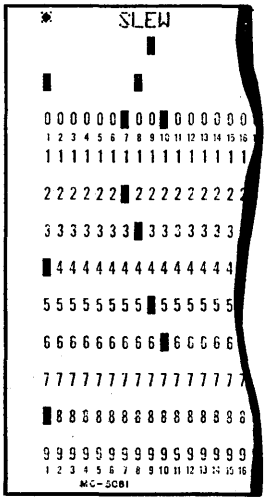
Format:



Use: This card causes the tape on handler I (I = 1,...7) to be rewound. All activity ceases until the tape is rewound.

* SLEW

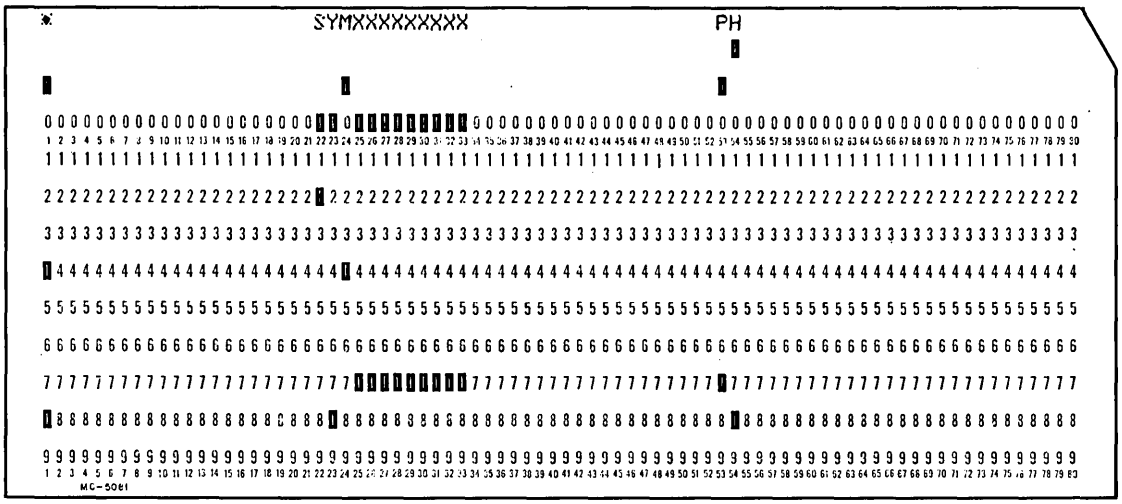
Format:



Use: This card causes the paper in the printer to be advanced (slewed) to the top of the next page.

* SYMxxxxxxxxx

Format:

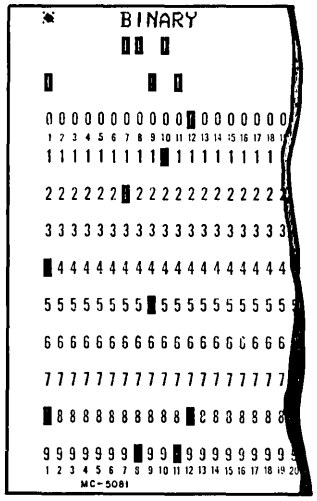


Use: This card causes the tape written in the binary mode on plug (p) and handler (h) to be positioned after the symbolic run locator record containing SYMxxxxxxxxx in the first four words. If plug (p) and handler (h) are not punched, the Executive assumes plug 1, tape 4.

Control cards calling on background programs stored on disc are as follows:

* BINARY

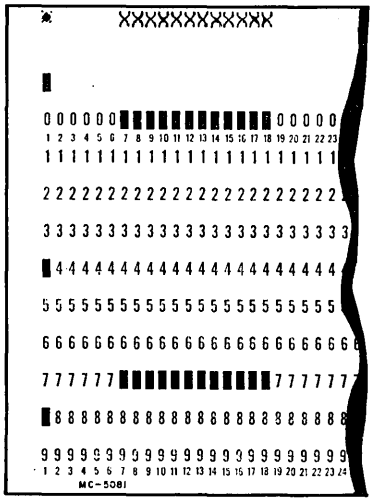
Format:



Use: This card causes the Exec to call the Batch Binary Card Loader (BBCL) from the disc, and transfer control to it. The BBCL then reads into memory a background program from the card reader, and transfers control to this program. Needless to say, such a program must follow all the rules herein explained for background programs, except that it need not have the background program header information. (Refer to "Background Program Header Information" later in the chapter.)

* xxxxxxxxxxxx

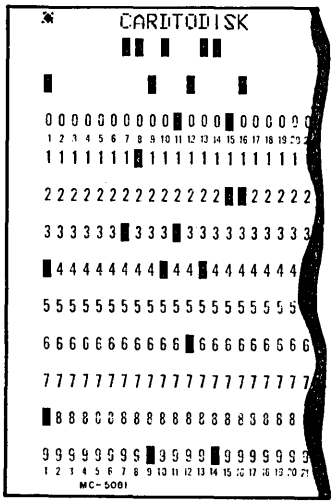
Format:



Use: This card causes the Exec to search the background card catalog for a background program whose name as given in its header is xxxxxxxxxxx. When this entry is found, the Disc Card Image Loader (DCIL) program is read in as an overlay to the Exec. The DCIL then loads the background program from the disc into memory, and turns control over to it.

* CARDTODISK

Format:



Use: This card causes the Exec to call the card to disc (CTD) program from the disc and turn control over to it. CTD then loads the background program immediately following the * CARDTO-DISK card in the card reader onto the disc, making the proper entries into the background card catalog. This enables the user to store frequently used background programs on the disc, instead of loading them with a * BINARY control card each time they are run.

Programming Conventions for Background Programs

Programs meeting the requirements indicated below may be run as "background" concurrently with the time-sharing system. These programs obtain central processor time on the same basis as other time-sharing jobs (priority 5).

The Background Executive resides in memory during background processing. This Executive takes care of dumping and reloading the time-sharing system. It ensures that all peripheral operations are completed before dumping the system, eliminating interrupts and dumps during such tasks.

Background programs must meet these requirements to be run:

1. The program must never use memory locations $34000\text{-}37777_8$ or $0\text{-}234_8$.
2. The program must always make its terminal exit to 37001_8, with zero in the A-register.
3. The program must never use disc storage except by way of the subroutines supplied by the Executive.
4. The program must operate with the SPB switch set to ALL.
5. Tape handlers 0 or 7 must never be addressed. Tape 0 is the billing tape and 7 is the SYSOUT tape.
6. The program must operate in API mode. It must <u>not</u> be out of API mode for more than 220 milliseconds.
7. PBK should be set around DECMODE operations. Otherwise the remembered carry may be lost. PBK must also be set around card read operations (SET PBK, RCB X HCR, BCN, BRU*-1, SET PST.)
8. The program must not run in the trapping mode (TRPMODE). (Not applicable on GE-255.)
9. The program must begin at a memory location equal to 0 modulo 64.

The Background Executive uses 3000 octal memory locations. It provides several subroutines which simplify batch-compatible format. In many cases these subroutines process programs more efficiently than in a non-batch situation.

These subroutines are called by an SPB 37001_8, 1 on index group 0, with a code number in the A-register signifying the subroutine desired. (37001 will hereafter be called EXEC.) EXEC is in upper memory, therefore, either the SPB must be executed in upper memory or a link must provide an unconditional branch to EXEC. Returns from EXEC vary, depending upon the subroutine called. In most cases, parameter lists follow the SPB EXEC, 1 specifying the operation desired. EXEC saves no index registers and it destroys all registers in the group of index registers in which it is entered.

Background Subroutines

The list below indicates the available subroutines and their A-register codes:

Exit background	0000000
Tape operation subroutine	0000001
Disc operation subroutine	0000002
Typewriter output	0000003
Overlay or new system call	0000004
Write SYSOUT tape	0000005

In addition, an option to execute a portion of a user's program as an API program is available. Discussion of the five available subroutines follows:

TAPE OPERATION.

Function

The tape operation subroutine executes any specified tape operation. It takes care of end-of-tape, end-of-file, and error indications. Background programs not using this subroutine will not lose information transferred in read or write operations, but may lose end-of-file, end-of-tape, and/or error indications.

Calling Sequence

Use one of the following two calling sequences for tape operation:

Direct Call:

```
LDO
SPB EXEC, 1
SEL x (controller number)
WORD 1 of a tape command (operation, operand)
WORD 2 of a tape command (tape unit, number of words)
FLAG DEC 0
Return Location . . . .
```

Indirect Call:

```
LDO
SPB EXEC, 1
DEC ADDRESS
--- return here ---
where ADDRESS is a pointer to a four-word parameter list:
      ADDRESS - SEL x (controller number)
      ADDRESS+1 - word 1 of tape command (operation, operand)
      ADDRESS+2 - word 2 of tape command (tape unit, no. words)
      ADDRESS+3 - flag word
```

Plug 1 only is allowed.

Procedure

The entrance to EXEC causes the specified tape commands to be inserted in a task list and executed when the tape controller is ready. Location FLAG is then set to zero and control is returned to the user's program. On return, the specified tape operation is not completed; in fact it may not have been initiated.

When the tape operation is completed, location FLAG is set to nonzero. The nonzero contents indicate the status of the tape controller after the tape operation is finished:

Accumulator Contents	Indicates
1	Normal (no special conditions). Note: On rewinds, bit 1 will be set ON when the controller is ready, but the routine does not wait for the rewind to be completed.
2	End-of-tape indication was given on the operation.
4	End-of-file indication was given on the read.
10_8	An error indication was caused by this read operation, but after a retry in a different read mode, the record was read. When EXEC detects an error during a tape read, it will automatically try five more times before it switches modes. If the error condition persists, EXEC will switch to the original mode and give a 20_8 in the flag word. No mode switching is done if a Read Special Binary command is being used. Successful read mode is returned in high order bits as: 0500010 if successful read was in binary mode. 0400010 if successful read was in decimal mode.
20_8	An error condition resulted from this operation. If a read instruction was executed, the tape is positioned after the faulty record and action is left up to the user. If a write instruction was executed, the EXEC detected a tape error but erased tape until a good section was found and then wrote the record.
40_8	The specified tape operation caused a permanent "not ready" indication from the tape controller. You lose.

The tape error codes represent bits and more than one may be on at the same time. For example, you might have an EOT and also a parity error.

Rule

If a program uses the EXEC tape operation subroutine for any tape operation, it should use it for all of them. Otherwise the following may occur:

BCS BTN, 1	
BRU *-1	The user waits for tape's ready indication.
INTERRUPT	This happens if the tape controller is not ready. Now, the API program may initiate another tape operation.
SEL 1	Return from the API will be to this location.
RTB	An echo alarm will result, as the tapes are no longer ready...

DISC OPERATION

Function

The disc operation subroutine executes any specified disc operation.

Calling Sequence

Use this calling sequence for disc operation:

```
LDA TWO
SPB EXEC, 1
DEC ADDRESS
Return location . . . .
```

where ADDRESS is the memory location of the operation parameter list. This list must be prepared in the following format:

ADDRESS	Bits 0-4 - Operation code for disc 12_8 for Read MRADS File (RRF), or 37_8 for Write MRADS File (WRF). Bits 13-19 - Number of 64-word records to be read or written. This must be a number less than 97.
ADDRESS+1	Starting memory address to read into or write from.
ADDRESS+2	Disc address for read or write (may be negative as in special cases described a few paragraphs below).
ADDRESS+3	Flag location, set to indicate special conditions caused by this operation.

Procedure

As with the tape operation subroutine, entrance to the disc operation subroutine serves only to put the operation in a task list to be executed as a part of an API program. On entrance to the subroutine, ADDRESS+3 is set to zero and on completion of the disc operation, it is set to nonzero, with its contents indicating the return status of the specified operation.

The returns are as follows:

Bit ON	Indicates
19	Normal return, no special conditions.
4	An illegal disc address was specified.
2	An attempt was made to read or write more than 96 records.
1	A parity error occurred on the operation, but was recovered on a subsequent retry.
0	After 5 tries, the parity error persisted and bad parity was transferred to memory. User must remove bad parity from memory. (Try moving memory to memory.)

If ADDRESS+2 is negative on entrance to the disc subroutine, the EXEC will supply a scratch area if available. The address of this scratch area will be returned in ADDRESS+2. The user must keep track of his location on the disc and supply the correct addresses for subsequent operations. At present, the disc address supplied is at the beginning of a 6k block. The positions of this block may be addressed sequentially. Four such areas are available, thus four calls to the disc subroutine may be made with ADDRESS+2 negative. After four calls, negative calls will result in an illegal address (BIT 4) return.

TYPE SUBROUTINE

Function

Background programs must use the type subroutine when they need to type a message. Standard mode of the time-sharing system is Keyboard On (KON), and every effort is made to keep it that way. If this subroutine is not used, the typeout of a user message might be interrupted and a few cryptic comments inserted about the time-sharing system performance.

Calling Sequence

Use this sequence for the type subroutine:

```
LDA THREE
SPB EXEC, 1
DEC ADDRESS . . . . . .
```
where ADDRESS is the full 14-bit address of the message to be typed.

Procedure

The message to be typed may be up to 30 words long and must terminate with an end-of-message character (55/8). When the Type Subroutine has finished typing the message, a return to the normal time-sharing mode, KON, is made. Control returns to the Background Executive. Loading the A-register with a 3 with the sign bit set before entering the EXEC will cause a terminal exit to be executed after the desired message is typed out.

OVERLAY OR NEW PROGRAM CALL

Function

This subroutine permits calling another background program from within a program already running. It is not possible to do this without destroying at least part of the program already in memory, so the user must determine what memory areas the new program requires for loading. In addition, index groups 0 and 1 will be destroyed.

Calling Sequence

```
LDA FOUR
SPB EXEC, 1
ALF SYS
ALF TEM
ALF NA
ALF ME....
```

Four BCD words specifying the name of the program to be brought in.

Note: In calling both a new program, or giving a terminal exit to EXEC, the program should ensure that all peripheral output operations are complete, as no check is made on such an exit.

Procedure

After loading an overlay (or new program) control is transferred to the location specified by the program being loaded. There is no return to the overlay calling sequence.

EXECUTION OF SYSTEM API PROGRAM

Function

This subroutine permits a background program to execute a special operation as an API program. An example of this might be a card read.

Execution

To execute a background API program, put a BRU API (26xxxxx) into octal location 37000, where API is the location of the background API program.

Procedure

On every interrupt, the EXEC will execute an SPB 37000, 1 before exiting from its own API program. All significant registers (with the exception of AAU conditions) will have already been saved, and there will be an 8k bit in index register 3. When the return is made, the 8k bit must still be there. The return is BRU 1, 1.

Rule

The user's special program must not exit API (SET PST). It must not take more than 220 milliseconds to complete, under worst-case conditions. Any hang-up in the background API program requires that the GE-225/235 be reloaded from the DATANET-30. This results in a major hang-up of the entire system. It is impossible to call EXEC subroutines from a background API program. Users must do all tape and disc operations through the EXEC tape and disc operations subroutines.

SYSOUT SUBROUTINE

Function

The SYSOUT subroutine performs listable and punch output on magnetic tape for background programs. Tape 7 is used.

Calling Sequence

Use one of the following subroutines to call SYSOUT.

Direct Call:

```
LDA FIVE
SPB EXEC, 1
Control word 1
Control word 2
DEC DATA
--- Return Here ---
```

where DATA is the memory location of the data for the special operation.

Indirect Call:

```
LDA MIFIVE     (MIFIVE) = 2000005₈
SPB EXEC, 1
DEC ADDRESS
--- Return Here ---
```

where ADDRESS is a pointer to a three-word parameter list.

(ADDRESS) = Control Word 1
(ADDRESS+1) = Control Word 2
(ADDRESS+2) = Location of Data

Procedure

The EXEC picks up the control words and data and moves them immediately to the EXEC's buffer. When the output operation is completed, control returns to the background program.

The two control words function in the same way as do the two peripheral controller words used with the General Assembly Program instruction SEL.

The low-order bits of the second control word must always contain the number of words of output. Maximum output is 80 words.

Rules

Prepare the two control words by specifying the type of output operation to be performed as follows:

Operation	Control Words Contents
Print	Put a 1 in the low-order bits of control word one. The high-order bits are the same as the high-order bits of the normal printer controller word one. (Slew count LSB.) The last word in the print line must have bit 0 set. Specify the length of the output in the low order bits of word two. The high-order bits are the same as in the normal printer controller word two.

Operation	Control Words Contents
Set Format	Put a 2 in the low-order bits of word one. Specify the address of the horizontal format information to be used in all subsequent print-with-format records in word two. The high-order bits of the two words are the same as in normal printer controller words. If many lines are to be printed with this same format the Set Format call need only be made once.
Punch Decimal	Put a 7 in the low-order bits of word one. Specify the word count in the low-order bits of word two.
Punch Binary	Put a 10_8 in the low-order bits of word one. Specify the word count in the low-order bits of word two.
Punch Full	Put an 11_8 in the low-order bits of word one. Specify the word count in the low-order bits of word two.

The Exec uses tape 7 as SYSOUT tape. When a tape is full, it is end filed, rewound, and the Exec types out a message requesting a new tape 7. It then waits for SW19 to be toggled. The user need only give the call for SYSOUT as directed and his output will be executed.

Background Program Header Information

Every background program must have a seven word header as the first seven words of the program. The memory address assigned to these words may be any address, but they must be assigned an address. The seven words have the following significance:

Word	1	ALF	xxx	12-character BCD
	2	ALF	xxx	name by which
	3	ALF	xxx	this program
	4	ALF	xxx	will be called.
	5	OCT	xxxxx	Addresses of two memory locations to be used by the EXEC
	6	OCT	xxxxx	for buffering the loading of this program from the disc.
	7	OCT	xxxxx	Length of each of the above buffers, less than or equal to 2000/8.

Note: Neither the loading buffers described above nor the background program itself may overlay any of the following memory locations (all locations given in octal):

0 - 240; 34600 - 37777;

nor may they occupy any area occupied by the background program itself. The beginning addresses of the buffers and their length must be 0 modulo 64.

SYMMAINT—SYMBOLIC MAINTENANCE PROGRAM

General Description

SYMMAINT is a background program which may be used to build and maintain symbolic files on tape. This program can maintain multifile tapes in BRIDGE II format or single files consisting entirely of card images on the tape. The elements of each file are ordered by "sequence numbers", which are 5 digits in length and appear in the 26th and 27th words of each card image in the file. These sequence numbers are generated by SYMMAINT, and need not be punched into the input cards. SYMMAINT requires that the last card in the file have the literal END in columns 8, 9, and 10 and that no card in the file have a + in column 1.

Control Card Formats

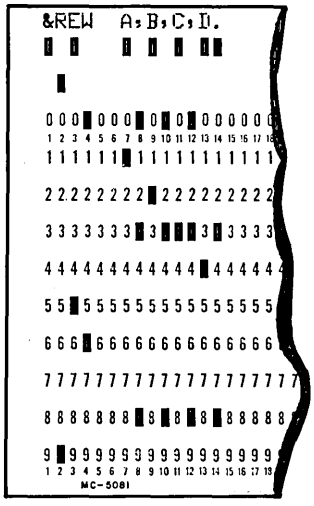
The following rules govern the preparation of SYMMAINT control cards:

Column 1	Enter a + for all SYMMAINT control cards.
Columns 2-6	Enter a three letter function code, followed by two blanks.
Column 7	Enter any required numerical parameters, separating them by commas and placing a period after the last one. EXEC scans cards that require parameters for these numbers and ignores blanks. The scan is terminated when EXEC reaches column 65 or detects a period. Control cards not scanned are +END, +FIN, +DIS, and +REM. In these cards, the contents after column 7 are not used as parameters.

The following two general control cards are valid for execution any time SYMMAINT is searching for control cards:

+REW (Rewind)

Format:

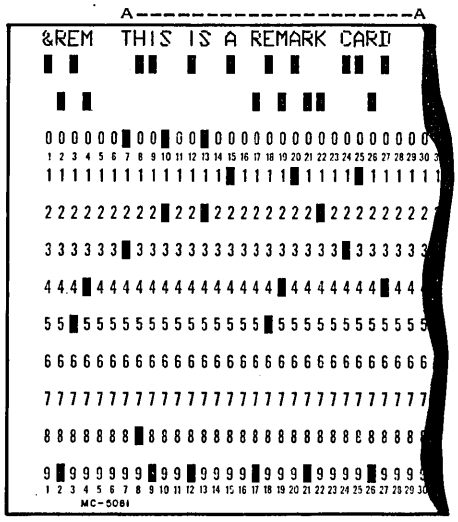


where a,b,c,d represent magnetic tape units which are to be rewound.

Use: SYMMAINT will rewind the specified magnetic tapes. All background activity ceases until no tapes are rewinding. Up to four tapes may be specified.

+REM (Remark)

Format:



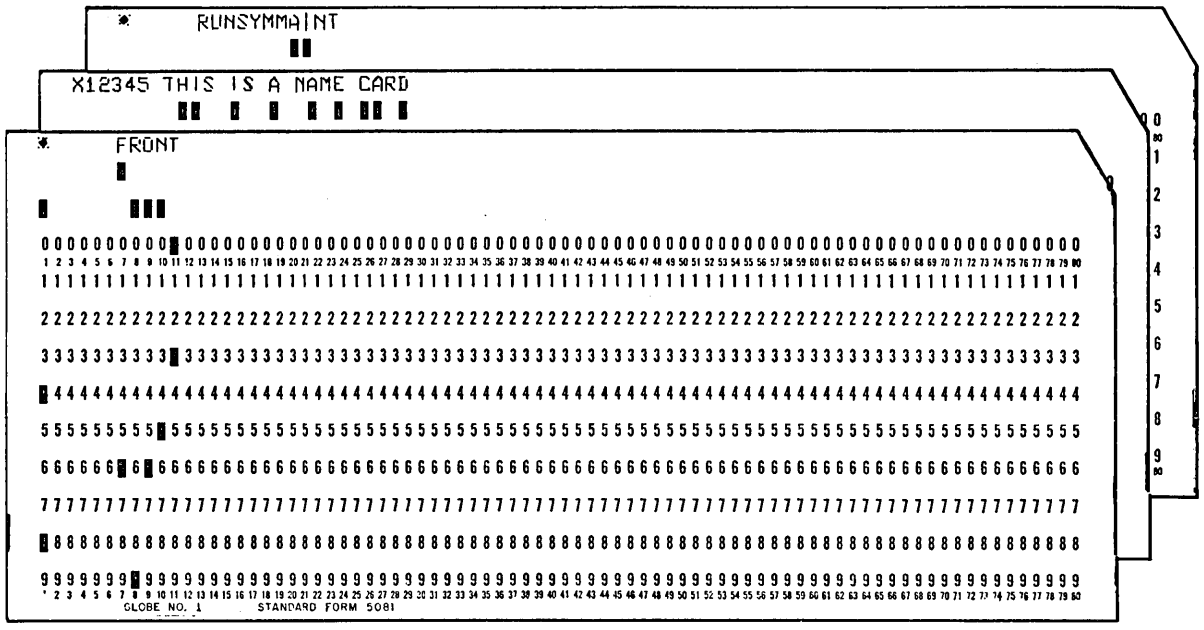
where a. . . . . a represents the remarks of the programmer.

Use: The contents of columns 7-78 are typed out on the console typewriter and all background activity halts until either switch 1 or switch 19 is toggled.

Both of these cards demand that the next card in the card hopper be a control card, or another +REW or +REM card.

Operation

Background call card deck for running SYMMAINT is as follows:



Building Tapes

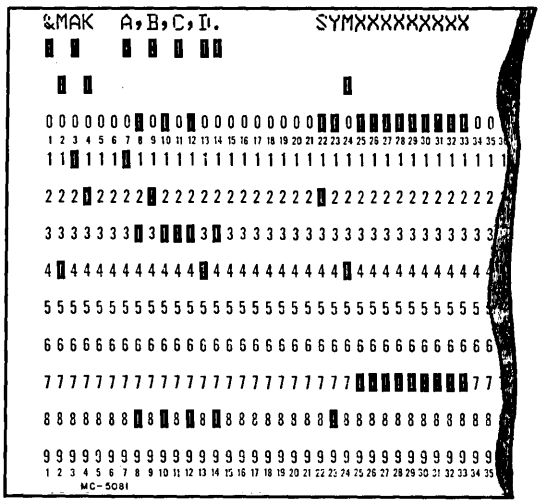
SYMMAINT builds a tape in the format of BRIDGE II, except that the run locators are all dummies and the symbol run locator (SRL) indexes are empty. SYMMAINT constructs multifile tapes and accepts input from the card reader or from auxiliary tapes.

Control Cards

To Create a New File:

+MAK

Format:



Where:

a = 0 means that the entire file will be read in from the card reader. SYMMAINT will read cards onto the tape until it detects and writes out a symbolic END card. Any control card occurring before the symbolic END card will be in error. After reading this card, SYMMAINT will demand another control card.

a ≠ 0 means that the file is on tape unit a, positioned on the first record of the file. SYMMAINT will read the tape, ignoring records which are not multiples of 27 words, until it has found and written out a symbolic END card.

b indicates the output tape unit. It should be initially rewound, since SYMMAINT writes a beginning tape label before the first file.

c indicates the number of card images per record on a physical tape (= the output blocking factor). It must be less than or equal to 75.

d indicates the resequencing increment. The first card will have sequence number d, the second 2d, the third 3d, etc.

SYM must begin in column 22.

x---x must be the next 9 characters after SYM, and indicates a 9-character program name.

Deck Setup: An illustration of a sample control deck follows in Figure 11.

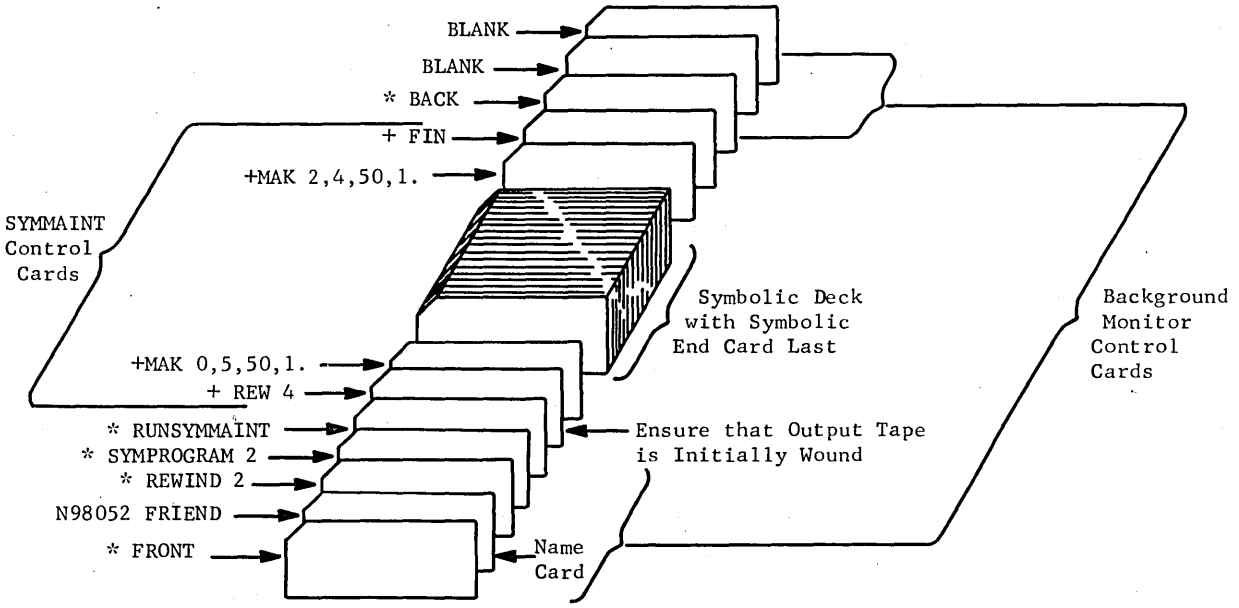
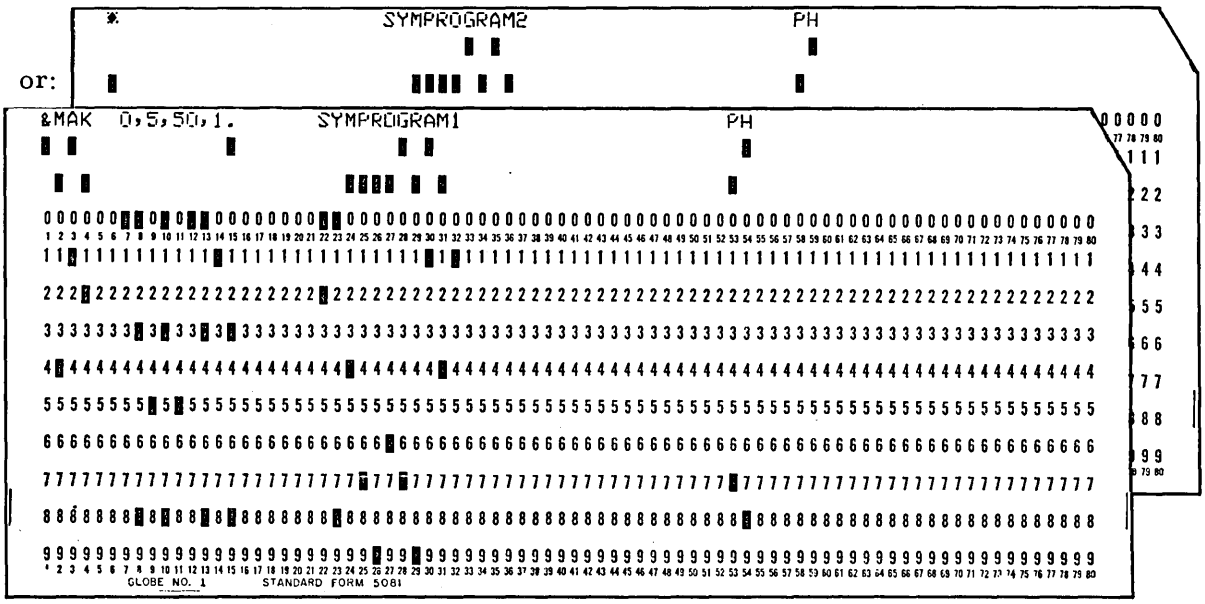


Figure 11. Sample SYMMAINT Control Deck

Note: On cards which specify symbolic run locators, the locator name must begin in column 22 and the tape plug and handler number in columns 53 and 54.

Thus:



CPB-1455

Subsequent Files

Three control cards may follow the +MAK card:

+REM card

+FIN card

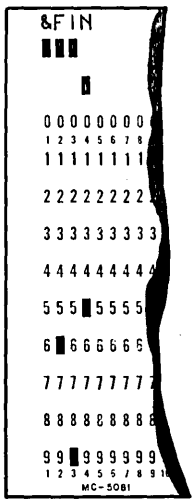
another +MAK card

For subsequent +MAK cards, the format is the same, except that parameter b (the output tape unit) is ignored. However, this parameter must be there.

To End the Tape:

+FIN

Format:



Use: Insert a +FIN control card after the last +MAK card. This card tells SYMMAINT to write an end-of-reel fence on the output tape. The user must not rewind this tape himself or the end-of-reel fence will be the first record on the tape. SYMMAINT then transfers control to the Background Executive.

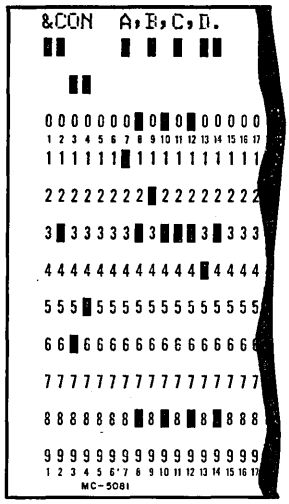
Maintaining Tape Files

SYMMAINT updates files while the tape is being copied from one tape to another. Tape copying is initiated with a +CON control card.

To Copy:

+CON

Format:



Where:

a indicates the input tape unit.
b indicates output tape unit.
c indicates the output blocking factor.
d indicates the resequencing increment.

Omitting c causes the output blocking factor to be the same as on the input tape.

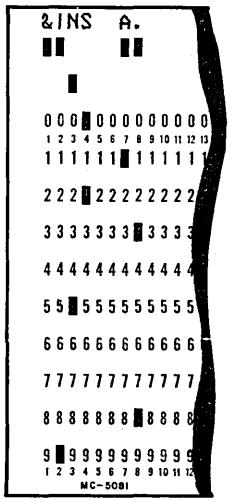
Omitting d results in no resequencing.

Use: When SYMMAINT detects a +CON card, it starts to copy from a to b, searching for the card images of the first file. Then it demands another control card to obtain the data needed to update within a single file. Use the following control cards for the functions as described.

To Insert:

+INS

Format:



Where:

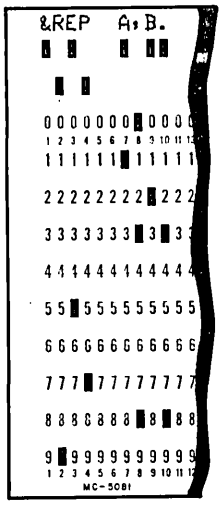
a indicates a specified card image on the input tape.

Use: SYMMAINT inserts after a, all of the cards in the input hopper, until it detects the next control card.

To Replace:

+REP

Format:



Where:

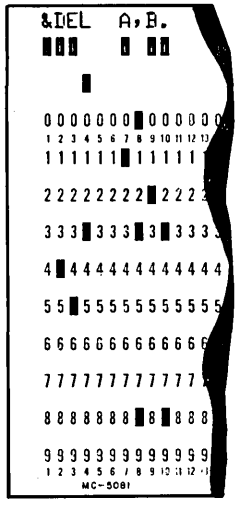
a and b indicate the beginning and end card images of a block on tape.

Use: SYMMAINT replaces all the card images on the input tape between a and b inclusive with the cards in the card hopper until it detects the next control card.

To Delete:

+DEL

Format:



Where:

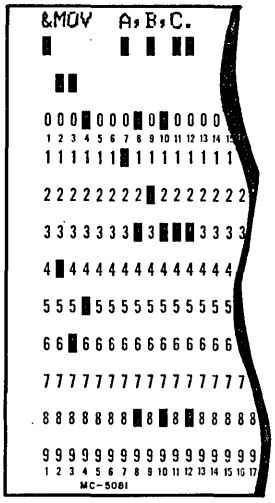
a and b indicate the beginning and ending card images of a block on tape.

Use: SYMMAINT deletes all card images on the input tape between a and b inclusive.

To Move:

+MOV

Format:



Where:

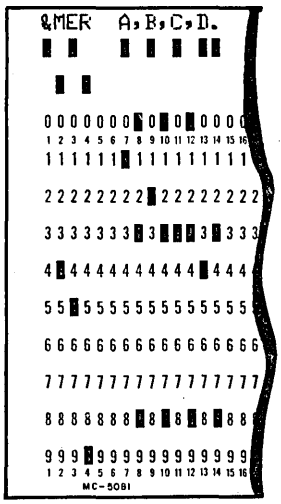
a,b, and c represent the sequence numbers of card images on the input tape.

Use: SYMMAINT moves the block of card images whose sequence numbers are b to c inclusive to a position in the file after a. Sequence number c must be greater than b. The block of cards may be anywhere in the file. SYMMAINT searches the input file for this block, copies it into place, and then restores the input tape to its previous position. The card images are not deleted from their old position on the input tape. They may be deleted with a +DEL card whether they come before or after a. (b<c<a or a<b<c). The MOV command where b<a<c makes sense and will be executed by SYMMAINT, but it would not make sense to then ask to delete the block from b to c.

To Merge:

+MER

Format:



Where:

a indicates the tape unit number.
b indicates a location on the master input tape.
c-d represent a sequence of locations on the auxiliary tape.

Use: SYMMAINT inserts, after location b, the card images from the auxiliary tape on unit a which have the sequence numbers c through d inclusive. The auxiliary tape should be located at the first record of the file from which you are merging. Both c and d must be in the forward direction from the position of the auxiliary tape. (If the auxiliary tape is positioned on card image x, then x<c<d.)

It is impossible to merge one part of the auxiliary tape to the output tape and then later to merge an earlier part of the same auxiliary tape onto the output tape. However, it is possible to merge from different handlers. The merge tape may be blocked up to 75.

Records on the tape which are not integral multiples of 27 words (= 0 modulo 27) are ignored. The BRIDGE II symbolic run locator record is mod 27, so the user must position the tape beyond it. SYMMAINT will allow merging the END card from the auxiliary tape only if its sequence number is equal to the last parameter on the +MER card. Otherwise, an error message will be typed "END CARD IN A STRANGE PLACE -- TERMINATING RUN." Refer to "Operations on Symbolic END Cards" for the control deck requirements for copying the END card.

When positioning the auxiliary tape to merge, the merge routine looks for the sequence number on the auxiliary tape which is equal to the third parameter on the +MER control card.

The merge parameter on the control card must match a sequence number on the merge tape or the error message SEQUENCE NUMBER NOT EXACT MATCH will occur.

SYMMAINT ignores blank cards which it finds in the hopper unless switch 18 is down. If switch 18 is down, SYMMAINT accepts blank cards and inserts an asterisk (*) in column 81.

Place the control cards in the control deck in ascending order by the first parameter which refers to a sequence number. In some cases the same sequence number may appear several times. It is permissible to insert several blocks of cards after a given card.

Example:

The following examples illustrate correct and incorrect sequences.

This sequence will work:

```
+MOV   100,50,250.
+INS   100.
+MER   4,100,90,110.
+INS   100.
```

This sequence will not work:

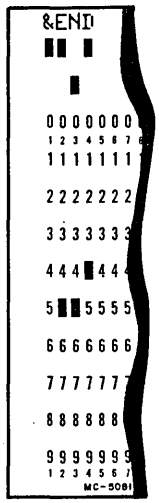
```
+DEL   100.
+INS   100.
```

When all necessary corrections to a file have been completed, close the file with a +END control card.

To Close the File:

+END

Format:



Use: SYMMAINT continues to copy until it finds the next end-of-file or the end-of-reel fence. It then demands another control card.

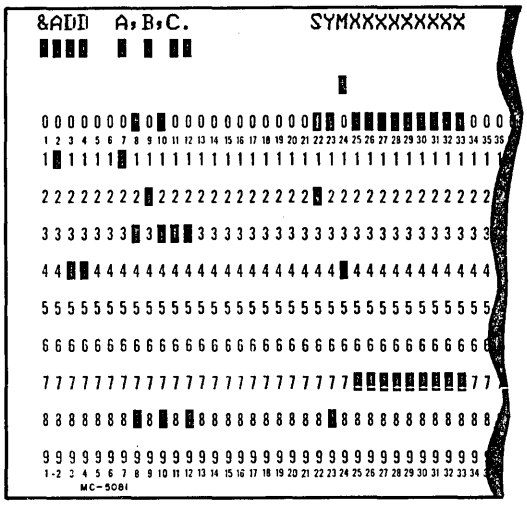
Other Cards Used During Copy Process

Two additional control cards are available for manipulation of entire files during the copying process. Each can be used correctly only when SYMMAINT has just detected another file (or in the case of +ADD, the end-of-reel fence).

To Add a File:

+ADD

Format:



Where:

a = 0 means input from cards.

a ≠ 0 means input from tape unit a as described for +MAK.

b indicates the blocking factor. This changes the blocking factor for all subsequent files until it is again changed by an +ADD or +CON card. If b is omitted the blocking factor remains unchanged.

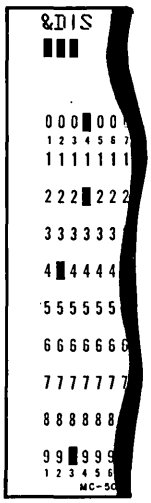
c if present, indicates a number which changes the sequencing increment.

SYMx--x indicates a 12-character program name. The SYM name serves to introduce a new file onto the output tape. It must begin in column 22.

To Discard a File:

+DIS

Format:



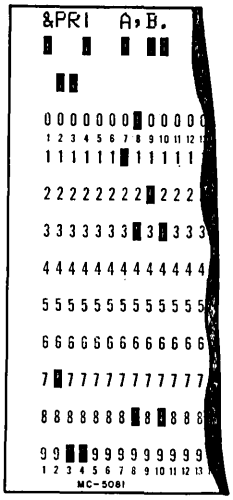
Use: SYMMAINT does not copy the file currently positioned onto the output tape.

Output Control Cards

To Print:

+PRI

Format:



Where:

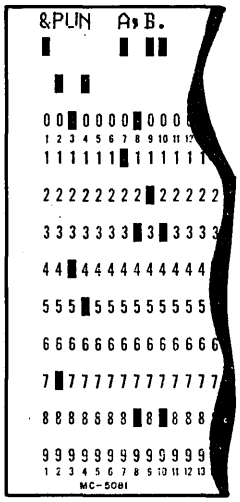
a and b represent the beginning and ending sequence number of the card images on tape.

Use: SYMMAINT causes all card images written on the output tape between sequence numbers a and b inclusive to also be printed while the input tape is positioned on these card images. For example, a +PRI 0,99999 card placed before the first correction of a given file would cause the whole file to be printed out as corrected by that run. If switch 9 is down, the output will be direct, otherwise it will be via SYSOUT.

To Punch:

+PUN

Format:



Where:

a and b represent beginning and ending locations for card images on tape.

Use: SYMMAINT performs the same as for PRI, except that the output is punched in decimal cards. If switch 9 is down, the output will be direct, otherwise it will be via SYSOUT.

Operations on Symbolic END Cards

The symbolic END card is essential to the successful operation of SYMMAINT. This card must be the last card in the symbolic deck. SYMMAINT performs special checking procedures to ensure the accuracy of this card. If, while correcting a file, the user attempts to put an END card into the file, SYMMAINT checks to see that this was very last operation intended for the file.

The criteria used are:

- The next card in the card hopper is a +END card or a +ADD card.
- On a +MOV or a +MER control card, the sequence number is equal to the last parameter on the control card.

If these conditions are true, the END card will be written out and the rest of the input file will be skipped. Otherwise, SYMMAINT will type a terminal error message and end the program.

Likewise, if while executing a +DEL or +REP, SYMMAINT detects that it is deleting the END card from the input tape, it also checks to ensure there is a symbolic END card followed immediately by a +END card. If this is not the case, SYMMAINT types a terminal error message and ends the program.

Any time that SYMMAINT detects a symbolic END card when one is not expected, it types an error message and ends the program. This condition might be caused by an attempt to insert a card after the symbolic END card, an attempt to move cards to a position after the END card, an attempt to move a block of cards from a position past the symbolic END card, or an attempt to merge from a position on the auxiliary tape which is past the symbolic END card.

All terminal errors concerned with symbolic END card are serviced by one general error message: END CARD IN A STRANGE PLACE -- TERMINATING RUN.

Error Messages

Card Error Messages:

NO END CARD SW 1 TO EXIT, SW 19 TO COPY ON

SYMMAINT found a +FIN card while attempting to copy a file from one tape to another. The usual cause of this is too few +END or +DIS cards. The total number of +END and +DIS cards must equal the number of files on the input tape. Restart to correct.

+ADD OR +DIS CARD AT WRONG TIME -- TERMINATING RUN

+ADD and +DIS cards can only appear in three places; immediately after a +CON card, immediately after a +END card, or immediately after a symbolic END card. At the time of this message, the tapes are both out of position. Restart to correct.

END REEL FOUND BEFORE A +END OR +DIS CARD -- TERMINATING RUN

SYMMAINT has been requested to close out or delete a file after it has discovered an END REEL fence on the input tape. The tape will have been copied correctly up to the point when the error was detected.

END CARD IN A STRANGE PLACE -- TERMINATING RUN

SYMMAINT detected a symbolic END card in an incorrect position. SYMMAINT terminates the program.

CONTROL CARD ERROR, 1 TO REREAD, 19 TO SKIP IT (followed by the first half of the erroneous control card).

This error means one of the following:

- SYMMAINT was searching for a control card and didn't find it.
- The control card format was wrong. (Check especially for missing parameters or period.)
- The control card was out of sequence in the control deck.
- The first parameter on the control card was not equal to a sequence number on the input tape.

Note: The last restriction does not apply to +PUN and +PRI cards.

After this message, the next fifty output cards will be printed on the high-speed printer.

Tape Error Messages:

END OF TAPE, HDx (where x indicates the tape unit number)

SYMMAINT found the physical end of tape on the tape unit specified. It continues copying until the operator depresses switch 0 and manually aborts the program.

TAPE READ ERROR HDx

The Background Executive has already tried the operation five times. SYMMAINT accepts all tape write errors since the Background Executive has already erased past the faulty section of tape.

SERVICE PROGRAMS

Loaders

The GE-200 Series Time-Sharing System uses several loading routines. A functional description of each of these routines follows.

GE-225/235 16k BINARY/OCTAL CARD LOADERS. (Self-loading) Cards to be loaded into upper memory must have the 0-row in card column 1 punched. The binary cards may be single or multiple origin. This routine also loads octal correction cards, which may be single or multiple origin. The initial address on each octal correction card must begin after column 2. Fields of more than one and less than six characters are considered by the loader to be addresses. Fields of more than five characters are interpreted as corrections. Each address and/or correction must be separated by at least one blank column. Scan of the correction card is terminated by a single character field or upon reaching column 80.

Loading terminates when the loader encounters a binary transfer card. The routine then transfers control to the location punched in the binary transfer card. Checksum errors cause the loader to hang in a loop (BRU *). Recovery from checksum error is effected by backspacing two cards in the reader, pushing the A→ I switch, and depressing START.

This loader is contained in three binary cards.

DATANET-30 EXECUTIVE LOADER. (Not self-loading) An ordinary binary loader (such as the GE-235 Binary/Octal Card Loader above) must be placed in front of this loader to start the loading process. The DATANET-30 Executive loader loads DATANET-30 binary cards containing the DATANET-30 Executive, plus any octal corrections, into the GE-235 memory. This loader then writes the Executive onto the disc in four blocks of 4k words each. The beginning disc addresses of the blocks are: 100, 500, 1100, and 1500. The octal correction cards must be in the same format as those for the GE-225/235 16k Binary/Octal Card Loader.

Checksum errors cause the loader to hang on a BRU * at octal location 10111. Recovery is effected by backspacing two cards in the reader and depressing the MANUAL, A→ I, AUTO, and START switches.

DATANET-30 PPT BOOTSTRAP LOADER. This loader is punched into paper tape, which is made into a continuous loop and placed in the DATANET-30 paper tape reader. If for any reason the DATANET-30 goes into a hardware-load condition, this loader is read in by the DATANET-30 hardware. The loader, in turn, reads in the DATANET-30 Executive from the high speed tracks of positions 0, 1, 2, and 3 on disc 0, and transfers control to the Executive.

DISC CARD IMAGE LOADER. The Background Executive loads this loader into the GE-225/235 memory. The Disc Card Image Loader loads the required background program into the GE-225/235 memory from the disc.

The Background Executive enters the loader in group 0 with index register 2 pointing to a list with the following items:

Word	Contents
0	System name
1	with blanks
2	replaced by
3	zeros
4	Loader code
5	Disc address of first program record
6	Dump code: 0 -dump is to the disc not 0 -dump is to tape 7 and disc
8	Disc address of background catalog

Each background program is stored on the disc in blocks of 1k or less. The first record (i.e., block) is 64 words in length. Each block will be in the same format.

The first four words in each block constitute a record header which points to the next block.

Word	Contents	
1	Z12 n	disc read (n indicates the number of records to read)
2	Z00 m	command (m indicates the memory address to read into)
3	OCT	position of record on disc
4	DEC 0 or 1	buffer flag
	0	no buffering for next read
	1	buffering on the next read

The remainder of the record consists of load strings, each of which has a two word load-string header:

Word	Contents	
1	Z00 m	memory address of string
2	DEC -L	where L indicates the number of words in the string. The L words following the load-string header are to be moved to memory location m.

The last load string in the record is followed by a one-word trailer flag which is zero if there is another record to be read in. The trailer flag has the sign bit set ON if there are no more records. In this case, the remaining bits contain the address of the first executable instruction of the program.

If a non-recoverable disc-read error occurs during loading, the message SYSTEM NAME MUST BE RELOADED-RUN ABORTED is typed and a terminal exit is made to the Executive.

The Disc Card Image Loader must be loaded into the GE-225/235 with an ordinary 16k binary loader, but it writes itself onto the disc.

BATCH BINARY CARD LOADER. The Background Executive reads this loader into the GE-235 memory when it encounters a * BINARY control card. The batch binary card loader reads a background program punched in General Assembly Program binary cards plus any octal correction cards from the card reader into the GE-225/235. The loader is self-loading onto the disc, but is not self-loading into the GE-225/235 memory from cards. An ordinary 16k binary card loader may be used for this purpose. (Refer to "GE-225/235 Binary/Octal Card Loader.")

The format for octal correction cards follows:

Columns 1 and 2 — Leave blank to define the octal correction card as such.

Columns 3 to 76 — Begin fields in these columns. Fields are defined as any consecutive string of non-blank columns, delimited by one or more blank columns. Upon detecting such fields the octal correction routine takes the following action:

1. A 1-column field causes the octal routine to ignore the remainder of the card, which may be used for comments or left blank.
2. Fields of from two to five characters are assumed to be addresses and set the octal address accumulator in the routine.
3. Fields of six or more characters are assumed to be instructions. They will be stored in the address presently in the octal address accumulator. The address in the accumulator is then incremented by 1 and saved. Thus, it need not be reset for continuous blocks of corrections. Corrections in upper memory must have the full upper memory address.

Background Assembly Programs

Assembly programs for the GE-225/235 and the DATANET-30 are included in the GE-200 Series Time-Sharing System as background programs. Since these programs have most of the same features as the standard Computer Equipment Department assemblers, only the difference between the two will be noted here. The reader is referred to the following publications:

CPB-374, GE-235 Central Processor Reference Manual, Chapter VII, and CPB-1250, General Assembly Program (Appendix A to DATANET-30 Programming Reference Manual).

The current version of the GE-235 Executive program for the GE-265 Time-Sharing System, as well as the current versions of the ALGOL and BASIC compilers, must be assembled using the background version of the GE-235 General Assembly Program. This is because the symbol tables of these programs have become too large to be accommodated by the standard version. The symbol table sizes of the two assemblers are: ST1 = 250, ST2 = 1600.

The assembly programs are run as background jobs on the time-sharing system. They are called by the following card sequence:

	Card	GE-265	GE-255
	1	* FRONT	S-card
	2	Name card	BAT
	3	* SYMxxxxxxxxx	* FRONT
	4	* RUN235GAP	Name card
or			SYMxxxxxxxxx
	4	* RUND30GAPPO	* RUN235GAP
		* BACK	* RUND30GAPPO
		2 blank cards	* BACK
			2 blank cards

Card 3 is used if the symbolic input is in the form of card images written on a tape on plug 1 and handler 4 in BRIDGE II or SYMMAINT format. GE-225/235 General Assembly Program has the option of reading symbolic cards from the card reader. This option is not available in DATANET-30 General Assembly Program. A set of condensed operating instructions for both assemblers is given within this assembly description.

The symbolic function code set is the same as for the standard versions of the assemblers with the following additions:

Function Code Mnemonic	Name
STL	Subtitle

This instruction allows a subtitle to be added to individual sections or pages of the assembly. The desired subtitle is punched in columns 31-75. The function code NAM is identically equal to TTL in function.

Only the contents of columns 12-75 of a card containing a REM function code are printed and these columns are shifted left six characters.

Condensed Operating Instructions

GE-200 Series GENERAL ASSEMBLY PROGRAM. If symbolic input is from BRIDGE II or SYMMAINT format tape, use the following background program call cards:

Card	GE-255	GE-265
1	S-card	* FRONT
2	BAT	Name card
3	* FRONT	* SYMxxxxxxxxx
4	Name card	* RUN235GAP
5	SYMxxxxxxxxx	* BACK
6&7	* RUN235GAP	2 blank cards
	* BACK	
	2 blank cards	

If the symbolic input is from the card reader or from a symbolic tape containing straight card images, use the following background program call cards:

Card	GE-255	GE-265
1	S-card	* FRONT
2	BAT card	Name card
3	* FRONT	* RUN235GAP
4	Name card	* BACK
5&6	* RUN235GAP	2 blank cards
	* BACK	
	2 blank cards	

Console switch settings:

Switch 5 Up - absolute assembly
Down - relocatable assembly

Switch 6 Up - binary card output will be Dartmouth 16k format
Down - binary card output will be in GAL Loader format

Switch 7	Up - binary cards will be single origin Down - binary cards will be multiple origin
Switch 8	Up - listing written on SYSOUT tape on TU7 Down - listing printed on the on-line printer
Switch 9	Up - binary card output written on SYSOUT tape, TU7 Down - binary cards punched on the on-line punch
Switch 16	Up - symbolic input from a tape on TU4 Down - symbolic input from the card reader

Tape assignments: all tapes on plug 1

Symbolic input from tapes:

Tape	Use
2	Scratch
4	Symbolic input
7	SYSOUT (if used)

Symbolic input from cards:

Tape	Use
2	Scratch
4	Scratch
7	SYSOUT (if used)

DATANET-30 GENERAL ASSEMBLY PROGRAM. If symbolic input is from a BRIDGE II or SYMMAINT format tape use the following background program call cards:

Card	GE-255	GE-265
1	S-card	* FRONT
2	BAT card	Name card
3	* FRONT	* SYMxxxxxxxxx
4	Name card	* RUND30GAPPO
5	* SYMxxxxxxxxx	* BACK
6&7	* RUND30GAPPO	2 blank cards
	* BACK	
	2 blank cards	

CPB-1455

If symbolic input is from a tape containing straight card images of one file, use the following background program call cards:

Card	GE-255	GE-265
1	S-card	* FRONT
2	BAT card	Name card
3	* FRONT	* RUN30GAPPO
4	Name card	* BACK
5&6	* RUN30GAPPO	2 blank cards
	* BACK	
	2 blank cards	

Console switch settings: none

Tape assignments:

Tape	Use
2	Scratch
4	Symbolic input
7	SYSOUT

Card-to-Disc Program

GENERAL DESCRIPTION. The Card-to-Disc program may be used to put background-compatible programs onto the disc. These programs may then be called by name from disc to be run. This eliminates the need to load the binary deck for every run of the program.

OPERATION.

Preparing to Use the Program. The only requirement for putting a program on the disc is the binary deck of the background-compatible program, with the following restrictions:

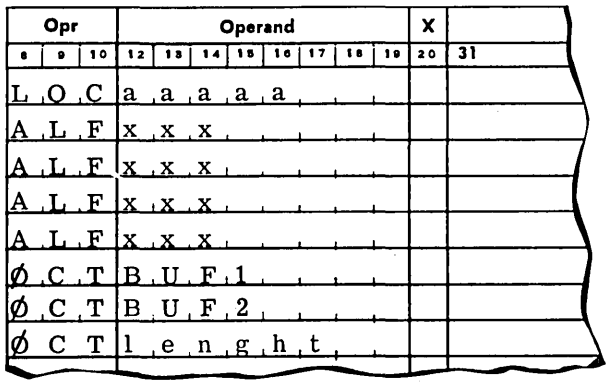
- The first seven words (instruction words) of the binary deck must contain the information listed below.
- These seven words may be the first seven assembled words, or they may consist of a seven word octal correction card appended to the front of the deck.
- Although these words must be assigned addresses, the addresses are ignored. Only the contents of the seven words are significant.

The contents of the seven words is as follows:

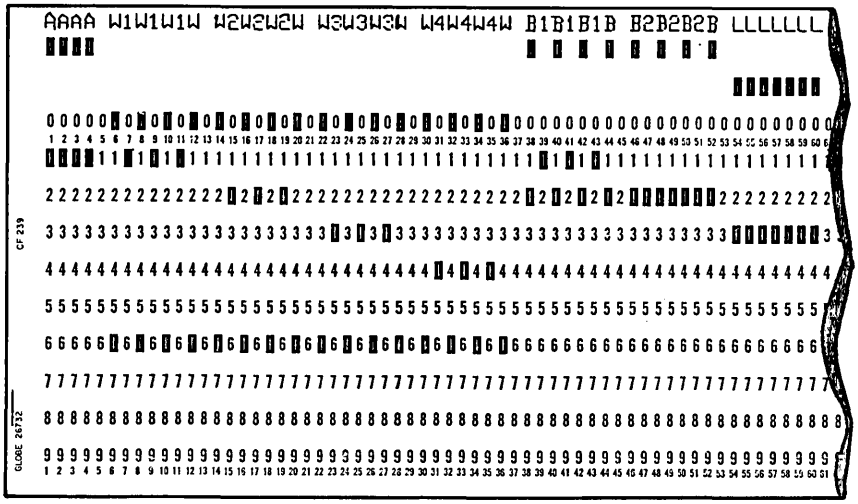
Words 0-3	ALF xxx ALF xxx ALF xxx ALF xxx Where xxxxxxxxxxxx indicates a 12-character name for the program. Conventionally this name begins with RUN, but this is not required. If the name is less than 12 characters, fill the field with zeros.
Words 4-5	Memory addresses of the two memory buffers used in loading the program from the disc.
Word 6	Length of the above two buffers. Buffer addresses and length chosen must not overlay the program or each other.

As an additional consideration in allocating memory, a "Disc Card Image Loader" which will eventually load the background program, resides at $35500\text{-}36000_8$. Neither the program nor the buffers may overlay this loader.

The format for seven assembled words is:



The format for a seven-word octal correction card is:



Where:

a = address
w1 = first word of program name
w2 = second word of program name
w3 = third word of program name
w4 = fourth word of program name
b1 = first buffer address
b2 = second buffer address
l = buffer length

CPB-1455

Using the Card-to-Disc Program. A program prepared in the format specified on the previous page may be written on the disc by following these steps.

1. Place the binary deck for this program in a background program call deck with this format:

Card	GE-255	GE-265
1	S-card	* FRONT
2	BAT card	Name card
3	* FRONT	* CARDTODISK
	Name card	Binary Program Deck
4	* CARDTODISK	* BACK
5&6	Binary Program Deck	2 blank cards
	* BACK	
	2 blank cards	

2. Place this deck in the card reader.

3. Type BAT on the console typewriter.

The Card-to-Disc program will read the binary deck and write the program onto the disc as card images. The console typewriter will type READY when the loading operation is complete.

After the program has been loaded onto the disc, it may be called for running by the following background program call deck:

Card	GE-255	GE-265
1	S-card	* FRONT
2	BAT card	Name card
3	* FRONT	* xxxxxxxxxxxx
4	Name card	* BACK
5&6	* xxxxxxxxxxxx	2 blank cards
	* BACK	

where xx----x represents the program name given in the background program header information (which see) for this program.

The Card-to-Disc program puts the background program on the disc in a series of linked disc blocks. Each block specifies the address of the next block. The program picks up available disc addresses from address 3660 on the disc, and sets them not available when they have been used. It also modifies a card catalog located at 3662 on the disc so that the program name will be recognizable to the Background Executive.

When an * xxxxxxxxxxxx card is read by the Background Executive, the executive supplies the address of the first program record in the named program to the Disc Card Image Loader located at 35500 (mentioned above). This loader then brings in the linked disc records of the named program, and transfers control to the location specified on the transfer card in the original binary deck.

Disc Edit Routine

GENERAL DESCRIPTION. The Disc Edit program is run to "compact" the contents of the disc storage unit (DSU). It eliminates "holes" or gaps in the catalogs where programs have been "unsaved", and moves the programs down into unused areas. The obvious application of the Disc Edit program is to make more room available when the DATANET-30 Executive says "NO MORE ROOM IN SAVED STORAGE", when, in fact, room exists because of programs having been unsaved. The Disc Edit program may also be used to discard unwanted, saved programs on the basis of their coded date.

The Disc Edit program is run as a straight batch job with the DATANET-30 halted. It reorders the saved programs and writes them out on tape unit 3 in the same format as that used by the GE-225/235 Exec "DUMP" function. This enables the resulting edited tape to be reloaded onto the disc with the GE-225/235 Exec "LOAD" function.

OPERATION.

1. Mount tape with write rings on tape units 2 and 3.
2. Push SINGLE CYCLE on the DATANET-30 console.
3. Clear the DSU Controller.
4. Manually load the Disc Edit program deck.
5. The GE-225/235 will hang in a loop waiting for entries in the console switches. If it is desired merely to compact the disc, without purging any programs from it, toggle switch 0. If it is desired to edit out (discard) all programs between two coded dates, then enter the lower coded date (LCD) in the control switches in octal, right adjusted. Then depress (not toggle) switch 0. Then set the upper coded date (UCD) into the control switches, in octal, right adjusted. Raise switch 0. The Disc Edit program will edit out all programs on the disc whose coded dates are between the LCD and UCD, inclusive.

Programs which are discarded are written onto tape unit 2 in the following format:

1. File 1- One 30-word label record containing GENERAL ELECTRIC CO. TIME SHARING SYSTEM EDIT TAPE LCxxxUCyyy.
   Where xxx indicates the lower coded date entered in the console switches, and yyy is the upper coded date.
2. End of file.

3. File 2- the edited programs, one program per record, each record carrying a six-word header containing the following information:

Word	Contents
1	User
2	Number (BCD)
3	Problem
4	Name (BCD)
5	Length of program expressed as the number of disc records necessary to contain it.
6	Length flag from the catalog. This flag will = 0 for a 64 word program = 1 for a 128 word program = 2 for a 256 word program = 3 for a 512 word program = 4 for a 1024 word program = 5 for a 2048 word program

4. End of file.

Catalogs and programs to be retained are written onto tape 3, one program per record, each record containing a two-word header with the following information.

Word 1- Beginning disc address of this record

Word 2- Number of 64-word disc records necessary to contain this record.

If more than one tape 3 is necessary, the program will write an end of file on the original, and request a new scratch on 3. When the new tape is mounted, switch 0 should be toggled to continue the program.

Upon completion of the edit, the program will write end-of-file marks on 2 and 3, and rewind them. It will then type REALLOCATION DONE, and stop.

8. COMPILER SYSTEMS

SYSTEM INTERFACE AND PROGRAMMING CONVENTIONS

This section describes how to prepare a foreground compiler system for the time-sharing system. It explains how the system and the GE-225/235 interact. Conventions which must be observed in preparing a compiler system are listed.

Functions of the GE-225/235 Executive

The GE-225/235 Executive (Exec) performs the following functions:

- Brings in the compiler system (CS) from the disc under the direction of the DATANET-30.
- Unpacks the CS, if desired, once it has been loaded into the GE-225/235. (That is, the programmer may specify that a portion of the CS be moved by the Exec to another location in memory. Such specification is part of the CS Header Information, which is discussed later.) This feature allows code or constants to be loaded as part of the CS, moved to lower memory by the Exec, and more code to be loaded at the same place in upper memory as an overlay.
- Supplies the edited source program at octal location 6000.
- Transfers control to the specified starting location. (Refer to "CS Header Information".)
- At the end of the scheduled time interval or when the CS generates a full output buffer, saves the information needed for restart and dumps the 6k area (4000_8 to 17777_8) onto the disc. The DATANET-30 Executive retrieves the output area (4100_8 to approximately 6000_8) for output on the current user's teletypewriter.
- Upon request of the CS, transfers the output area to the disc and tells the DATANET-30 that the current run has been completed.

The GE-225/235 Executive will also perform the following functions if given the appropriate call.

- Terminal Exit - Transfers output to the disc and terminates the run. Calling Sequence: BRU 20000_8 (hereafter called EXEC) with a 0 in the A-register.
- Intermediate Output Exit - When a program has generated 1000 (or less) words of output and cannot continue until the output area has been cleared, a call for intermediate output is made. The Exec transfers the output to the disc, clears the output area, resets the output area pointer, and returns control to the location following the SPB.

  Calling Sequence: SPB EXEC, 1 with a 1 in the A-register.

- Input Call - Transfers the output area to the disc, resets the output area pointer, accepts one line of input from the teletypewriter and places it in octal location 4100 and the words which follow. The CS must furnish a question mark as the last printable character of output. If no output is waiting, the question mark must be supplied anyhow. An end of message (EOM, $55/_8$) must be the last character in the output area when the call for input is made.

  Calling Sequence: SPB EXEC, 1 with a 2 in the A-register. Returns control to the word following the SPB.

- Overlay Call - Allows one overlay (in addition to the main system) to be called into memory. Only one such overlay may be in memory at any one time.

  Calling Sequence: SPB EXEC, 1 with a 3 in the A-register. (Refer to "System Overlay Call" later in this chapter.)

- Overlay Delete Call - Stops the overlay from being brought in every time the program is restarted when the overlay is no longer needed.

  Calling Sequence: SPB EXEC, 1 with a 4 in the A-register. Returns control to the location following the SPB.

  If the compiler is simply exchanging one overlay for another, no delete call is required. Only one overlay is permitted at a time and an overlay call deletes any previous one.

- Disc Operations Call - Allows the CS to read or write on the disc. The calling sequence is explained in detail under "Disc Usage" later in this chapter.

Programming Conventions

The following conventions must be observed when preparing a time-sharing compatible compiler system.

The system may use decimal mode (DECMODE) only out of API (with PBK set). However, the system may not be out of API more than 220 ms in the worst case.

When considering program modification, keep in mind that the only area of memory you can be sure will be saved is the 6k area. Program and constants in upper memory or at octal location 1400 are not dumped and will be reloaded in their original form.

You may modify instructions temporarily in upper memory by setting the priority break (PBK). PBK must also be set during the transfer of output information because the pointer to the output area will be reset to 0 when the program is restarted. The following sequence of instructions would cause a loss of information:

```
LDX  OUTPNT,3      (OUTPNT EQ0 4001)

     (An interrupt may occur here)

STA  OUTPUT,3      (OUTPUT EQ0 4100)
```

A correct sequence of instructions would be:

```
SET     PBK
LDX     OUTPNT,3
STA     OUTPUT,3
INX     1       ,3
STX     OUTPNT,3
SET     PST
```

WARNING: The GE-225/235 Executive and the DATANET-30 must communicate with each other. Communication is effected by hardware interrupts, and cannot be made with PBK set. The CS may operate with PBK set for no more than 220 milliseconds, after which the DATANET-30 will bootstrap the GE-225/235 Executive.

If a CS uses the trapping mode, the TRPMODE index group and "branch to" location must be initialized when the CS is first entered. These locations will be saved and restored by the Exec on subsequent dumps.

The AAU mode of operation must be set by the CS when it is first entered. This is also true for index register. The CS must also save its own index registers before making subroutine calls to the Executive.

The CS must provide for the time message that is typed at the end of a run. The executives do not perform this output.

Memory Allocation

The table which follows outlines the use of memory when running a time-sharing compatible system.

Octal Location	Contents
1400-3777	Constants and/or program. This area is not saved when a program is dumped. When reloaded, this area may assume its original form. No modification should be made to the contents of this area.
4000	Starting time. This location contains the adjusted starting time, the C-register image of the program run. The GE-225/235 Executive updates this location. The current C-register time minus this location equals the actual elapsed time for the current program (including swap time).
4001	Output area pointer. The output area is assumed to begin at 4100. The pointer is set to the word after the last data word in the output area. The output pointer is relative to 4100 and is equal to the number of words in the output area.
4003	Length of source program. This number is the smallest integer greater than, or equal to, the actual source program length in words, divided by 64. (This is the number of disc records used.)

Octal Location	Contents
4004-4077	The Executive uses these locations for storing restart information.
4100-17777	This area must contain all working storage, variables, and flags of the running program except for information stored on the disc. The output region, by convention, starts at 4100 and extends no more than 1000 words; it may not extend past 5777. (The area from 4100 to 6000 is referred to as the 2k area. The area beginning at 12000 is referred to as the 3k area.)
20000-20010	System header information.
20011-33777	The current system.

Note: The area from $4000/_8$ to $17777/_8$ is known as the "6k area." It is saved when a running program is swapped out of the GE-235, and is restored before the program is restarted. Information in any other area in memory may be restored to its original state upon restart of the program.

A long system may be divided into two parts, the compiler program and the run-time portion. The run-time portion can be called in as an overlay when the compiler is no longer required. During compilation, the 3k area is available for working storage.

If possible, an overlay should replace the whole compiler even if portions are repeated. This is because of the length of time required to load both a compiler and an overlay.

Compiler System Header Information

Each time-sharing compatible system must include certain information for the GE-225/235 Executive in its header. The format is fixed and must be followed for systems, overlays, and replacements.

The header words start at octal location 20000. The format follows:

Word No.	Octal Loc.	Contents
0	20000	System exit location. The Executive supplies the branch when the system is brought into memory.
1	20001	Entry point. The Executive transfers here to begin running a program.
2	20002	Spare
3	20003	Spare
4	20004	Alphanumeric system name. Only the first three letters are used.
5	20005	Number of replacement of overlay. A zero is used for systems. If it is an overlay which destroys the system or replacement that called it, the sign bit is set ON.

Word No.	Octal Loc.	Contents
6	20006	Relocation constants. A zero in word six means no relocation will be done by the Exec to the CS.
7	20007	If word six is nonzero the Exec will move - (minus) the number of words specified by word seven from the location in memory specified by word eight to the location in memory specified by word six.
8	20010	

Example:

Word No.	Octal Loc.	Contents	
6	20006	0004000	Move to Loc. $4000/_8$
7	20007	3777000	$1000/_8$ words
8	20008	0021000	From Loc. $21000/_8$

System Overlay Call

An overlay may be used to supplement or replace part or all of a system. If a system is replaced by an overlay, only the replacing overlay will be called back in after swaps; furthermore, system replacements may have their own overlays.

Two conventions must be rigidly adhered to:

1. All systems, overlays, and replacements must have the same heading information in the same format.

2. The numbering system for overlays, replacements, and systems must be unique, that is, if overlays, replacements and systems are considered as integral units of core, then each of these units must have a unique identifying number in the word after the system name.

The calling sequence is as follows:

A — SPB EXEC, 1 with a 3 in the A-register.

A+1 — Replacement number of current unit in memory, unless a new replacement is being called, in which case this should have the number of the new replacement. This is the only case in which overlay and replacement numbers may match up in the calling sequence. (See next item.)

A+2 — Number of overlay being called. If the overlay destroys the system currently in memory, then this word should have the sign bit on. This is so that if a dump occurs while the overlay is being brought in, the Executive will not needlessly read in the system again for a new problem.

A+3 — Length of overlay in words. This will be truncated, so if length is not an exact integral multiple of 64 words, it should be extended at least as far as the next 64-word multiple.

A+4 Memory address, where the overlay is desired, which must be an integral multiple of 64 words.

A+5 Return here.

Disc Usage

The Exec allows a CS to either read data from a specific disc address, or to acquire and use scratch areas on the disc. Each CS may use up to forty-eight 64-word records for scratch area.

The calling sequence for the Executive subroutine is:

A SPB EXEC, 1 with a 5 in the A-register.

A+1 DEC xxxxxx Indirect pointer to a parameter list explained below.

A+2 SET PST Return address. The return is executed immediately. The completion of the operation is signalled by setting a flag in the parameter list. The instruction at this location must be a SET PST.

The parameter list consist of a four-word table as follows:

P Number of 64-word records in bits 5-19 (≤96)
Type of operation in bits 0-4
12 indicates a read operation
37 indicates a write operation

P+1 Starting memory address - must be an integral multiple of 64.

P+2 Disc address or record number. If the CS wants a scratch area on the disc to be assigned by the Exec, bit 0 of this word should be ON, and bits 14-19 should contain the record number (0 through 47) desired. The actual disc address used by the Exec disc operation will be returned in this word upon completion of the operation. If the desired disc address is known beforehand, bit 0 should be set OFF, and bits 2-19 should contain the desired disc address.

P+3 Flag to indicate the end of an operation. The system must initialize the flag to zero. Upon completion of the operation the flag is set odd if the operation was successful, even if not. Certain indications are given by the high-order bits:

Bit 4 illegal address (error), no operation.

Bit 3 too many requests stacked up (error) no operation.

Bit 2 interrupt occurred and program was swapped. Transfer was not completed so try again.

Bit 1 parity error - recovered (no error)

Bit 0 parity error - unrecovered. Record with error was rewritten on disc.

A maximum of three simultaneous calls is allowed. There must be as many parameter files as there are simultaneous calls. Do not modify the parameter list for a given call until that disc operation has been completed.

Compiler System Loader

The GE-225/235 Exec contains a loader and disc write routine for compiler systems. When a time-sharing compatible CS binary deck is placed in the card reader and "SYS" is typed on the console typewriter, the following things will happen:

1. The CS will be loaded into the GE-225/235 memory until a transfer card is encountered.

2. The Exec will execute an SPB on index register 2 and index group 0 to the location punched into the transfer card. This is to allow the CS to rearrange itself in core, if necessary. WARNING: Since the loader writes onto the disc only from octal location 20000, the CS must move any code loaded into other areas to the area starting at 20000. The CS must execute a return to the Exec via an SXG 0, BRU 1,2. If an overlay is being loaded, the A-register must contain the length of the overlay in words, extended to the next highest integral multiple of 64 words, when control is returned to the Exec.

3. Upon regaining control from the CS, the Exec will write the 6k region, (if a CS or replacement is being loaded; otherwise, the number of words specified by the A-register) beginning at octal location 20000, onto the disc.

4. The Exec will then read the next card. The loading process will be terminated on a hopper-empty condition. If an attempt is made to load into an address outside the octal range 1400 to 33777, an error message will be typed on the console typewriter, the card will not be loaded, and the next card in the reader will be read in.

Source Program Processing

The GE-225/235 Executive has an edit routine which reorders a source program, making appropriate replacements, insertions, and deletions. In this way, source statements are kept in an order corresponding to the most recent input. For this reason each source statement for a CS must have a line number of five or less digits.

For example, the column on the left would, after editing, be ordered as in the column on the right:

```
10 STATEMENT A          10 STATEMENT A
20 STATEMENT B          20 STATEMENT E
30 STATEMENT C          25 STATEMENT D
25 STATEMENT D          30 STATEMENT C
20 STATEMENT E          50 STATEMENT G
40 STATEMENT F          60 END
50 STATEMENT G
40
60 END
```

The maximum length for any unedited source program, including corrections, which may be input from a teletypewriter is $3072/_{10}$ words.

When the source program is brought into memory at octal location 12000 (3k area), the edit routine reorders it and places it into the area known as the 2k area starting at octal location 6000. The CS should look for the source program in this area.

After processing, the compiler may place its object program into the now available 3k area. The output area may be used for working storage.

The maximum length of an edited source program is 2048 words. The Exec edit routine will not give an error indication, but will omit that portion of the source program which exceeds 2048 words.

As illustrated in "Memory Allocation" the output area begins at octal location 4100. Whenever output from a source program fills an area up to octal location 6000, the CS must perform an intermediate output exit. The Exec dumps the accumulated output onto the disc. From there it is transferred to the DATANET-30 for output to the current user's teletypewriter.

When a program has terminated, an extra 64 words in the output area are available from octal location 6000 to 6100. The BASIC CS now uses part of this area to give the running time for a program (TIME: xxx MIN. xx SEC) as packed BCD characters.

Program Interrupt

Whenever a program has run for a length of time determined by the DATANET-30 Executive, the GE-225/235 Executive interrupts it and dumps it onto a 6k area (associated with the particular user's channel) in disc storage. The location where the program was interrupted, the index groups 0-4, AX, QX, AAU mode, A and Q, and overflow are saved in the first 64 words, beginning at octal location 4004. This is known as the "save area".

When other programs have had their turn, the interrupted program is read back into memory. The working registers are restored, and control is returned to the location following the one being executed when the interruption occurred.

At the same time, the Executive checks to see whether the appropriate system is still in memory. If not, the Exec reads it back from the disc into octal location 20000, and from there moves it, if so indicated. (Refer to "Compiler System Header Information" earlier in this chapter.)

A system must be designed so that an interrupt will not harm it. However, the SET PBK instruction should be used as little as possible. (Refer to "Programming Conventions" earlier in this chapter.)

Generated Output

The GE-225/235 Executive returns generated output from a source program to the disc for transmission to the user's teletypewriter.

The output area begins at octal location 4100 and may extend as far as 5777. The CS places the output in this reserved memory area and leaves a pointer in memory to tell the Exec where the last memory location used for output is. The pointer to the next available output area location must be kept in octal location 4001. This pointer is relative to 4100.

The Executive empties the output area and resets the pointer to the beginning of the area at every dump of the program, on an intermediate output exit. The CS must supply carriage returns. The Exec will supply a line feed after every carriage return.

As indicated in "Memory Allocation", the CS may keep track of actual running time for a program at octal location 4000. The Executive stores the contents of the C-register on the "START" entry at 4000 and updates this location with the total real running time.

Example of a System: BASIC

This example illustrates how BASIC, a time-sharing compatible system, uses memory when it is initially read in and during execution.

BASIC has three parts: the actual compiler, the run-time monitor for execution, and the Matrix Arithmetic package, which is an overlay. Use of the working storage depends upon whether the program is in compilation or execution.

Compile Time Memory Allocation:

Octal Loc.	Contents
1400 3777	Constants and Run-Time Subroutines
4000	Adjusted Starting Time
4001	Output Buffer Word Pointer
4003	Length of Source Program (expressed as the number of 64-word records necessary to contain the source prog.)
4004 4077	Restart Information (Set by Exec)
4100 7723	Working Storage
7724	Object Program
17326 - Length 17326	Source Prog. (Edited) (Length is the length of the edited source program in words)
20000 33777	Compiler and Upper Memory Run-Time Routines

Run Time Memory Allocation: BASIC

Octal Loc.	Contents
1400 4077	Same as Compile Time
4100 5633	Output Buffer
5634 6521	Working Storage
6522 33777	Same as Compile Time

Input/Output Code Conversion

The following table lists the BCD character set on the Model 33 and 35 Teletype machines which have an equivalent in the GE-225 and GE-235, and their ASCII octal equivalents.

BCD Character	GE-225/235 Internal Code	Teletype Code (ASCII)	BCD Character	GE-225/235 Internal Code	Teletype Code (ASCII)
0	00	060	-	40	055
1	01	261	J	41	312
2	02	262	K	42	113
3	03	263	L	43	314
4	04	264	M	44	115
5	05	065	N	45	116
6	06	066	O	46	317
7	07	267	P	47	120
8	10	270	Q	50	321
9	11	071	R	51	322
'	12	047	$	53	044
:	13	072	*	54	252
(	14	050	EOM	55	003
;	15	273	>	56	276
=	16	275	↑	57	336
\	17	134	Space	60	240
+	20	053	/	61	257
A	21	101	S	62	123
B	22	102	T	63	324
C	23	303	U	64	125
D	24	104	V	65	126
E	25	305	W	66	327
F	26	306	X	67	330
G	27	107	Y	70	131
H	30	110	Z	71	132
I	31	311	LINE FEED	72	012
BELL	32	207	,	73	254
.	33	056	)	74	251
"	34	042	[	75	333
?	35	077	]	76	335
<	36	074	FILL or	77	377
CR	37	215	DELETE		

NOTE: All other characters except the control characters produced by Models 33 and 35 teletypewriters are discarded.

Figure 12. Input/Output Code Conversion

THE COMPILER SYSTEMS

Three compiler systems are presently being used with the GE-265 Time-Sharing System: BASIC, FORTRAN and ALGOL. For complete information concerning these three compilers, refer to the following publications:

CPB-1150, GE-200 Series Time-Sharing BASIC
CPB-1424, GE-255 Time-Sharing FORTRAN
CPB-441, GE-200 Series Time-Sharing Dartmouth ALGOL

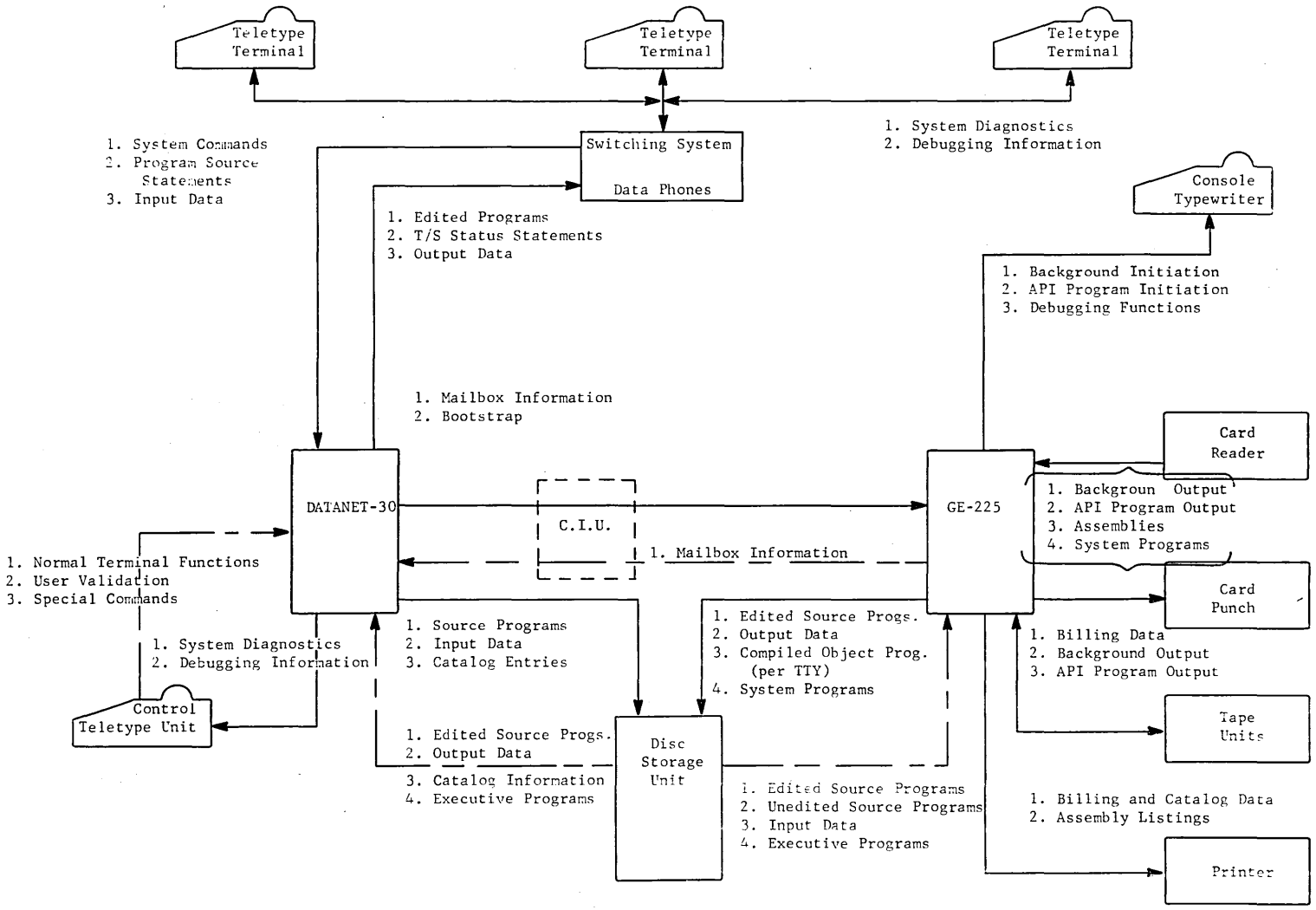
For information describing system commands used in conjunction with these compilers refer to:

CPB-1476, GE-200 Series Time-Sharing Terminal User's Manual

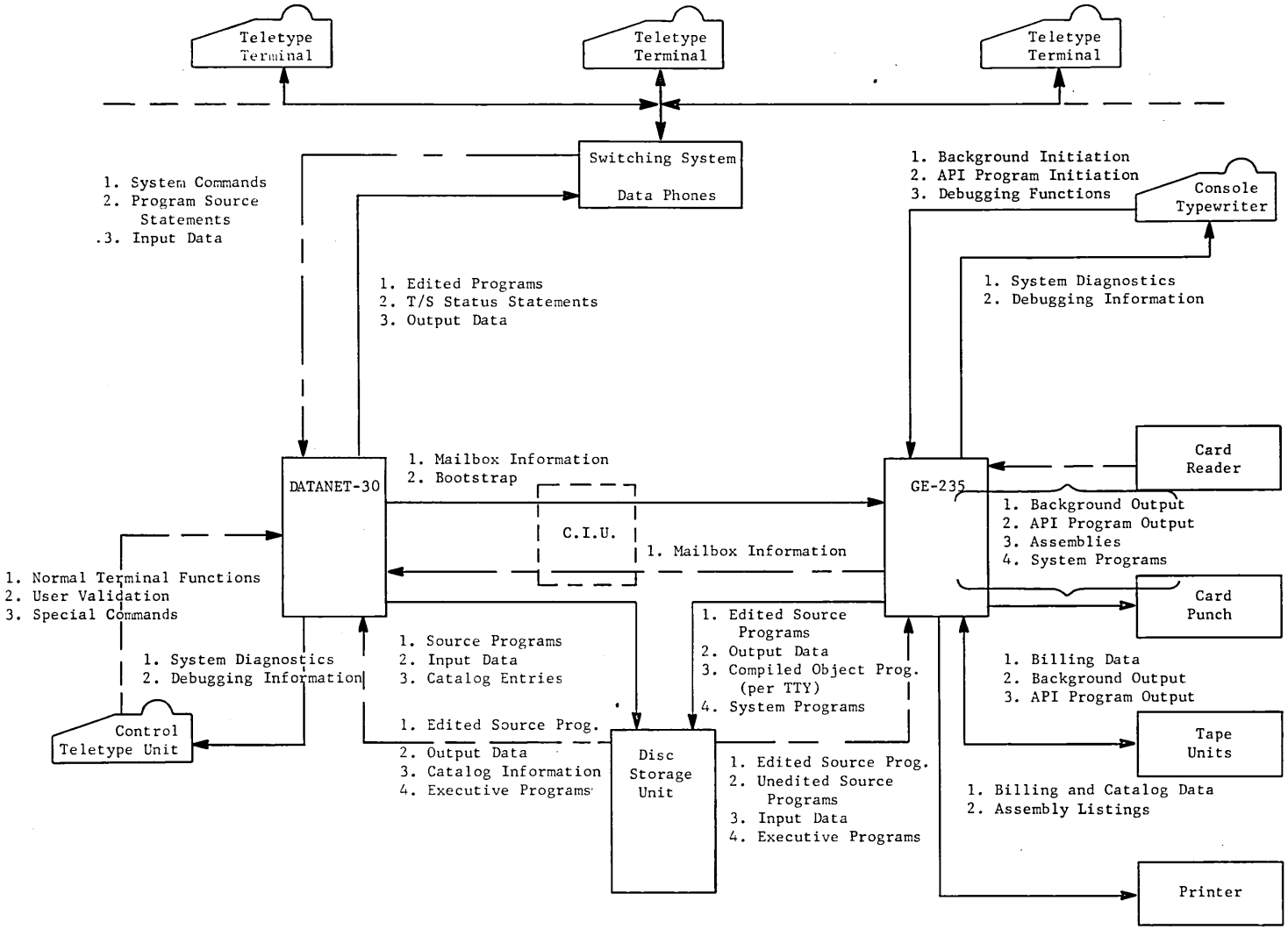
9. SYSTEM ORGANIZATION

SYSTEM FLOWCHARTS

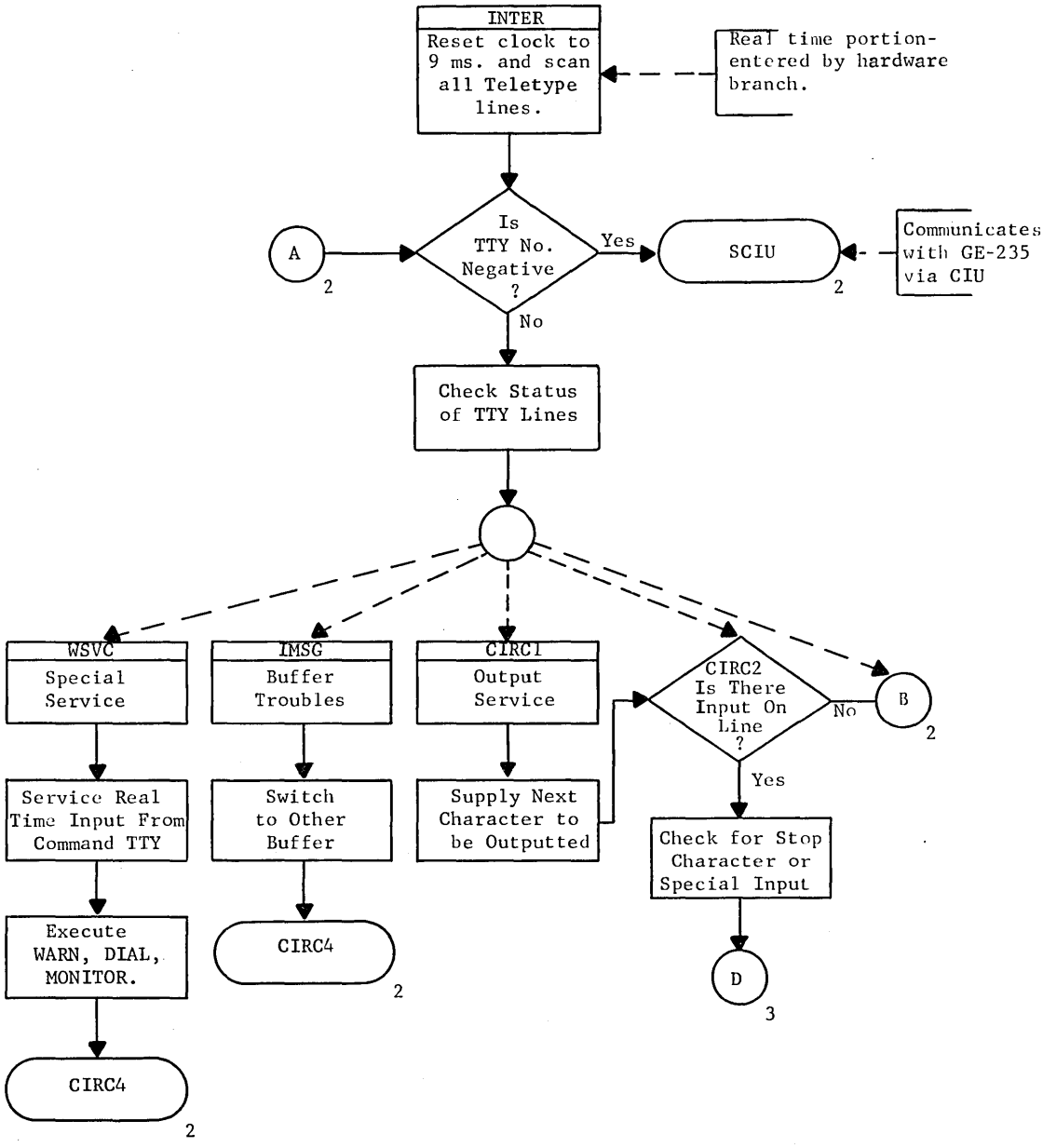
Information and functional flowcharts are shown on the following pages.



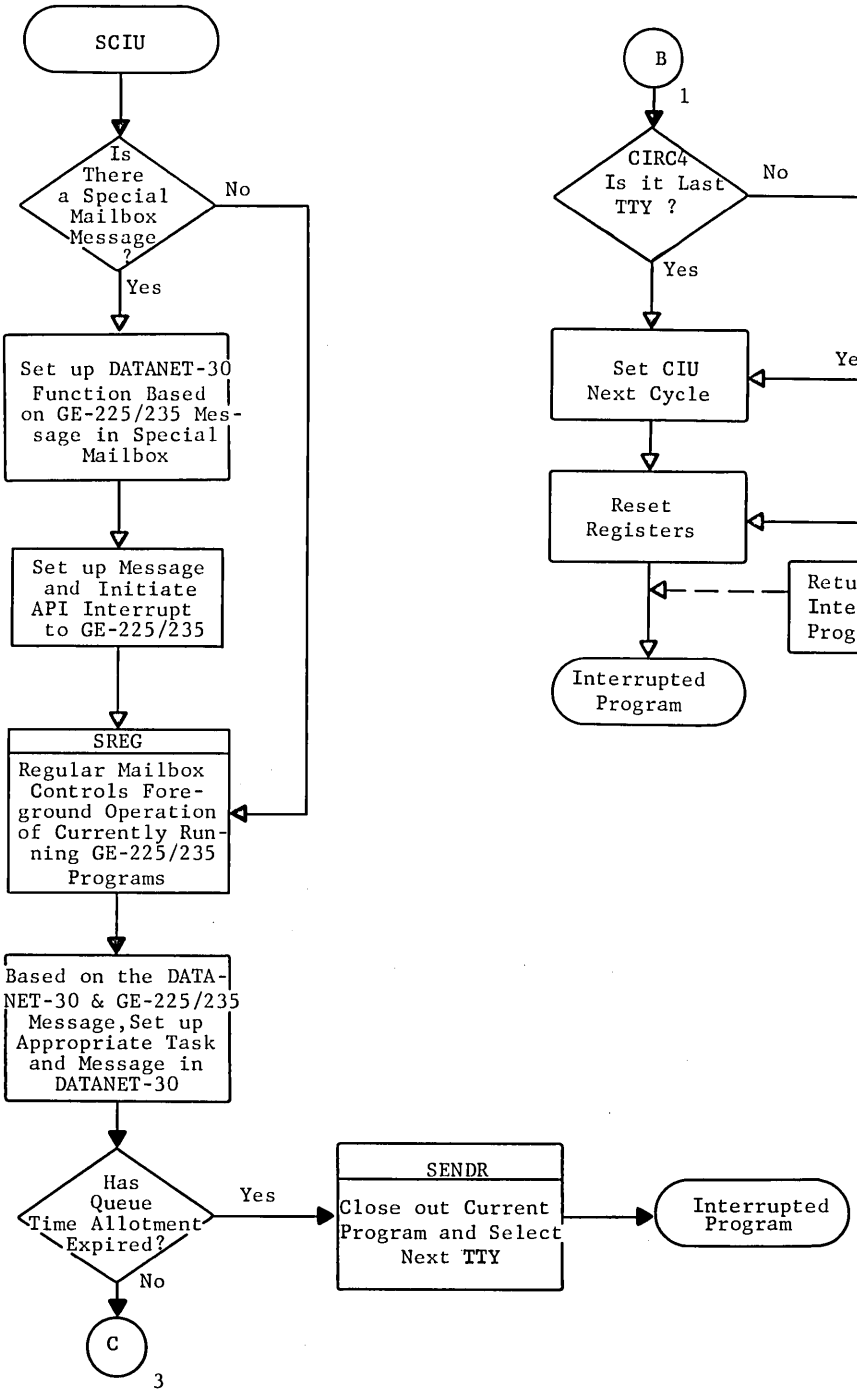
Information Flowchart GE-255



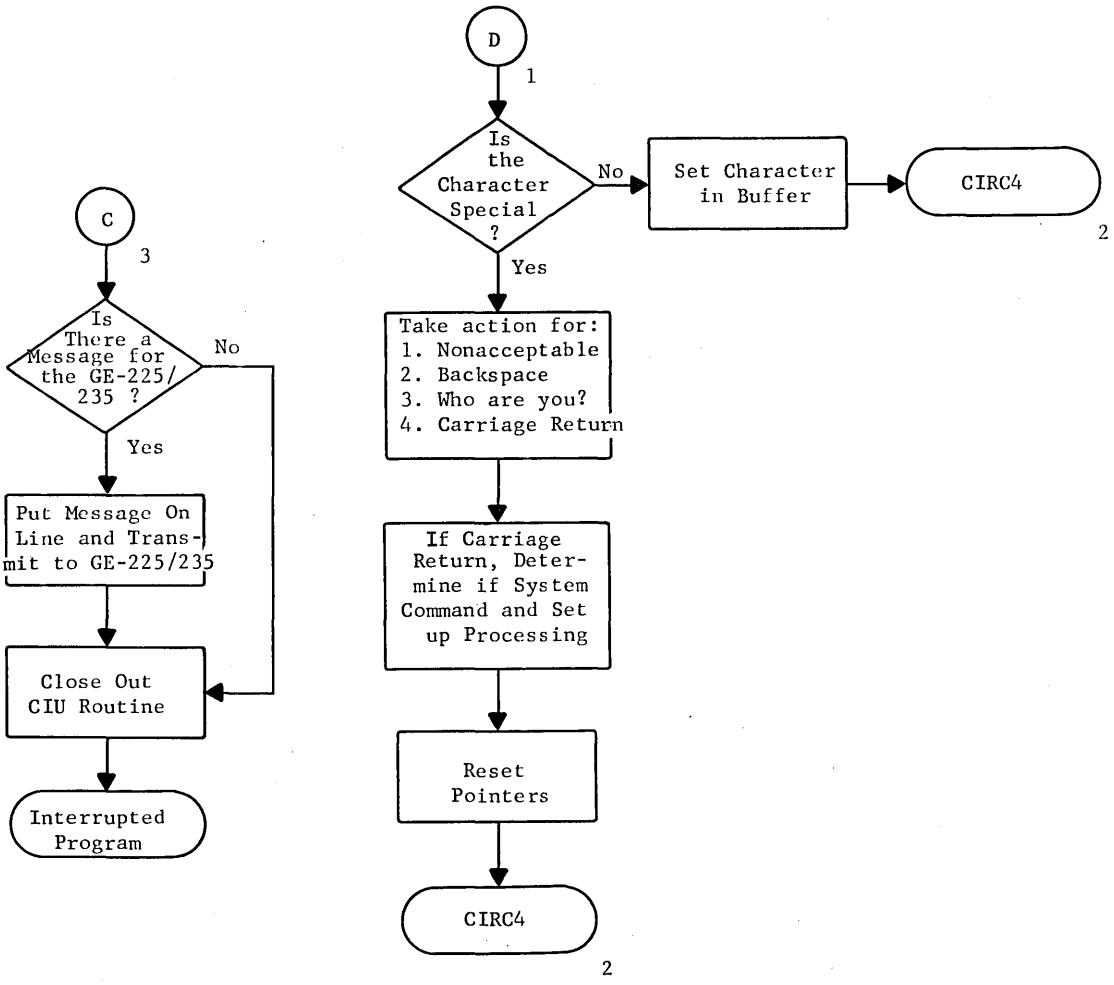
Information Flowchart GE-265



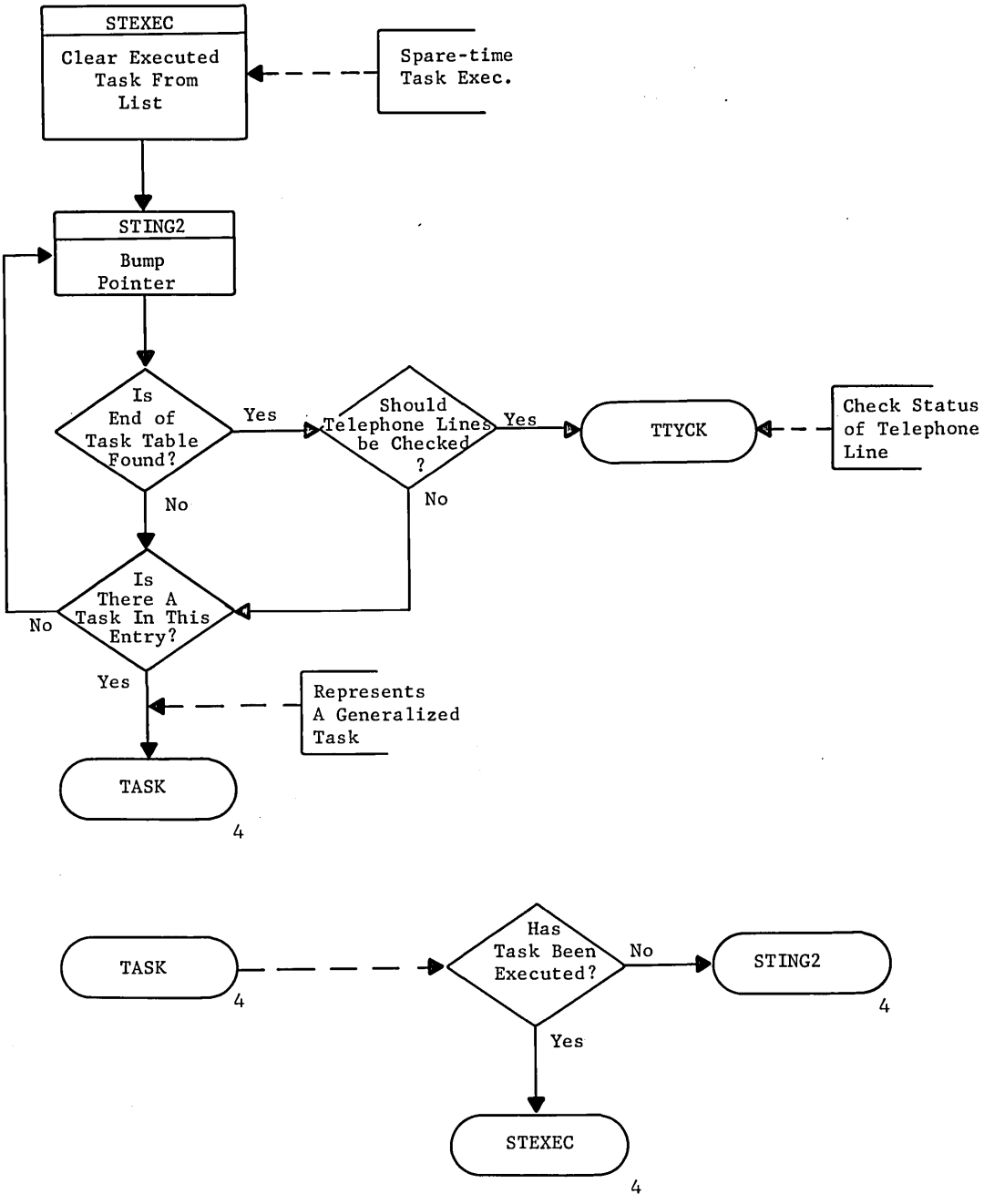
Functional Flowchart
(DATANET-30)



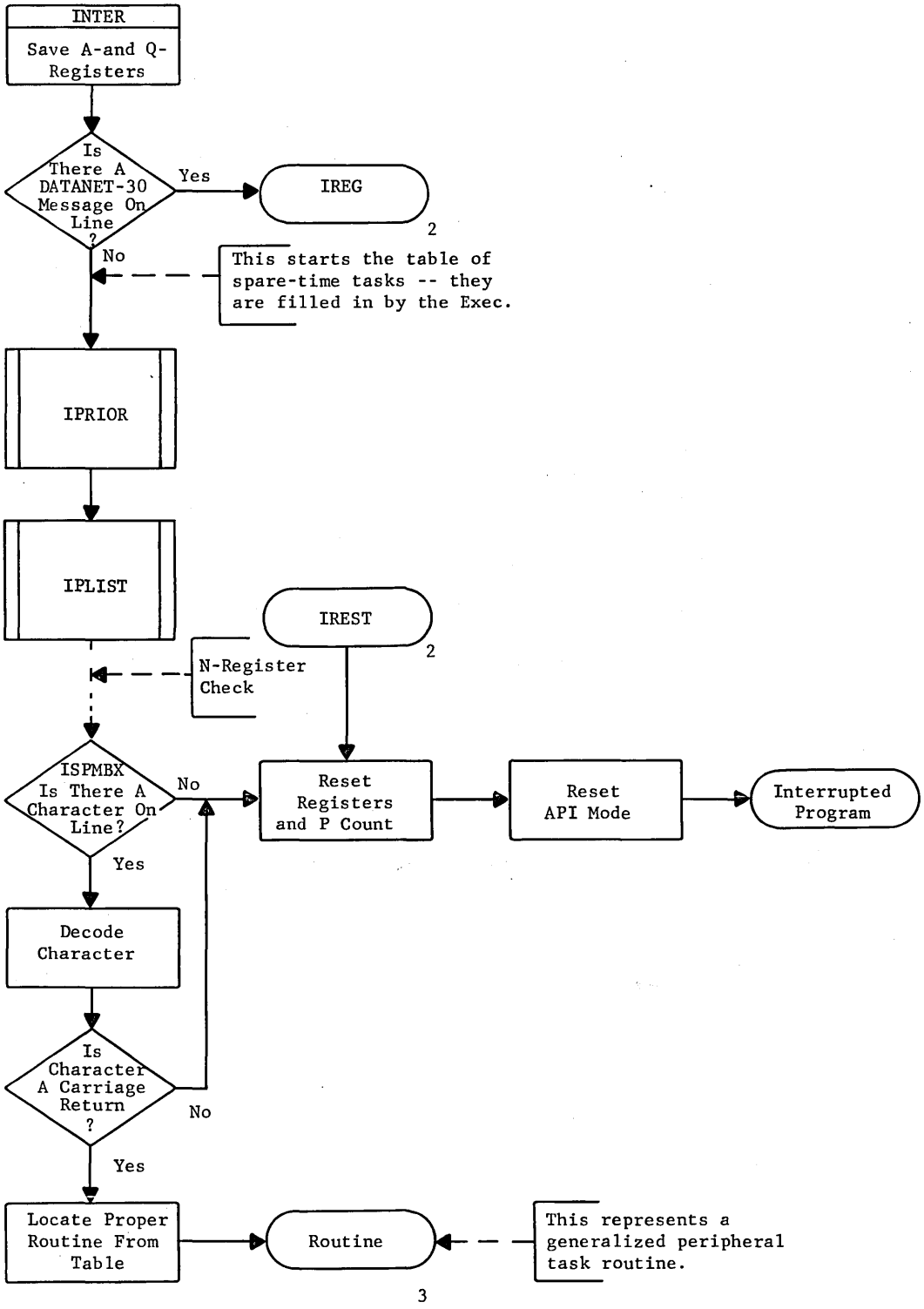
Functional Flowchart
(DATANET-30)



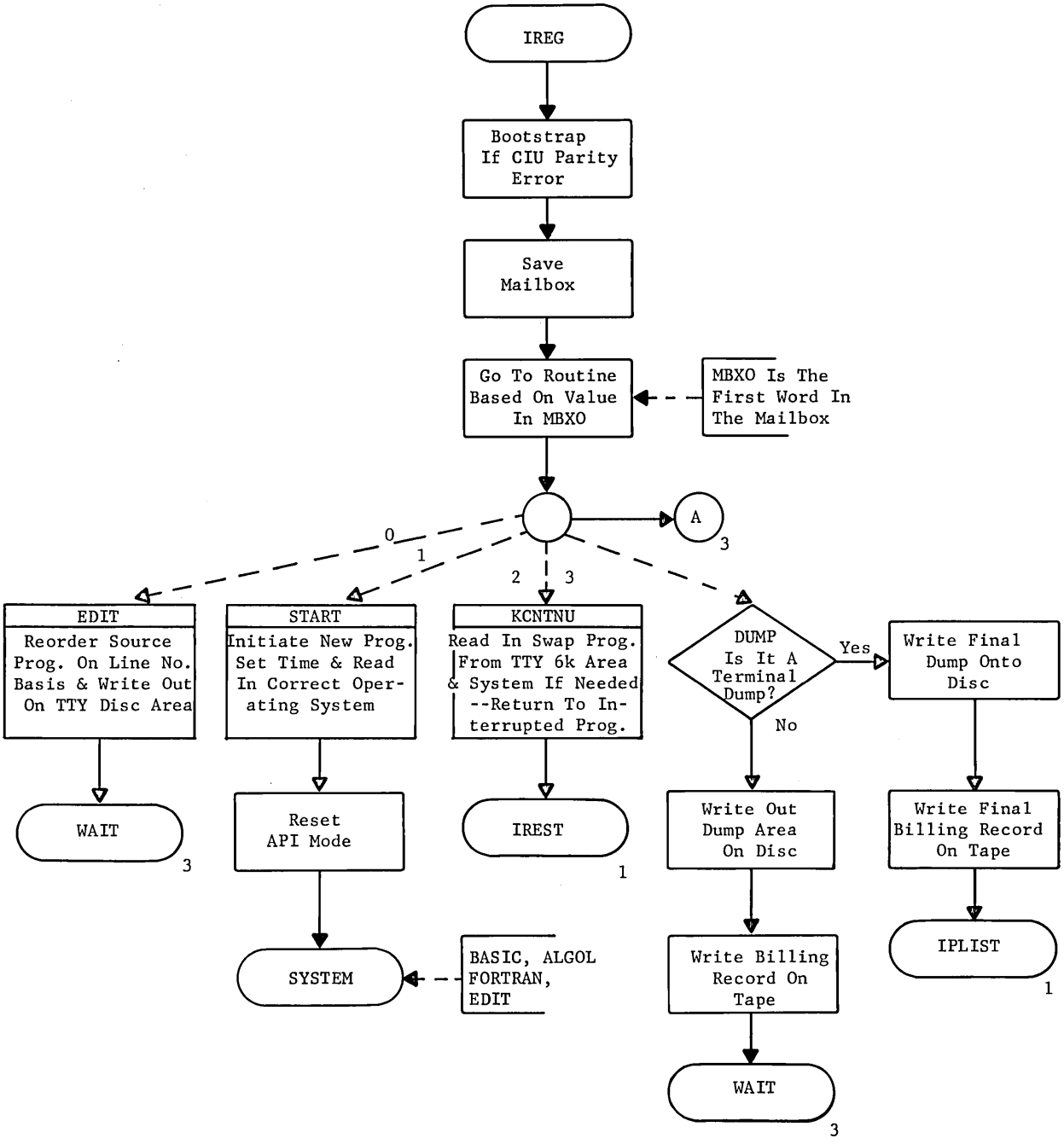
Functional Flowchart
(DATANET-30)



Functional Flowchart
(DATANET-30)

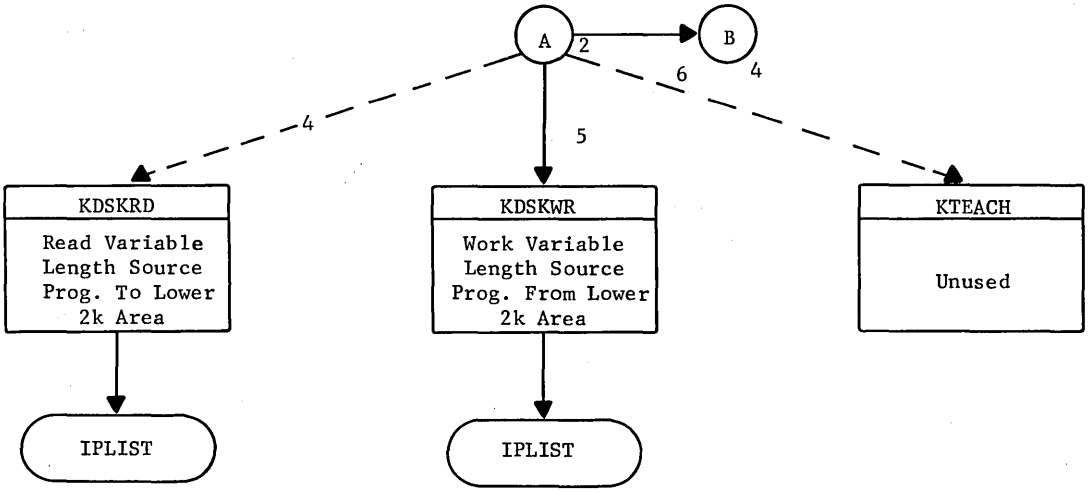


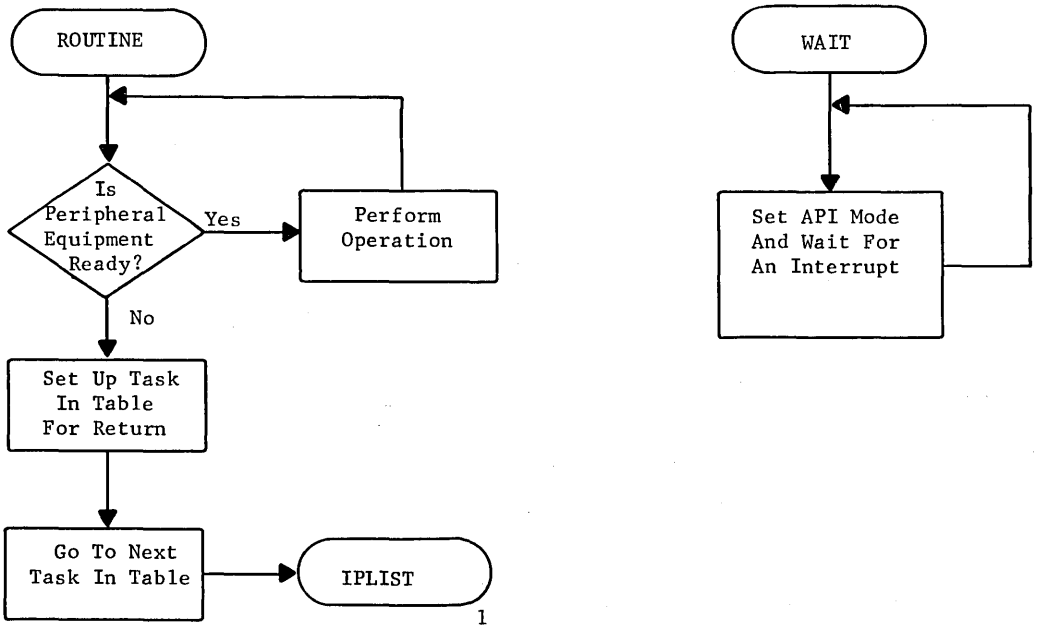
Functional Flowchart
(GE-225/235)



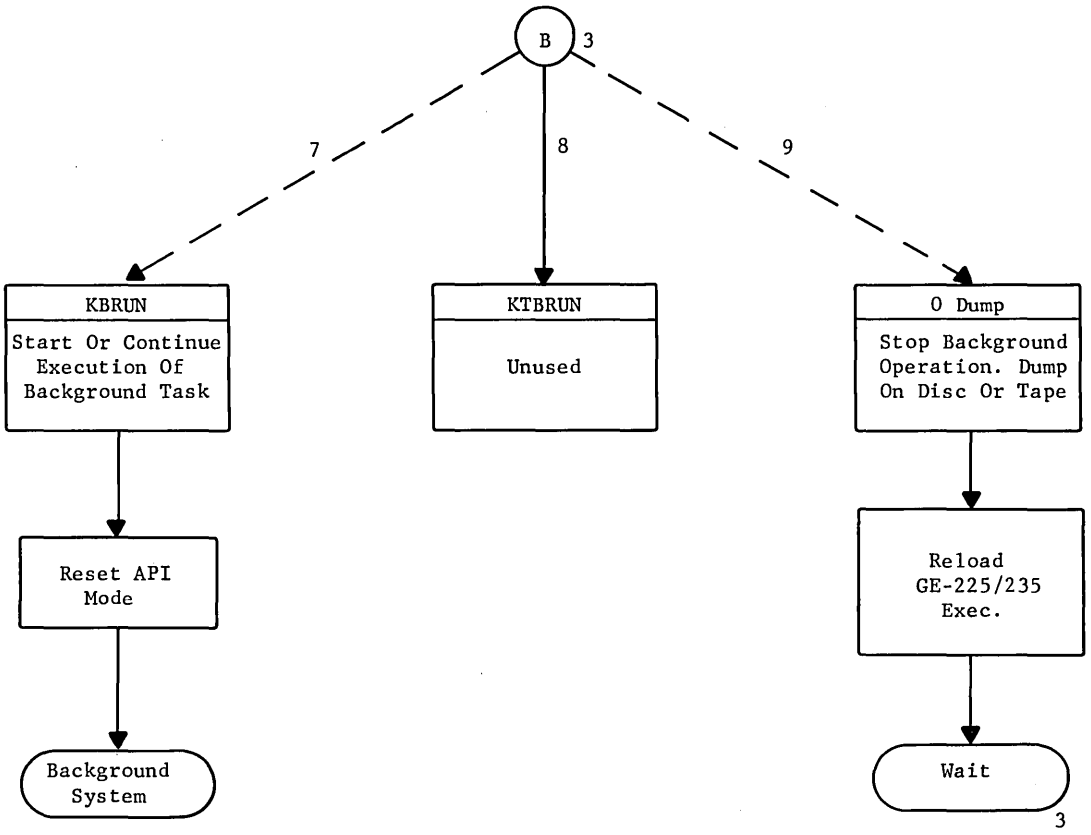
Functional Flowchart
(GE-225/235)

CPB-1455





Functional Flowchart
(GE-225/235)



Functional Flowchart

MEMORY ALLOCATION MAPS

Disc Storage Allocation - Disc 0

NOTE: Disc addresses given are inclusive.

Disc Address	Disc	Pos.	Rec.	Contents
0	0	0	00	T and D programs (Product Service)
76	0	0	31	
100	0	0	32	Block 1 of D-30 EXEC
276	0	0	95	Loc. 0-777/8
400	0	1	00	64-word region from DATANET-30 saved periodically on disc. Loc. 600-677/8.
402	0	1	01	System Efficiency Data
404	0	1	02	Summary from GE-225/235
406	0	1	03	Not used
476	0	1	31	
500	0	1	32	Block 2 of DATANET-30 EXEC
676	0	1	95	Loc. 10000 - 17777/8.
1000	0	2	00	Not used
1076	0	2	31	
1100	0	2	32	Block 3 of DATANET-30 EXEC
1276	0	2	95	Loc. 20000 - 27777/8.
1400	0	3	00	Not used
1476	0	3	31	
1500	0	3	32	Block 4 of DATANET-30 EXEC
1676	0	3	95	Loc. 30000 - 37777/8.
2000	0	4	00	Reserved for DATANET-30 EXEC
2276	0	4	95	Expansion.
2400	0	5	00	Batch (Background)
2474	0	5	30	Simulator
2476	0	5	31	GE-225/235 EXEC Bootstrap Loader.
2500	0	5	32	Block 1 of GE-225/235 EXEC (Lower memory)
2536	0	5	47	Loc. 0-1777/8.
2540	0	5	48	Block 2 of GE-225/235 EXEC (Upper memory)
2576	0	5	63	Loc. 34000 - 35777/8.
2600	0	5	64	Block 3 of GE-225/235 EXEC (Upper memory)
2616	0	5	71	Loc. 36000 - 36777
2620	0	5	72	Not used
2676	0	5	95	
3000	0	6	00	Batch (Background)
3076	0	6	31	Simulator
3100	0	6	32	GE-225/235 EXEC overlays
3276	0	6	95	Loc. 37000 - 37777/8
3400	0	7	00	Batch "FRONT" card record
3500	0	7	32	GE-225/235 EXEC overlays
3676	0	7	95	Loc. 37000 - 37777/8
4000	0	8	00	Not used
4076	0	8	31	
4100	0	8	32	GE-225/235 EXEC overlays
4220	0	8	71	Loc. 35000 - 37777/8

Disc 0 continued

Disc Address	Disc	Pos.	Rec.	Contents
4222	0	8	72	Not used
4676	0	9	95	
5000	0	10	00	BASIC
5276	0		95	
5400	0	11	00	ALGOL
5676	0		95	
6140	0	12	48	ALGOL, Overlay 1
6276	0		95	
6540	0	13	48	ALGOL, OVERLAY 2
6676	0		95	
7000	0	14	00	
7276	0		95	
7400	0	15	00	
7676	0		95	
10000	0	16	00	Experimental ALGOL
10136	0		47	
10140	0	16	48	
10276	0		95	
10400	0	17	00	Experimental BASIC, Overlay 1
10536	0		47	
10540	0	17	48	BASIC, Overlay 1
10676	0		95	
11000	0	18	00	Experimental BASIC
11136	0		47	
11140	0	18	48	ALGOL, Overlay 1
11276	0		95	
11400	0	19	00	Experimental FORTRAN
11676	0		95	
12000	0	20	0-47	Experimental FORTRAN, Overlay 1
12276	0	20	48-95	
12400	0	21	00	Experimental FORTRAN, Overlay 2
12676	0		95	
13000	0	22	00	EDIT
13276	0		95	
13400	0	23	00	FORTRAN,
13676	0		95	
14000	0	24	00	FORTRAN, Overlay 1
14276	0		95	
14400	0	25	00	FORTRAN, Overlay 2
14676	0		95	
15000	0	26	00	TSAP, Overlay 1
15276	0		95	
15400	0	27	00	ALGOL, Overlay 3
15676	0		95	
16000	0	28	00	FORTRAN, Overlay 3
16276	0		95	
16400	0	29	00	WIZOR
16676	0		95	

Disc 0 continued

Disc Address	Disc	Pos.	Rec.	Contents
17000	0	30	00	WIZOR
17276	0		95	
17400	0	31	00	WIZOR, Overlay 1
17676	0		95	
20000	0	32	00	Experimental System 3
20276	0		95	
20400	0	33	00	Experimental FORTRAN 2, Overlay 1
20676	0		95	
21000	0	34	00	Experimental FORTRAN 2
21276	0		95	
21400	0	35	00	Experimental FORTRAN 2, Overlay 2
21676	0		95	
22000	0	36	00	Not used
24076	0	40	31	
24100	0	40	32	Batch Dump Area
24276	0		95	
24400	0	41	00	Not used
24476	0		31	

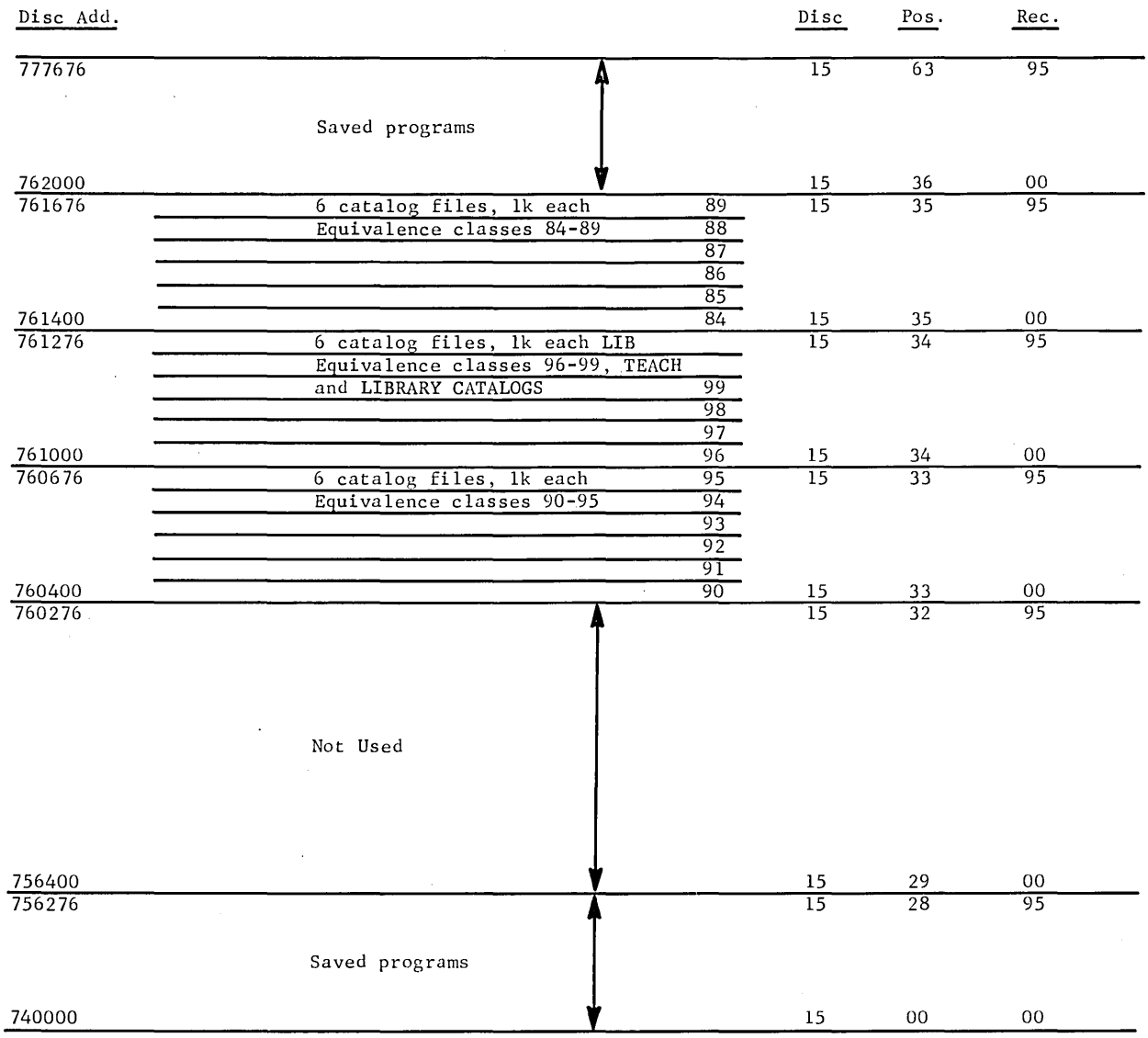
Disc Layout - Disc 1

Disc Add.			Disc	Pos.	Rec.
77676			1	63	95
	Saved programs				
62000			1	36	00
61676	6 catalog files of 1k each	6	1	35	95
		5			
	Equivalence classes 00-05	4			
		3			
		2			
61400		1	1	35	00
61276			1	34	95
	3k scratch area, TTY #3				
61140			1	34	48
61136			1	34	47
	3k standard area, TTY #3				
61000			1	34	00
60676			1	23	95
	6k area, TTY #3				
60400			1	33	00
60276			1	32	95
	3k scratch area, TTY #2				
60140			1	32	48
60136			1	32	47
	3k standard area, TTY #2				
60000			1	32	00
57676			1	31	00
	6k area, TTY #2				
57400			1	31	00
57276			1	30	95
	3k scratch area, TTY #1				
57140			1	30	48
57136			1	30	47
	3k standard area, TTY #1				
57000			1	30	00
56676			1	29	95
	6k area, TTY #1				
56400			1	29	00
56276			1	28	95
	Saved programs				
52000			1	20	00
51676			1	19	95
	Background programs				
40000			1	00	00

Disc Layout - Discs 2-14

Disc Add.			Disc	Pos.	Rec.
xx7676			x	63	95
		Saved programs			
xx2000			x	36	00
xx1676	6	CATALOG FILES OF 1k EACH	x	35	95
	5				
	4	Equivalence classes 06-83 (13 discs)			
	3				
	2				
xx1400	1		x	35	00
xx1276			x	34	95
		3k scratch area, TTY's 6, 9, ----			
xx1140			x	34	48
xx1136			x	34	47
		3k standard area, TTY's 6, 9, ---			
xx1000			x	34	00
xx0676			x	23	95
		6k areas, TTY's 6, 9, 12, 15, ---			
xx0400			x	23	00
xx0276			x	32	95
		3k scratch area, TTY's 5, 8, ---			
xx0140			x	32	48
xx0136			x	32	47
		3k standard area, TTY's 5, 8, ---			
xx0000			x	32	00
xx7676			x	31	95
		6k area, TTY's 5, 8, 11, 14, ---			
xx7400			x	31	00
xx7276			x	30	95
		3k scratch area, TTY's 4, 7, ---			
xx7140			x	30	48
xx7136			x	30	47
		3k standard areas, TTY's 4, 7, ---			
xx7000			x	30	00
xx6676			x	29	95
		6k area, TTY's 4, 7, 10, 13, ---			
xx6400			x	29	00
xx6276			x	28	95
		Saved programs			
xx0000			x	00	00

Disc Layout - Disc 15



CPB-1455

DATANET-30 Executive

Note: The equipment is a 16k Mod III DATANET-30. The real-time portion of the Executive is in octal memory locations 12000 to 15077. The remainder of the program is executed in spare time.

Octal Locations	Contents
0 5	Interrupt link and Controller selector control words
6 61	Common bank Constants
62 63	Spare-time task Table pointers
64 102	Common bank Flag words
103 477	Common bank Subroutine linkages.
500 577	Buffer area for disc reads and writes from control TTY.
600 677	Pointers and executive statistics Periodically stored on disc.
700 777	Read buffer area.
1000 7777	Channel tables.
10000 11777	1024-word disc read-in area (Catalogs).
12000 12070	Real-time Executive loop Entered every hardware interrupt.
12071 13317	C. I. U. Routine. Entered on fourth, eighth, and eleventh bit times.
13320 13777	Output routine. Supplies the next character to outputted.
14000 14466	Input routine. Picks up last character input, and services system commands.
14467 14646	Special service routine. Services WARN, DIAL, MON modes.
14647 15077	Real-time subroutines.
15100 15143	Spare-time Executive loop.
15144 15777	Hello sequence tasks.

Octal Locations	Contents
16000 16536	Miscellaneous subroutines (RESET, RUNCH, etc.)
16537 17023	Disc I/O routines
17024 17212	List and output routines
17213 17372	Editing package
17373 17777	RUN & reflexive input Routines
20000 21207	SAVE, OLD, CATALOG, UNSAVE, & Validation read routines
21210 22420	Misc. commands (STOP, STATUS, CREATE TIME, OFF, TAPE, etc.)
22421 23101	BOOTSTRAP and LOAD
23102 23335	Debugging Package
23336 23777	Teletype service routines
24000 24777	Spare-time task table
25000 25077	Output character translation table
25100 25277	Input character translation table
25300 25443	Catalog disc address table
25444 25777	Legal system command table
26000 37777	Input buffers - 2 x 64 words for each of 40 lines

GE-235 Executive

Note: All memory locations given are in octal, and are inclusive.

0 23_8 $24\text{-}27_8$	Index groups 0-4 reserved for language use.	Index group 0 used by "Edit" 5 used by Exec.	
30 177_8	Temporary Storage and constants used by GE-225/235 Executive.		
200 203_8	Index group 32 (API) used by GE-225/235 Executive.		
204_8	Entered by an API.		
205_8	Entered on an AAU trap: overflow.		
206_8	Entered on an AAU trap: underflow.		
207_8	Entered on an AAU trap: divide check.		
210 213_8	AAU trapping mode index group (34).		
214 225_8	Regular communications Mailbox area.		
226 227_8	Special communications Mailbox area.		
230 237_8	Communications save area.		
240 250_8	Date (as on heading line) and elapsed time on "runs".		
251 577_8	GE-225/235 Executive constants.		
600 677_8	64-word block written periodically on disc.		
1000 1377_8	Buffer areas for card I/O.		
1400 3777_8	Time-sharing languages constant and run time subroutines area.		
4000 4077_8	Area used by GE-225/235 Executive to save relevant information during a 6k swap.	Save Area	6k area Includes Save Area
4100 5777_8	Output area for use by time-sharing compatible compiler system.		
6000 11777_8	Edited source program prior to compilation by a compiler system.	2k area	
12000 17777_8	Unedited source program prior to editing.	3k area	
20000 33777_8	Time-sharing compatible language or system.		
34000 36777_8	Upper memory portion of GE-225/235 Executive.		
37000 37777_8	Overlays of GE-225/235 Executive - such as "Disc Dump,", "lister", etc.		
34600 37777_8	Background Executive.		

10. COMMUNICATIONS HARDWARE

INTERFACE EQUIPMENT

The interface communications hardware used with the GE-200 Series Time-Sharing can best be illustrated by the following chart.

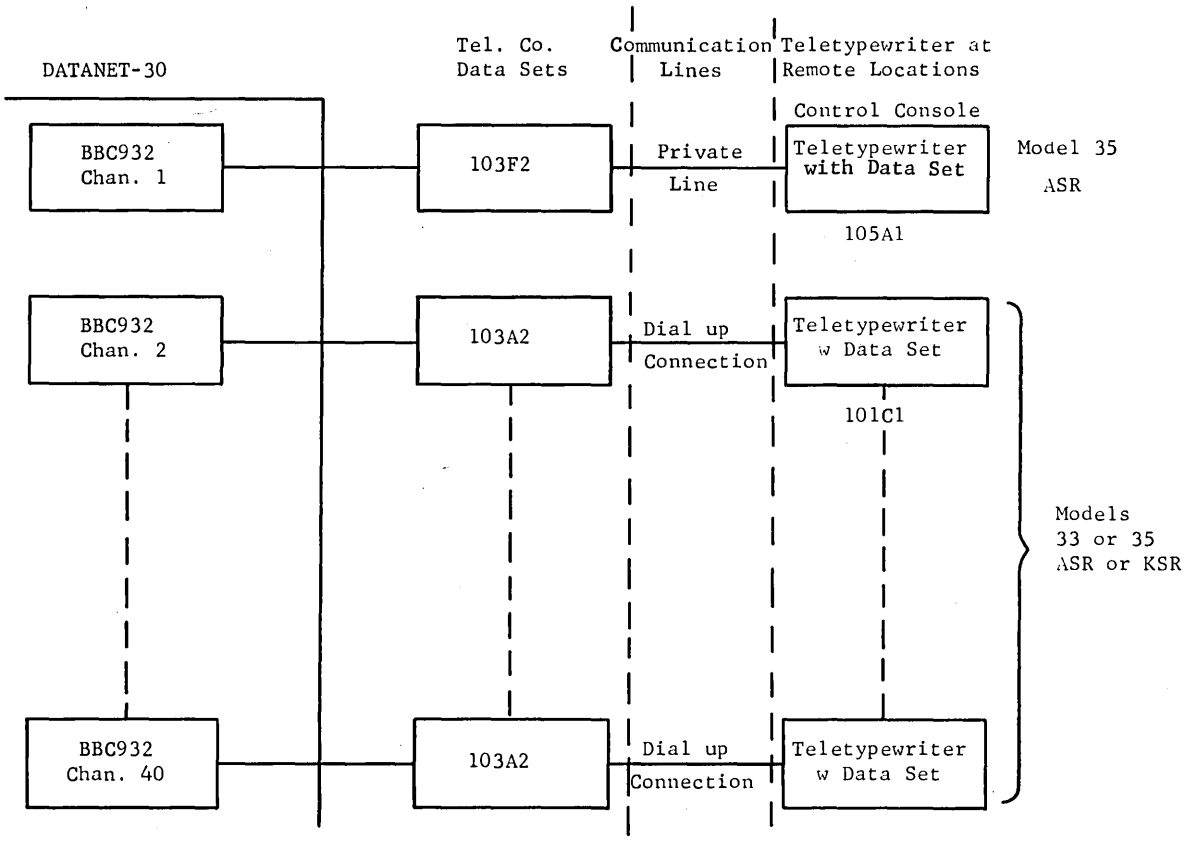


Figure 13. Interface Communications Hardware

As indicated above, there are 39 bit buffer channels (2-40) in the DATANET-30, each of which is connected to 39 Data Sets of type 103A2.

Acknowledgement: This chapter includes material taken from Bell System Data Communications Technical Reference Manuals-Data Set 103A and 103F Interface Specifications (c) American Telephone and Telegraph Company 1963, 1964.

One additional bit buffer channel is connected to a Data Set 103F2. This special channel serves the control console which is hard-wired (private line) to the 103F2 Data Set.

The 103A2 Data Sets are equipped with the automatic answer option and are able to automatically answer incoming calls and establish a connection with the DATANET-30.

All data sets are equipped for "upright" service. (Refer to "Controls" later in this chapter. This service is indicated by the last digit (2) of the Data Set model number.

Some installations may have the nonstandard "inverted" service. In this case, data sets of model 103A1 must be used.

This chapter describes in detail the data set's communication with a bit buffer channel. The data sets are phone company property and documentation for these is not as accessible as for GE equipment.

This chapter does not describe the communication between the data set at the installation and the data set in the base of the teletypewriter except for instructions on how to establish connection and other procedures necessary for operating the teletypewriter.

Summary of Data Services

The following chart describes briefly the different data services offered by the Bell System.

It is included here for the purpose of information only as the standard for the GE-255/265 system has been chosen to be the DATA-PHONE Service described under item 3 on the following page.

SUMMARY OF BELL SYSTEM DATA SERVICES FOR USE WITH GENERAL ELECTRIC TIME-SHARED COMPUTER INSTALLATIONS
(Feb. 1966)

Communications Facility	Computer Interface	Remote Terminal
1. Private Line-150 baud channels.	EIA RS-232 type serial data interface provided as part of the channel termination. Present arrangements use 130 type subset with Data Auxiliary Set 816. Future arrangements may use channel terminations with different codes but with an EIA RS-232 type serial data interface.	Bell System provided Model 35 type teletypewriter stations, which include appropriate data sets. Present arrangements use 130 type subsets as part of the station. Future teletypewriter stations may use channel termination arrangements with different codes. For customer owned terminals, an EIA-RS-232 type interface is available at channel terminations.
2. Private Line-Voice Grade Channel	EIA RS-232 type serial data interface provided by Data Set 103F2.	Bell System Model 35 type teletypewriter can be provided along with Data Set 103F2 and a Data Set Coupler to convert the data set EIA RS-232 type serial data interface to the current type interface required by the teletypewriter. Future arrangements may include a data set with a different code designed for use directly with teletypewriters. With customer-provided terminals, an EIA RS-232 type serial data interface is provided by Data Set 103F2.
3. DATA-PHONE Service-Switched voice message network (DDD)	EIA RS-232 type serial data interface provided by Data Set 103A2 (when used in systems providing communications with teletypewriters equipped with 4-row keyboards and which use a version of the proposed ASCII code.)	Bell System Model 35 type teletypewriter station arrangements can be provided. Data Set 101G (or equivalent) is provided as part of the station arrangement. Future arrangements may include other existing or new teletypewriters and a data set with a different code. With customer-provided terminals an EIA RS-232 type serial data interface will be provided by Data Set 103A2. In the future, Data Set 103G may be used.
4. TWX Service -- TWX access lines and switching facilities for communication with regular TWX teletypewriter stations.	EIA RS-232 type serial data interface provided by CPT-TWX station arrangements with Data Auxiliary Set 811B.	Bell System (only) teletypewriter stations include an appropriate data set. At the present time, this data set may be 101A, 101B, 101C, 105A.

Communications Facility	Computer Interface	Remote Terminal
		Future station arrangements may include existing or new teletypewriters and a data set with a different code.
5. TWX-CE Service -- TWX access lines and switching facilities provides restricted communications between customer owned terminals (or between customer owned and Bell System provided teletypewriters) without the capability of interconnection with regular TWX teletypewriter stations.	EIA RS-232 type serial data interface provided by Data Set 103A1. Future arrangements may include a data set with a different code.	EIA RS-232 type serial data interface provided by Data Set 103A1 for use with customer owned terminals. Bell System teletypewriter stations include an appropriate data set. Modified teletypewriter type data sets are provided for this purpose.

Data Set 103A2

GENERAL DESCRIPTION. Data Set 103A2 provides for the transmission of binary serial data. The Data Set permits transmission rates up to 300 bauds (300 bits/second) in either or both directions, simultaneously if desired.

The transmission rate to the GE-255/265 Time-Sharing System is 110 baud and transmission can occur in both directions simultaneously (full duplex).

The operation of the time-sharing system requires full duplex communication circuits.

PHYSICAL INTERFACE. The cable from the bit buffer unit should be equipped with a cable terminating in a Cinch or Cannon DB-19604-432 plug mounted in a Cinch DB-51226-1 hood assembly or equivalent. The receptacle on the Data Set is equivalent to Cinch or Cannon DB-19604-433, and is equipped with threaded retaining spacers. The DB-51226-1 hood assembly includes retaining screws which enter these spacers retaining the plug against accidental disengagement.

The cable should not exceed 50 feet in length.

The 25 pins of the interface connector are assigned as shown in Table 1. Column I/O indicates whether the signals on each lead are inputs or outputs with respect to the data set.

ELECTRICAL INTERFACE. All data and control circuits in the interface operate with the interchange signals recommended by the Electronic Industries Associated in their document RS-232, "Interconnection of Data Terminal Equipment with a Communications Channel." The following description is in accordance with this document.

All circuits (other than the protective and signal grounds) carry bi-polar low-voltage signals suitable for use with electronic circuitry. The two binary conditions conveyed by these signals are:

Data Circuits	Control Circuits	Polarity
Mark ("1")	OFF	-
Space ("0")	ON	+

All voltages are measured with respect to circuit AB (signal ground) at the point of interconnection; i.e., the interface connector.

The source of an interchange signal shall deliver a voltage of between 5 and 25 volts (positive or negative) into an open circuit or a load whose resistance is not less than 3000 ohms.

The destination of an interchange signal must present an essentially resistive load of resistance not less than 3000 ohms. The capacitance of the load (measured from the interface connector) shall not be greater than 2500 pf (uuf).

The load must not contain an internal potential of more than 2 volts. Figure 14 below presents a table of interface connector pin assignments.

Pin	Circuit	I/O	Function
1	AA	-	Protective Ground
2	BA	I	Transmitted Data
3	BB	O	Received Data
4	-	-	-
5	CB	O	Clear to Send (or Request to Send)
6	CC	O	Data Set Ready
7	AB	-	Signal Ground
8	CF	O	Carrier Detector
9	(+P) +20 v	(Telephone Company Use Only)	
10	(-P) -20 v	(Telephone Company Use Only)	
11	-	-	-
12	-	-	-
13	-	-	-
14	-	-	-
15	-	-	-
16	-	-	-
17	-	-	-
18	-	-	-
19	-	-	-
20	CD	I*	Data Terminal Ready
21	-	-	-
22	CE	O	Ringing Indicator
23	-	-	-
24	-	-	-
25	-	-	-

Figure 14. Interface Connector Pin Assignments (103A2)

Voltage conditions between +3 volts and -3 volts are anomalous and require no specific response except in the case of "fail safe circuits", described below. Data and timing circuits must have rise times so that the signal remains in this anomalous region during each transition for no more than 3% of the minimum signal element length appropriate to the speed of the channel.

Certain control circuits are designed to be "fail safe." These include such circuits as "Data Set ready", "data terminal ready", and "request to send". "Fail safe" operation implies that the destination can interpret the signal condition as "OFF" when the source has lost power. In this case, no potential is applied by the source.

The source of any "fail safe" circuit must, under conditions of loss of power, provide a resistance to signal ground of not less than 300 ohms. This allows the use in the destination of shunt biasing circuits to ensure the "OFF" response under this condition.

Circuit functions are as follows:

Circuit AA (protective ground) is tied to the frame of the Data Set, which is in turn grounded to the power system ground through the power cord.

Circuit AB (signal ground) provides the reference point for all other interchange circuits. In this data set it is tied to the frame.

Circuit BA (transmitted data) is used by the bit buffer channel to present the data to be transmitted. It is only operative when circuit CB (clear to send) is ON.

Circuit BB (received data) delivers the data received by the Data Set. When the Data Set is idle, or when circuit CF (carrier detector) set is idle, or when circuit CF (carrier detector) is OFF, circuit BB is held in the MARK condition.

Circuit CB (clear to send) indicates when ON that the Data Set has established a connection with the distant Data Set, and that signals may be applied to circuit BA (transmitted data).

Circuit CC (Data Set ready) indicates when ON that the Data Set is in the data mode; that is, it is not in the idle, talk, test, or local condition, nor is it without power.

Circuit CD (data terminal ready) is used by the BBC to permit the Data Set to enter and remain in the data mode. It is turned ON to allow the Data Set to automatically answer an incoming call, if all other conditions are met.

Circuit CE (ringing indicator) turns ON to indicate the receipt of a ringing signal by the Data Set. If all conditions for automatic answering are met, it will turn ON for a brief period when the call is answered.

Circuit CF (carrier detector) indicates when ON that data carrier is being received from the distant end. In the method of operation used by Data Set 103A2, this circuit and circuit CB (clear to send) carry simultaneous signals.

Modulation Rate. The maximum modulation rate provided by Data Set 103A2 is 200 bauds (300 bits per second maximum).

The Data Set is set so that no limit on the interval of SPACE which may be transmitted exists.

Controls. The associated control unit is equipped with six pushbutton keys for control of the station:

DATA (non-locking; releases any depressed locking key)--If the TALK key has been depressed and the telephone handset is off the cradle, the DATA key transfers the Data Set from the voice mode to the data mode. It is illuminated when the Data Set is in the data mode.

TALK (locking)--When depressed and the handset is lifted, the Data Set is placed in the voice mode. If it had been in the data mode, it is transferred to the voice mode.

TEST 1 (non-locking)--Places the Data Set in the test mode. This key should only be used as directed by Telephone Company personnel. It is illuminated when the Data Set is in the test mode. If activated accidentally, the test mode may be canceled by depressing the DATA key.

TEST 2 (non-locking)--Returns the set from the answering to the originating mode for the test. This key should only be used as directed by Telephone Company personnel.

LOCAL (locking)--Places Data Set in the local mode. In this mode signals sent into circuit BA (transmitted data) appear on circuit BB (received data). This permits a check to be made of the continuity of the interface connections and of the signal handling stages adjacent to the interface in the Data Set and the BBC. It may be released by depressing the DATA, TALK, or AUTO keys.

AUTO (locking)--When automatic answer is provided on a key-controlled basis, this key is depressed to enable the feature. Circuit CD (data terminal ready) must also be ON for the feature to function. The key is illuminated when depressed. It may be released by depressing the DATA, TALK, or LOCAL keys.

OPERATION.

Frequency Assignment. Two different frequency bands are simultaneously used on a 103A2 type data connection, one carrying data in each direction.

Each band carries a single carrier tone which is shifted to one of two frequencies, one representing the MARK state, and one the SPACE state.

The two frequencies in the lower band are designated F1M and F1S for MARK and SPACE respectively.

The corresponding frequencies in the higher band are designated F2M and F2S.

The Data Set has two frequency modes, originating and answering. The originating, or calling, Data Set transmits F1 and receives F2. Refer to Figure 15.

Transmitted Frequencies	103A2 (Upright)	103A1 (Inverted)	
F1 Sending (Originating Station)	1270	1070	MARK
	1070	1270	SPACE
F2 Receiving (Terminating Answering Station)	2225	2025	MARK
	2025	2225	SPACE

Figure 15. Transmission Frequencies (CPS)

Each set is normally in the originating mode. When a ringing signal indicates the arrival of an incoming call, the Data Set switches to the answering mode and remains in it for the duration of the call.

If the call is unanswered, the called Data Set reverts to the originating mode.

Channel Establishment. Prior to the transmission of data, the two Data Sets must be placed in the data mode and an exchange of carrier tones called "handshake" performed. This process is repeated each time the Data Sets enter the data mode.

The total elapsed time from the placing of the answering Data Set into the data mode to the receipt of Clear to Send signal at each end is approximately 3.5 seconds.

Figure 16 illustrates the sequence of events in channel establishment.

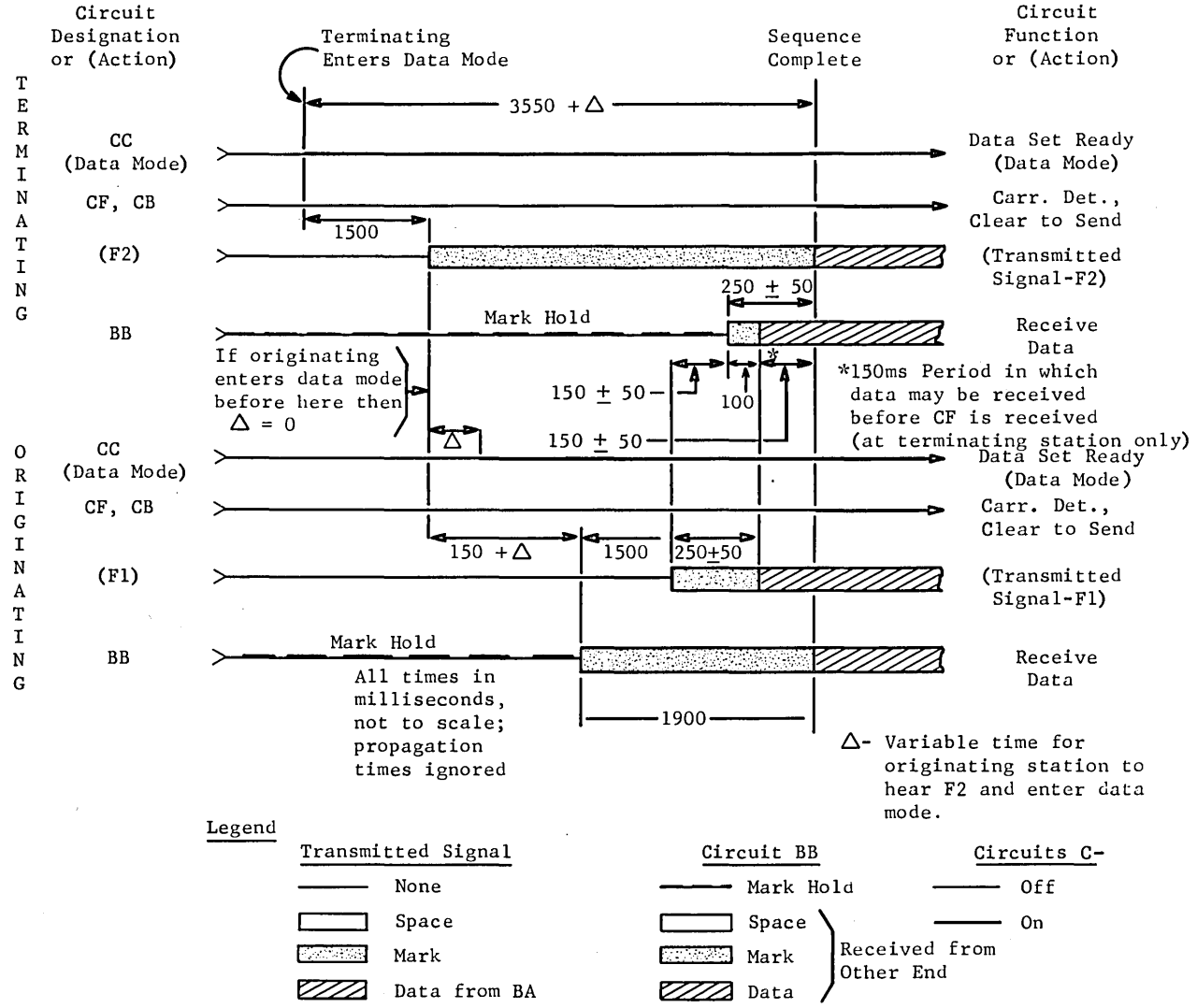


Figure 16. Channel Establishment

Return to Voice Mode. Either end may return to the voice mode by lifting the handset and depressing the TALK key if it is not already depressed. This transfers the telephone line to the Data Set and stops the transmission of tone.

As the Data Set leaves the data mode, circuits CB, CC and CF go to OFF and the DATA key lamp is extinguished. Circuit BB is placed in the MARK HOLD condition.

At the distant end, the loss of carrier causes circuits CB and CF to go OFF about 30 ms after the initial loss.

Disconnect. Whenever a disconnect is desired, the terminal equipment should be arranged to present an OFF condition on the Data Terminal Ready (CD) interface lead for at least 50 ms or until the Data Set Ready (CC) interface lead goes OFF; and, in addition, under the following circumstances:

1. When the terminal equipment detects a character or signal on the Received Data (BB) interface lead which can be interpreted to be an EOT indication sent from the remote terminal.

2. When an indication of loss of carrier transmitted by the remote data set is presented to the terminal equipment as an OFF condition on the Carrier Detector (CF) interface lead for an abnormal length of time (2 seconds for instance) and it can be determined that the remote attendant has not entered the voice mode.

3. When a call has been answered automatically as indicated by a brief ON condition on the Ringing Indicator (CE) interface lead followed by an ON condition on the Data Set Ready (CC) interface lead, without an ON condition presented on the Carrier Detector (CF) interface lead within 2 seconds. (This may happen when a call is placed in error by a voice telephone subscriber to the telephone number assigned to the line on which the terminal normally receives DATA-PHONE calls.)

If desired, the Initiate Long Space Disconnect and Respond to Long Space Disconnect options, with sequences shown in Figure 17, may be used in addition or in place of the use of an EOT character.

Loss of Circuit. Loss of continuity of either direction of transmission of the telephone channel will cause circuits CB and CF to go OFF at the end or ends losing tone. This may be used to call attention to this loss.

Automatic Answer. The Data Set is wired for the option of key-controlled automatic answer.

The automatic answer feature is effective only when circuit CD (data terminal ready) is ON.

When all conditions for automatic answer have been met, an incoming call will be automatically answered, the Data Set will be put in the data mode, and channel establishment will proceed.

The DATA key will be illuminated when the Data Set achieves the data mode.

A short ON signal on circuit CE (ringing indicator) will occur as the call is answered. (This is the BEEP tone heard when connection between the users teletypewriter and the computer is established.)

If the call is not automatically answered, the telephone bell will ring and circuit CE will come ON with each ringing cycle as previously described.

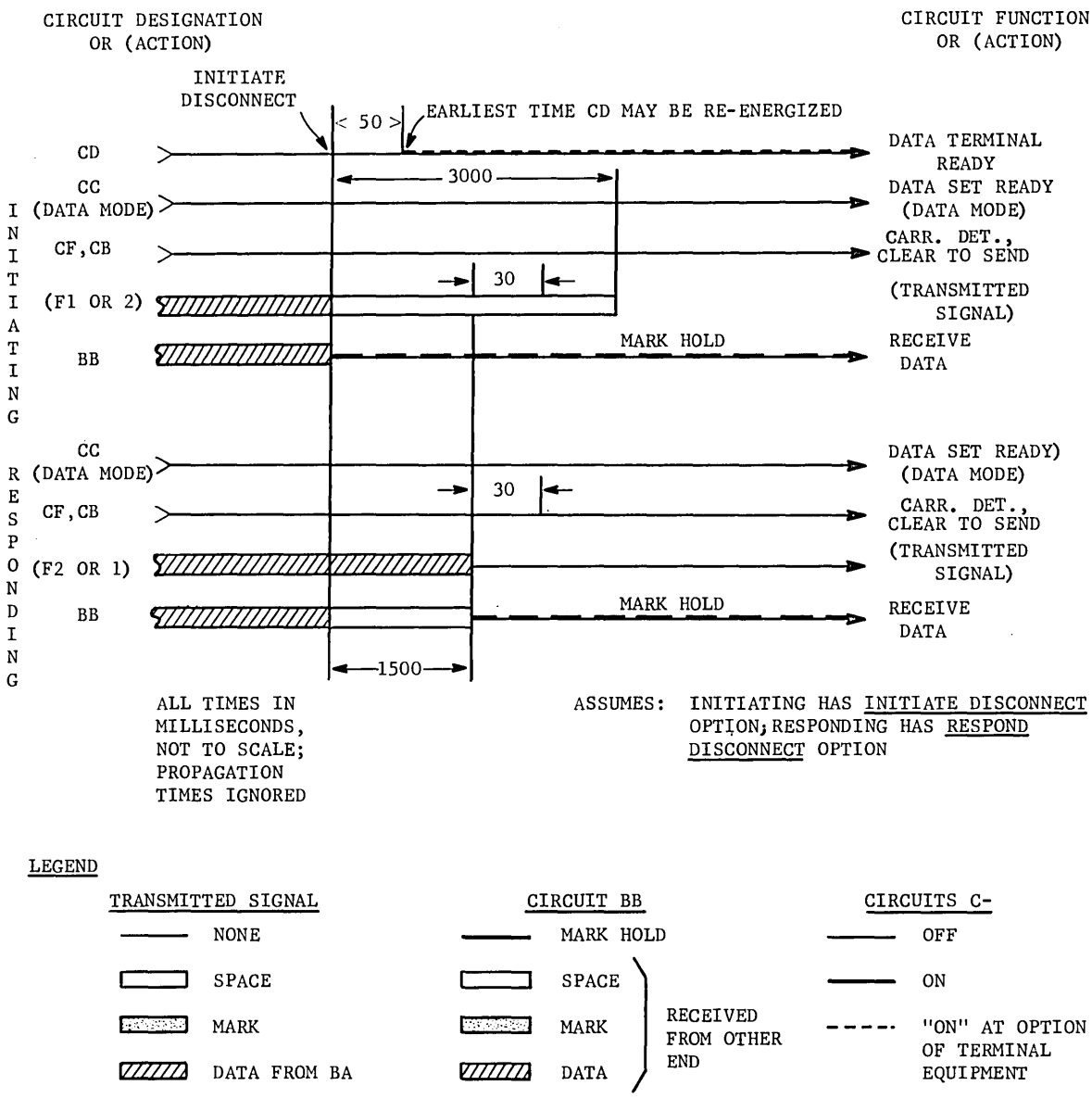


Figure 17. Data Set 103A Space Disconnect Sequence

Local Mode. When the LOCAL key (locking) is depressed, the Data Set enters the local mode. In this mode, the signals applied to circuit BA are repeated out through the circuit BB. This permits a "loop-back" test of the BBC cable, the interface connectors, and the signal handling stages in the DATANET-30 adjacent to the interface. Circuits CB, CC and CF are OFF while in the local mode. However, the DATANET-30 software is not programmed to perform this test.

If an incoming call should be automatically answered while in the local mode, the Data Set will revert to normal operation for the duration of the call. The local mode is inoperative while in the test mode.

Test Mode. The TEST keys are used under Telephone Company direction only.

When the Data Set is in the test mode, circuits CB, CC, and CF are OFF and circuits BA and BB are opened.

Data Set 103F2

GENERAL DESCRIPTION. Data Set 103F2 provides for the transmission of binary serial data on private line data services. The Data Set permits transmission rates up to 300 bauds (300 bits/second maximum) in either or both directions, simultaneously if desired.

The transmission rate to the GE-200 Series Time-Sharing System is 110 baud and transmission can occur in both directions simultaneously (full-duplex).

PHYSICAL INTERFACE. The cable from the bit buffer unit should be equipped with a cable terminating in a Cinch or Cannon DB-19604-432 plug mounted in a Cinch DB-51226-1 hood assembly or equivalent to a Cinch or Cannon DB-19604-433. The cable is equipped with threaded retaining spacers. The DB-51226-1 hood assembly includes retaining screws which enter these spacers, retaining the plug against accidental disengagement.

The cable should not exceed 50 feet in length. The 25 pins of the interface connector are assigned as shown in Figure 18.

Pin	Designation	Name	Pin	Designation	Name
1	AA	Protective Ground	14	-	Not Used
2	BA	Transmitted Data	15	-	"
3	BB	Received Data	16	-	"
4	CA	Request to Send	17	-	"
5	CB	Clear to Send	18	-	"
6	CC	Data Set Ready	19	-	"
7	AB	Signal Ground	20	-	"
8	CF	Data Carrier Detector	21	-	"
9	+ P	Positive Power	22	-	"
10	- P	Negative Power	23	-	"
11	CY	Originate Mode	24	-	"
12	CX	Local Mode	25	-	"
13	-	Not Used			

Figure 18. Interface Connector Pins Assignment (103F2)

ELECTRICAL INTERFACE. All data and control circuits in the interface operate with the interchange signals recommended by the Electronic Industries Association in their document RS-232-A, "Interface Between Data Processing Terminal Equipment and Data Communications Equipment." The following description is in accordance with this document.

All circuits (other than the protective and signal grounds) carry bipolar low-voltage signals suitable for use with electronic circuitry. The two binary conditions conveyed by these signals are:

Data Circuits	Control Circuits	Polarity
Mark ("1")	OFF	-
Space ("0")	ON	+

All voltages are measured with respect to circuit AB (Signal Ground) at the point of interconnection; i.e., the interface connector.

The source of an interchange signal must deliver a voltage of between 5 and 25 volts (positive or negative) into a load whose resistance is not less than 3000 ohms.

The destination of an interchange signal must present an essentially resistive load of resistance not less than 3000 ohms. The capacitance of the load (measured from the interface connector) shall not be greater than 2500 pf (uuf).

The load shall not contain an internal potential of more than 2 volts.

Voltage conditions between +3 volts and -3 volts are anomalous and require no specific response except in the case of "fail safe circuits", described below. Data and timing circuits must have rise times so that the signal remains in this anomalous region during each transition for no more than 3% of the minimum signal element length appropriate to the speed of the channel.

Certain control circuits are designed to be "fail safe". These include such circuits as "Data Set ready", "data terminal ready", and "request send", when provided. "Fail safe" operation implies that the destination can interpret the signal condition as "OFF" when the source has lost power. In this case, no potential is applied by the source.

The source of any "fail safe" circuit must, under conditions of loss of power, provide a resistance to signal ground of not less than 300 ohms. This allows the use in the destination of shunt biasing circuits to ensure the "OFF" response under this condition.

Circuit functions are as follows:

Circuit AA (protective ground) is tied to the frame of the Data Set, which is in turn grounded to the power system ground through the power cord.

Circuit AB (signal ground) provides the reference point for all other interchange circuits. In this Data Set it is tied to the frame.

Circuit BA (transmitted data) is used by the data terminal equipment to present data to be transmitted. It is operative when circuits CA (request to send) and CB (clear to send) are ON.

Circuit BB (received data) delivers the data received by the Data Set. When the Data Set is idle, or when circuit CF (carrier detector) is OFF, circuit BB is held in the MARK condition.

Circuit CA (request to send) is used by the data terminal equipment to turn carrier on or off in the Data Set depending upon whether the CA lead is placed in the ON or OFF condition.

Circuit CB (clear to send) indicates when ON that the Data Set has established a connection with the distant Data Set and that signals may be applied to circuit BA (transmitted data).

Circuit CC (Data Set ready) indicates when ON that the Data Set is in the data mode; that is, that it is not in the idle, talk, test, or local condition, nor is it without power.

Circuit CF (data carrier detector) indicates when ON that data carrier is being received from the distant end. In the method of operation used by Data Set 103F, this circuit and circuit CB (clear to send) carry simultaneous signals.

Circuit CX (local mode), when placed in the ON condition by the data terminal equipment, holds an OFF condition on the CC circuit and delivers local copy of the data on the BA circuit to the BB circuit. Carrier is not transmitted to the communication channel in this mode.

Circuit CY (originate mode) allows the data terminal equipment the option to control operation of the Data Set in either the ORIGINATE or ANSWER mode. An OFF condition on the CY lead places the Data Set in the ANSWER mode; whereas, an ON, open circuit, or short circuit condition on the CY lead places the Data Set in the ORIGINATE mode. If the option to control is not desired, the Data Set is permanently strapped in either mode as required by the Telephone Company.

Modulation Rate. The maximum modulation rate of the channel provided by Data Set 103F2 is 300 bauds (300 bits per second) in each direction, simultaneously. The rate being used on the GE-255/265 system is 110 baud.

There is no limit on the interval of MARK or SPACE which may be transmitted.

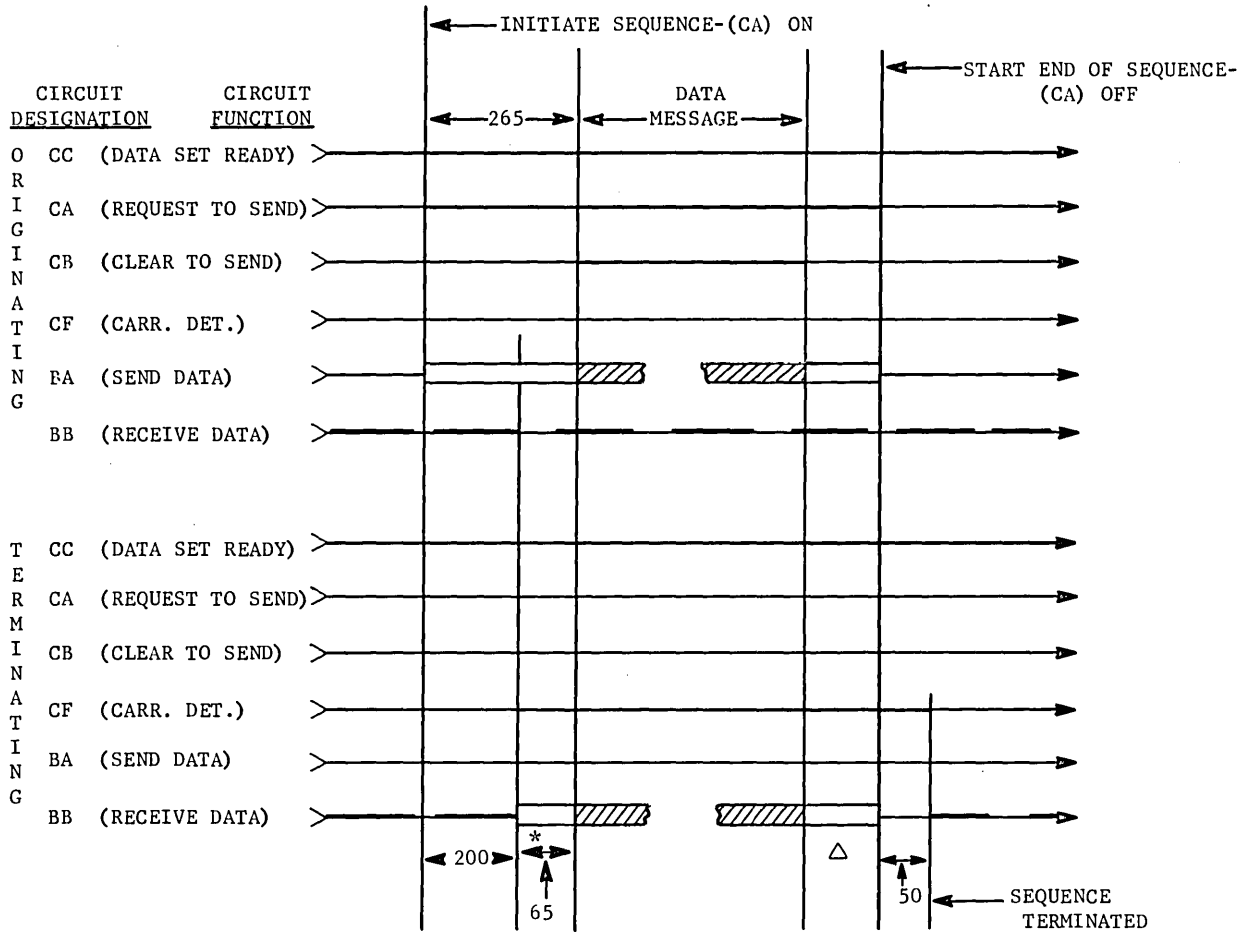
OPERATION.

Frequency Assignment. Frequency assignment is the same as for Data Set 103A2.

Timing. The CF lead of a given Data Set turns ON after carrier has been received continuously for 150 ms (±50). It will turn OFF approximately 50 ms (±25) after carrier is lost if the loss is longer than about 20 ms (±10). (Refer to Figure 19.)

Until CF is turned ON, the BB circuit is in the MARK HOLD condition. The HOLD is reapplied when CF turns OFF.

Transmission of data does not begin until at least 265 ms (±65) after CA is turned ON to allow the distant end to detect carrier and remove its HOLD condition. CB is turned ON to indicate the end of this interval.



NOTES:

*65 MS PERIOD IN WHICH DATA MAY BE RECEIVED (NOT RECOMMENDED)
VARIABLE TIME BETWEEN "END OF MESSAGE" AND STARTING OF TERMINATING SEQUENCE - ALL TIMES IN MILLISECONDS, NOT TO SCALE - PROPAGATION TIMES IGNORED

LEGEND

TRANSMITTED SIGNAL	CIRCUIT BB	CIRCUITS C-
NONE	MARK HOLD	OFF
SPACE	SPACE	ON
MARK	MARK	RECEIVED FROM OTHER END
DATA FROM BA	DATA	

Figure 19. Data Set 103F Timing Sequence

Two-Point Circuits. The connection of the central console is a two-point circuit consisting of a single segment terminating in a Data Set at each end. When data sets 103F2 are used on such a circuit, the set at one end operates in the OR ("Originate") frequency mode, and that at the other in the AN ("Answer") frequency mode. Thus, two-way communication is possible using F1 for one direction of transmission and F2 for the other.

Either station may turn its CA lead ON and send data to the other at any time. An interval of at least 265 ms should be allowed after turning CA on before data is sent to allow carrier recognition and BB circuit enablement at the far end, as discussed under "Timing" above.

Alternatively, the far end, when it receives the CG signal, may respond by turning on its CA, returning carrier to the near end. The appearance of a CF signal at the near end verifies the integrity of the channel and indicates that the near end may send.

It is, of course, possible to leave both CA leads on at all times. Either end may begin to send at any time, and the CF leads give continuous monitoring of channel integrity.

Loss of Circuit. Loss of continuity of either direction of the telephone channel will cause the CF lead to go OFF and BB to the MARK HOLD condition at the end or ends losing tone. This may be used to call attention to this loss if its time of occurrence does not coincide with an expected carrier loss.

Local Mode. When the LOCAL circuit is turned ON, the Data Set enters the local mode. In this mode, the signals applied to the BA circuit are repeated out through the BB circuit. This permits a "loop-back" test of the BBC's interface cable, the interface connectors, and the signal handling stages in the DATANET-30 adjacent to the interface. However, the DATANET-30 software is not programmed to perform this loop back test.

In the local mode, the CC leads if OFF. In addition, the Data Set is prevented from transmitting until the local mode is turned OFF. The carrier detector and CF lead remain operative.

Test Mode. When the Data Set is in the test mode, the CC and CF leads are OFF, the CA and BA circuits are deactivated, and the BB circuit opened. The local mode is inoperative while in the test mode.

If the test buttons are accidentally pressed when no carrier is being received, the test mode is invoked, but will not lock in. Releasing the button will restore the Data Set to normal.

If the test buttons are accidentally depressed while carrier is being received, there will be no effect.

In either case, the button is not illuminated.

If a button should accidentally be pressed just as carrier is received, the Data Set may enter the test mode, indicated by illumination of the button.

In this case, the Data Set may be restored to normal by pressing and releasing the TEST button.

TERMINAL EQUIPMENT

The only terminals available for communicating with the GE-255/265 at the time of this writing are the Models 33 and 35 Teletype units produced by the Teletype Corporation.

Common to these two models is the fact that both transmit and can receive the American Standard Code for Information Interchange (ASCII) Character Set.

This character set and its transmitted bit patterns are shown in Figure 20. When the GE-255/265 Time-Sharing System receives these codes they are translated to the GE-225 or 235 codes. (Refer to Appendix B.)

b_7	b_6	b_5	b_4	b_3 b_2 b_1	N_8	0	1	2	3	4	5	6	7
						0_0	0_1	0_2	0_3	1_0	1_1	1_2	1_3
0	0	0	0		00	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL
0	0	0	1		01	BS	HT	LF	VT	FF	CR	SO	SI
0	0	1	0		02	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB
0	0	1	1		03	CAN	EM	SS	ESC	FS	GS	RS	US
0	1	0	0		04	SP	!	"	#	$	%	&	'
0	1	0	1		05	(	)	*	+	,	—	.	/
0	1	1	0		06	0	1	2	3	4	5	6	7
0	1	1	1		07	8	9	:	;	<	=	>	?
1	0	0	0		10	`	A	B	C	D	E	F	G
1	0	0	1		11	H	I	J	K	L	M	N	O
1	0	1	0		12	P	Q	R	S	T	U	V	W
1	0	1	1		13	X	Y	Z	[	~	]	^	_
1	1	0	0		14	@	a	b	c	d	e	f	g
1	1	0	1		15	h	i	j	k	l	m	n	o
1	1	1	0		16	p	q	r	s	t	u	v	w
1	1	1	1		17	x	y	z	{	¬	}	|	DEL

Control Characters

NUL	Null
SOH	Start of Heading (CC)
STX	Start of Text (CC)
ETX	End of Text (CC)
EOT	End of Transmission (CC)
ENQ	Enquiry (CC)
ACK	Acknowledge(CC)
BEL	Bell (Audible or attention signal)
BS	Backspace (FE)
HT	Horizontal Tabulation (punched card skip) (FE)
LF	Line Feed (FE)
VT	Vertical Tabulation (FE)
FF	Form Feed (FE)
CR	Carriage Return (FE)
SO	Shift Out
SI	Shift In

Control Characters

DLE	Data Link Escape (CC)
DC1	Device Control 1
DC2	Device Control 2
DC3	Device Control 3
DC4	Device Control (stop)
NAK	Negative Acknowledge (CC)
SYN	Synchronous Idle (CC)
ETB	End of Transmission Block (CC)
CAN	Cancel
EM	End of Medium
SS	Start of Special Sequence
ESC	Escape
FS	File Separator (IS)
GS	Group Separator (IS)
RS	Record Separator (IS)
US	Unit Separator (IS)
DEL	Delete

(CC) Communication Control. (FE) Format Effector. (IS) Information Separator.

Figure 20. Proposed Revised American Standard Code for Information Interchange

Symbol	Name	Symbol	Name
SP	Space (normally nonprinting)	;	Semicolon
!	Exclamation Point	<	Less Than
"	Quotation Marks (diaeresis)	=	Equals
#	Number Sign	>	Greater Than
$	Dollar Sign	?	Question Mark
%	Percent	`	Grave Accent (opening single quotation mark)
&	Ampersand		
'	Apostrophe (closing single quotation mark; acute accent)	[	Opening bracket
		~	Tilde
(	Opening Parenthesis	]	Closing bracket
)	Closing Parenthesis	^	Circumflex
*	Asterisk	_	Underline
+	Plus	@	Commercial at
,	Comma (cedilla)	{	Opening brace
-	Hyphen (minus)	¬	Overline
.	Period (decimal point)	}	Closing brace
/	Slant	|	Vertical line
:	Colon		

Figure 20. Proposed Revised American Standard Code for Information Interchange (continued)

Some of the peculiarities of these codes and keys are discussed below.

Model 33 Teletype Unit

Principal parts of the Model 33 Teletype Unit are:

Control Unit
Keyboard
Paper Tape Punch (Optional)
Paper Tape Reader (Optional)

Refer to Figures 21 and 22 for details on the Model 33 controls and keyboard.

CONTROL UNIT. (Modes of Operation)

Control	Use
Rotary Dial (or touch tone)	For dialing telephone numbers.
ORIG (Originate)	Depress to obtain a dial tone to dial a number.
CLR (Clear)	Depress to change from one mode to another, or to turn off teletypewriter when using Local Mode.
ANS (Answer)	Use only when receiving calls from another teletypewriter while in Local Mode of operation.
TST (Test)	Used by Telephone Company.
LCL (Local)	Depress to perform local off-line work such as tape punching. This mode cannot connect with the computer.
BUZ-RLS	Buzzer sounds when paper supply is low. Depress button to silence buzzer. Replace paper roll and push "CLR".
OUT OF SERV.	Places station out of service (i.e., for repairs, changing paper, tape, etc.) or for receiving calls on the telephone.
BRK-RLS (Break Release)	Depress to free keyboard after a "break" signal. (Signal causes keyboard to lock until this button is depressed.)
REST (Restrain)	Light indicates that sending speed is too fast when communicating with a station of lower speed. If the speed is not reduced a "break" signal will interrupt the communication.
NORMAL-RESTORE	Should always point to NORMAL.
Loudspeaker	Usually located under the keyboard at the right. A volume control key permits adjusting of the volume of the loudspeaker. (In some cases a handset may be provided.) If button is turned as far as possible counterclockwise no dial tone will be audible.

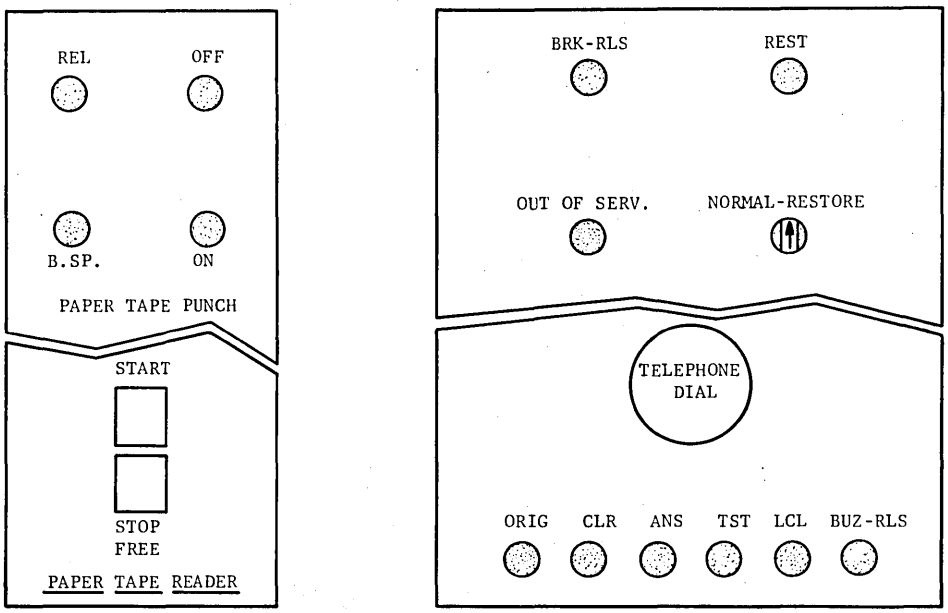


Figure 21. Model 33 Controls

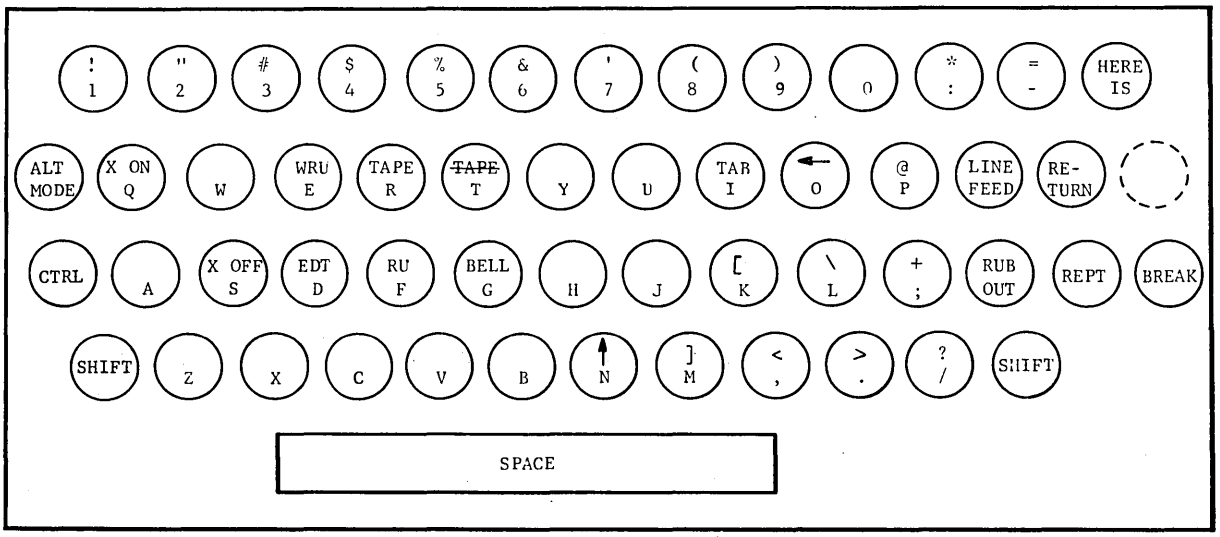


Figure 22. Model 33 Keyboard Arrangement

KEYBOARD. The keyboard operates in a similar fashion to a standard typewriter with the following exceptions:

The keyboard illustrated in Figure 22 is the correct one for a teletypewriter communicating with the GE-200 Series Time-Sharing System and it should be ordered like this from the Telephone Company.

Letters of the alphabet are printed in capital letters only. There are no small letters.

The SHIFT key is non-locking and must be held depressed when typing shift-type characters.

RETURN	Returns the carriage to the left margin.
LINE FEED	Moves the paper up one line at a time.
HERE IS	When this key is depressed, it causes the contents of the answer back drum to be transmitted.
REPT (Repeat)	To repeat the same character, this key is held depressed while the desired character key is operated. The latter is released and the REPT key is held until the desired number of characters have been typed. (If it is an upper case character, the SHIFT key must be held along with the REPT key.)
RUBOUT	This key has a non-printing function. It can also be used in conjunction with the backspace button on the tape punch to delete errors in punching tape.
ALT MODE (or ESC)	Causes line currently being typed to be deleted. On newer models this key is deleted and CONTROL X performs this function.
BREAK	Causes the keyboard to lock until the BRK-RLS (Break Release) is depressed. The computer will respond to this signal by terminating output (if transmitting output) and if it is running a program, it will stop execution. Response by the computer is acknowledged by the typeout "STOP/READY". Recommended procedure: depress simultaneously the CTRL (control) SHIFT, and P keys. This causes transmission of one (and only one) Break characters. This procedure prevents any possibility of terminating operations and does not cause the keyboard to lock.

The following keys are operated in conjunction with the control key. They are nonprinting, operational functions. By holding the CTRL key depressed and then depressing the desired key, these functions are activated.

WRU (Who are you)	This key will activate an immediate response from the computer: THIS IS TIME-SHARING GENERAL ELECTRIC CO.
EQT (End of Transmission)	When this key is depressed it will cause an immediate disconnection from the computer and turn off the teletype.
X-OFF	Some Model 33's come equipped with a perforated tape reader, which will stop if this code is encountered on the perforated tape or received from a remote station.
X-ON (Control Q)	Some Model 33's (optional feature) come equipped with a perforated tape reader which will start when receiving the X-ON code. (Refer to the description of the perforated tape reader which follows.)

PERFORATED TAPE PUNCH. For perforating tape from the local keyboard or from a remote location, the punch generates a row of holes for each character (including the nonprinting functions) on the teletypewriter. (The perforated tape punch is located on the upper left side of the teletypewriter.) It produces one inch (8 level) fully perforated tape. The eighth level is always punched with any keyboard generated code. (The eighth level is parity.)

The following buttons control the paper tape operation.

ON and OFF buttons - Any typed or printed information may be punched on paper tape simply by turning the punch unit "ON" (depressing the "ON" button). It will then punch all information until the "OFF" button is depressed to turn it off.

B.SP. (Backspace) - Each time this button is depressed the paper tape is moved backwards one character. This button is used with the RUBOUT key to delete errors in the tape. The character (or characters) in error are each moved back under the punch and then for each character to be deleted the RUBOUT key is depressed.

REL (Release) - This button frees the tape so that the user can manually pull blank tape through the punch for new tape insertion. (This tape cannot be read through the tape reader.)

PERFORATED TAPE READER. (Located at lower left side of the teletypewriter.) For transmitting information on the paper tape. The paper tape reader has one control switch with three positions:

1. START - forward position - starts the tape moving through the reader.
2. STOP - middle position - stops the tape reader.
3. FREE - locked bottom position - allows the tape to be pulled manually through the reader.

The Model 33 can be ordered with an option for automatic reader control. With this option, the paper tape reader will respond to the X-ON and X-OFF signals. However, this option must be acquired through a special order to the Telephone Company.

To insert the tape in the Tape Reader:

1. Open the clear plastic tape gate by pushing the grey lock on the right side to the right.

2. Place the tape surface facing upward with the tape feed holes (small holes) over the tape feed wheel (the smaller side of the tape to the left).

3. The code holes of the first character to be transmitted should be placed slightly behind the sensing pins.

4. Close and lock the tape gate by pushing down. When ready to transmit, put the tape read switch in the START position. (The operator must start the tape for each transmission to the computer.)

The tape will stop only when the central switch is moved to STOP or it runs out of tape, unless the special modification for "X-ON" and "X-OFF" has been made.

Note: A Model 33 is limited to printing 72 characters per line. However, the printing mechanism can easily be modifed to print 75 characters per line.

Model 35 Teletype Unit

Principal parts of the Model 35 Teletype unit are:

Control Unit
Keyboard
Perforated Tape Punch
Perforated Tape Reader

Refer to Figures 23 and 24 for details on the Model 35 controls and keyboard.

CONTROL UNIT. (Modes of operation)

Control	Use
Rotary Dial (or Touch Tone)	For dialing telephone numbers.
ORIG (Originate)	Depress to obtain a dial tone to dial a number.
CLR (Clear)	Depress to change from one mode to another, or to turn off teletypewriter when using Local Mode.
ANS (Answer)	Use only when receiving calls from another teletypewriter while in local mode of operation.
TST (Test)	Used by Telephone Company.
LCL (Local)	Depress to perform local off-line work such as tape punching. This mode cannot connect with the computer.
BUZ-RLS (Buzzer Release)	Buzzer sounds when paper supply is low. Depress button to silence buzzer. Replace paper roll and push "CLR".
OUT OF SERV.	Places station out of service (i.e., for repairs, changing paper, tape, etc.)
BRK-RLS (Break Release)	Depress button to free keyboard after a "break" signal. (Light causes keyboard to lock until button is depressed.)
REST (Restraint)	Light indicates that sending speed is too fast when communicating with a station of lower speed. If the speed is not reduced a "break" signal will interrupt the communication.
NORMAL-RESTORE	Should always point to NORMAL.
Loudspeaker	Usually located under the keyboard at the right. A volume control key permits adjusting of the volume of the loudspeaker. (In some cases a handset may be provided.) If a button is turned as far as possible counterclockwise, no dial tone will be audible.

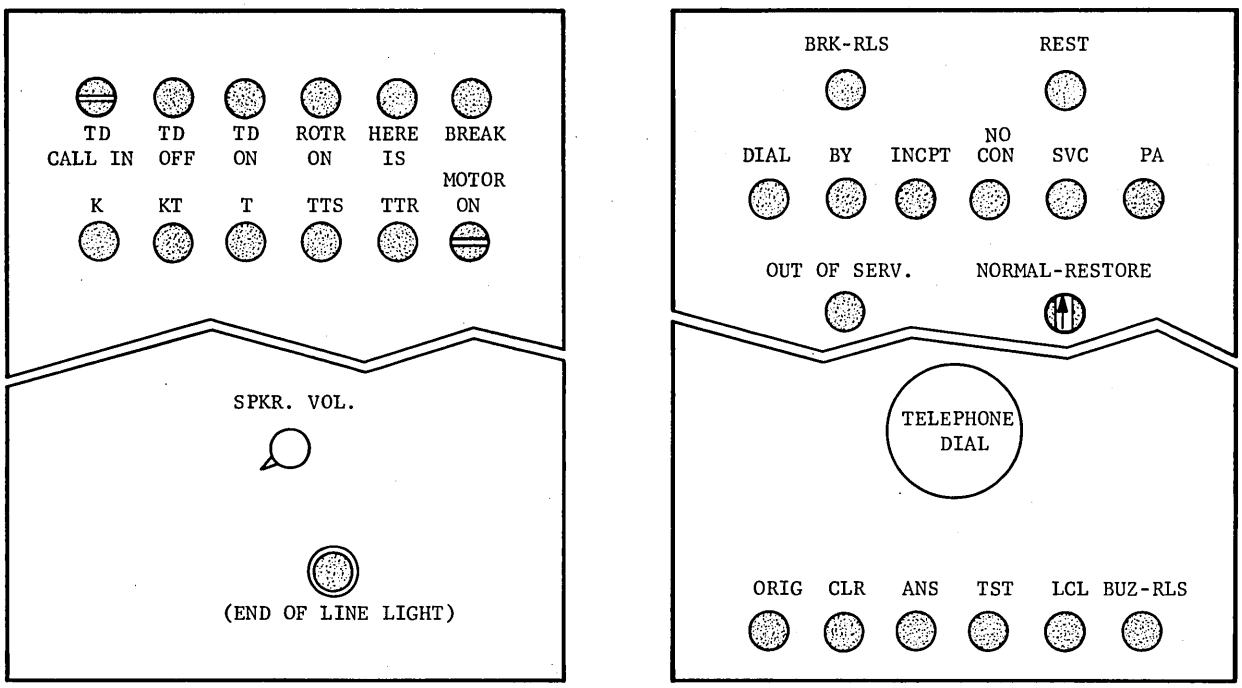


Figure 23. Model 35 Controls

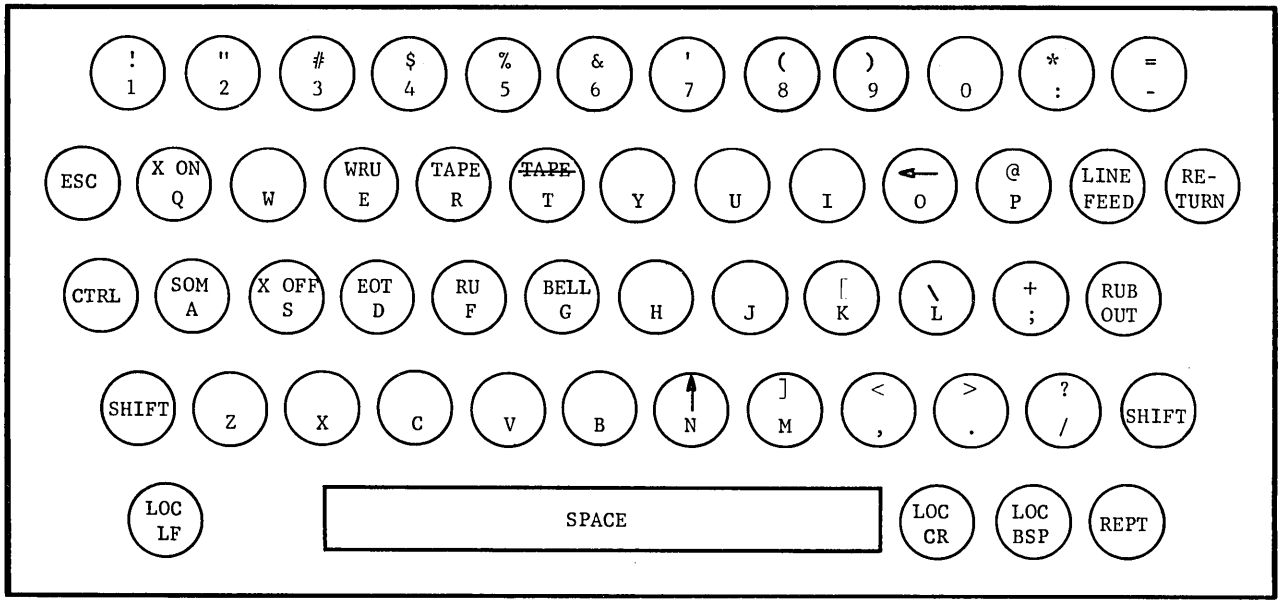


Figure 24. Model 35 Keyboard Arrangement

NOTE: In the new Telephone Company standard the ESC (or ALT Mode) key has been deleted and CTRL X performs the same function.

There are six lights on the upper right side of the unit which are not used with the system. These are:

DIAL, BY, INCPT, NO CON, SVC, PA

Column Indicator - (located at upper right side of keyboard.) The metal pointer on scale indicates which column has just been printed (typed/punched).

End of Line - (red light) Indicates when end of line is approached, and has no effect on computer or teletypewriter.

Control Buttons - (located to the left of the keyboard--all equipped with lights).

TD CALL IN	- not used
TD OFF	- turns local tape reader off
TD ON	- starts local tape reader
ROTR ON	- not used
HERE IS	- when this key is depressed, it causes the contents of the answer back drum to be transmitted.
BREAK	- will cause the keyboard to lock until the BRK-RLS (Break Release) is depressed. Depression of the break key will terminate whatever action is taking place in the computer with respect to this terminal, and cause a STOP/READY to be typed.

Control Modes:

K (keyboard)	- for obtaining page copy only.
KT (keyboard tape)	- for obtaining page copy and perforating tape simultaneously or for transmitting, punching a copy tape and page copy simultaneously.
T (Tape)	- for perforating tape only or transmitting tape with page copy.
TTR (Tape to Tape Receive)	- perforates tape from a remote source without page copy.
TTS (Tape to Tape Send)	- transmits tape without page copy.
MOTOR ON	- permits punching tape locally (without page copy) without placing station in LOCAL mode.

When originating a call, the station is automatically switched to the Tape (T) mode. If a request to the computer is to be made and has not been previously punched on tape, the user must depress the K button before any transmission can be effected.

Note on TTS and TTR modes: In these modes, any one inch wide tape of up to eight levels may be transmitted or received. If communication with the computer is desired with a nonstandard code, a special program to handle the conversion of code will be required.

KEYBOARD. The keyboard operates in a similar fashion to a standard typewriter with the following exceptions:

Letters of the alphabet are printed in capital letters only. There are no small letters.

The shift key is nonlocking and must be held depressed when typing shift-type characters.

RETURN	Returns the carriage to the left margin.
LINE FEED	Moves the paper up one line at a time.
REPT (Repeat)	To repeat the same character, this key is held depressed while the desired character key is operated. The latter is released and the REPT key is held until the desired number of characters have been typed.
RUBOUT	This key has a nonprinting function and is used following operation of the return to end-paper-tape input. It can also be used in conjunction with the backspace button on the tape punch to delete errors in punching tape.
ALT MODE (or ESC)	This key causes line currently being typed to be deleted. (On newer models this key has been deleted but control X will perform the same function.)

The following keys are operated in conjunction with the control key. They are nonprinting, operational functions. By holding the CTRL (Control key) depressed and then depressing the desired key, these functions are activated.

WRU (Who are you)	This key will give an immediate response from the computer: THIS IS TIME-SHARING GENERAL ELECTRIC CO.
EOT (End of Transmission)	When this key is depressed it will cause an immediate disconnection from the computer and turn off the teletypewriter.
X-OFF	This code causes the paper tape reader to stop if encountered on the paper tape.
X-ON (Control Q)	This key causes the paper tape reader to start if received from a remote station.

(Refer to description of paper tape reader on page 31.)

Four red keys, two on each side of the space bar, are used for local action only. They do not generate any code on a paper tape or transmit a code to the computer.

From left to right they are:

LOC B.SP.	Backspaces the paper tape in the punch, one space for each time it is depressed.
LOC LF	Spaces the carriage up.
LOC CR	Returns the carriage to the left margin.
REPT	Explained in previous section.

Note: The exact position of these keys may vary.

PERFORATED TAPE PUNCH. For perforating tape from the local keyboard or from a remote location, the punch generates a row of holes for each character (including the nonprinting functions) on the teletypewriter. (Located at the upper left side of the keyboard.) It produces one inch (8 level) of fully perforated tape. The eighth level is always punched with any keyboard generated code. (The eighth level is parity.)

The teletypewriter must be in LOCAL (LCL) and the "KT" mode for punching tape without transmission to the computer (It will also punch tape in the "T" mode, or master on, but will not generate a page copy.)

Deleting errors on the tape, press the "LOC B.SP" button for each character to be deleted; then, depress the RUBOUT key for each character. (The RUBOUT generates a row of 8 punches which is then ignored by the tape reader.)

PERFORATED TAPE READER. (Located on the far left of the teletypewriter.) For transmitting information via paper tape, the reader itself is equipped with a switch which has two positions:

FREE - for free wheeling, to insert tape without raising the tape gate. This is a non-locking position of the switch--it must be held in this position.

RUN - regular position of the switch.

Control of the tape reader is by means of the buttons TD ON and TD OFF. The teletypewriter must be in the KT, T, or TTS mode to operate the tape reader.

To position the tape in the tape reader:

1. Press the square button to release the tape gate.

2. Place the tape surface facing upward with the tape feed holes (small holes) over the tape feed wheel (the smaller section of tape facing away from the operator).

3. The code holes of the first character to be transmitted should be placed slightly behind the sensing pins.

4. Close and lock the gate by pressing it down.

5. To start the tape press TD ON.

The tape will stop when it reads an X-OFF code, runs out of tape, jams, or if any of the following keys are depressed: K, TTR or TD OFF.

11. OFF-LINE REPORTING ROUTINES

GENERAL

During a normal day's operation, the time-sharing system captures on magnetic tape and the disc storage unit the information needed to prepare customer invoices. The amount of each customer's central processor time is written on magnetic tape (the daily CPU usage tape). The amount of time each teletypewriter spends in accessing the time-sharing system is recorded on the disc storage unit.

At the end of each day's operation, their records are obtained from the time-sharing system. The daily CPU usage tape is replaced by another tape to capture the next day's information. The terminal time retrieval program is run on the time-sharing central processor to remove the teletypewriter time information from the disc and place it on magnetic tape. This magnetic tape (the monthly teletypewriter time) maintains an accumulation of the month-to-date time used. The teletypewriter time-accumulation areas on the disc are then set to zero in preparation for the next day's operation.

The daily CPU usage tape is then entered into the Billing Master Pack run. This run combines the information on the current day's tape onto a month-to-date accumulation tape (the monthly CPU usage tape).

At the end of each month, the monthly CPU usage tape and the monthly teletypewriter time tape are sorted into order by date within user number. These sorted tapes contain a detailed breakdown of time-sharing usage by each customer.

If automatic invoices are desired, a computer program must be written which accepts as input the two sorted monthly information tapes, a master name and address file, and punched card exceptions and changes. The output from such a program would be the invoice.

The Terminal Time Retrieval routine must be run on the time-sharing central processor. However, all of the other reporting routines may be run as off-line batch processing jobs on a GE-225 or 235 system if such a system is available. If such a system is not available, they must be run as batch processing jobs on the time-sharing central processor. In this event, the time-sharing system must include a printer and four magnetic tape units.

BILLING MASTER PACK

Purpose

The purpose of the Billing Master Pack routine is to combine all of the daily central processor unit (CPU) usage tapes, generated by the time-sharing system during the daily processing, onto a monthly CPU usage tape.

Input

The input to the Billing Master Pack routine consists of the daily CPU usage tape, and the previous day's monthly CPU usage tape. A date card is also inserted in the routine.

Output

The only output from the Billing Master Pack routine is the current monthly CPU usage tape.

Processing

The previous day's monthly CPU usage tape is copied onto the current monthly CPU usage tape. Today's daily CPU usage tape is then added to the current monthly CPU usage tape.

The records on the daily CPU usage tape are 24 words in length and are written one record to a block. Much of the information contained in this record is not needed for customer billing. When copying the record onto the monthly CPU usage tape, this unnecessary information is discarded and the necessary information is written as an 8 word record.

The abbreviation for the system name is written on the daily CPU usage tape as one full word of three BCD characters. When condensing this record to be written on the monthly CPU usage tape, it is converted to a one-character code as follows:

BAS	becomes	A
ALG	"	B
DIP	"	C
XAL	"	D
XBA	"	E
EDT	"	F
EDI	"	G
WIZ	"	H
FOR	"	I
XFO	"	J
TSA	"	K

Control totals of the number of CPU seconds that have been accumulated are typed on the console typewriter at end of the job.

Equipment Required

GE-225 or 235 central processor.

3 magnetic tape units on controller 1.

Operating Instructions

1. Prepare the date card in the following manner:

   Columns

1-4	Enter "DATE".
5-6	
7-8	Enter the month in numerals. If only one digit, use a zero to fill the field.
9-10	Enter the day. If only one digit, use a zero to fill the field.
11-12	Enter the year.

   Example: July 8, 1967 would be punched starting in column one as DATE 070867.

2. Place date card after transfer card.
3. Place the daily CPU usage tape on tape unit 0.
4. If other than the first day of the month, place the previous day's monthly CPU usage tape on tape unit 1.
5. Place a scratch tape on tape unit 2.
6. Set the console switches to normal.
7. Load the program deck.
8. After the typeout: SET 19 FIRST TIME TOGO 0, do one of the following: If this is the first day of the month, and there is no previous monthly CPU usage tape mounted on tape unit, set switch 19 and toggle the zero switch. If this is not the first day of the month and the previous day's monthly CPU usage tape is mounted on tape unit 1, toggle switch 0.
9. Save the previous day's tape from tape unit 1.
10. If backup is desired, run the GET tape copy subroutine (GET 042), using the tape from tape unit 2.
11. Third generation tapes may be used for new first generation tapes.

Typewriter Messages

PREVIOUS 1-6 SEC xxxxxxxxx

This is the total amount of CPU time in 1/6 of seconds that is being carried forward from the previous day. This figure should agree with the CURRENT 1-6 SEC typeout from the Billing Master Pack run of the previous day.

DAILY 1-6 SEC xxxxxxxxx

This is the amount of CPU time in 1/6 of seconds that was utilized during the current day's time-sharing operation.

CURRENT 1-6 SEC xxxxxxxxx

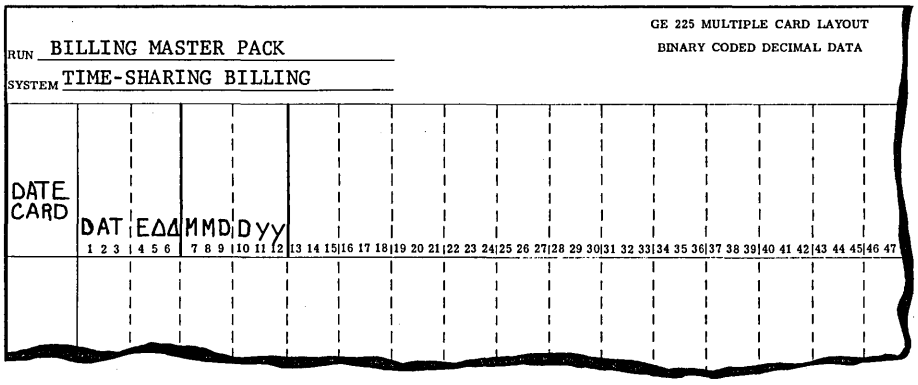
This is the total amount of CPU time in 1/6 of seconds that has been used for the current month. This figure should be the sum of previous 1-6 SEC and DAILY 1-6 SEC appearing immediately above. This figure should also agree with the previous 1-6 SEC typeout from the Billing Master Pack program which will be run the next day.

NO DATE CARD

No date card was inserted. Insert the date card and toggle Switch 0.

Input Card

The format for the date card required for the Billing Master Pack run follows.



Magnetic Tape Layouts

The magnetic tape layouts for both the input and output of the Billing Master Pack run follow.

INPUT

RUN: BILLING MASTER PACK — GENERAL ELECTRIC — RECORD LENGTH: 24 WORDS
FILE: DAILY CPU USAGE — BLOCKING FACTOR: 1 RECORD
RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

Daily CPU Usage Record

0	1	2	3	4	5	6	7
SYSTEM NAME			USER NUMBER				

8	9	10	11	12	13	14	15
		DATE			ON TIME		OFF TIME
		Δ M,O M,O / D,A D,A / Y,R Y,R					

RUN: BILLING MASTER PACK — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS
FILE: MONTHLY CPU USAGE — BLOCKING FACTOR: 60 RECORDS
RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

Tape Label

0	1	2	3	4	5	6	7
B T L O O I	M O Δ	C P Δ	U S G	Δ Δ Δ	Δ Δ Δ		

8	9	10	11	12	13	14	15

Monthly CPU Usage Record

0	1	2	3	4	5	6	7
USER NUMBER (BCD)		SYST NAME CODE	DATE (BCD)		TIME ON (1/6 SEC. BIN.)		TIME OFF (1/6 SEC. BIN.)
			M,O M,O / D,A D,A / Y,R Y,R				

8	9	10	11	12	13	14	15

CPB-1455

OUTPUT

RUN: BILLING MASTER PACK — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS

FILE: MONTHLY CPU USAGE — BLOCKING FACTOR: 60 RECORDS

RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

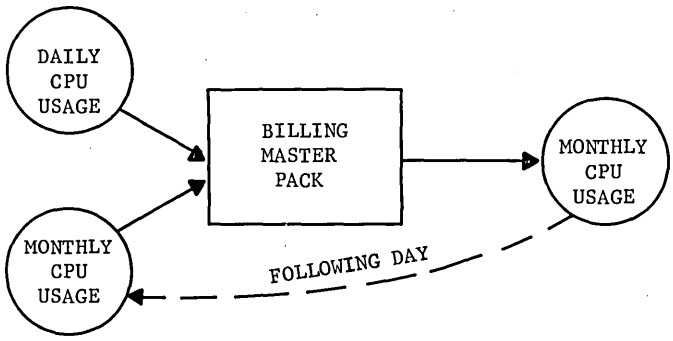
Tape Label

0	1	2	3	4	5	6	7
BTL00	1MOΔ	CPΔUSG	ΔΔΔΔΔΔ				
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23

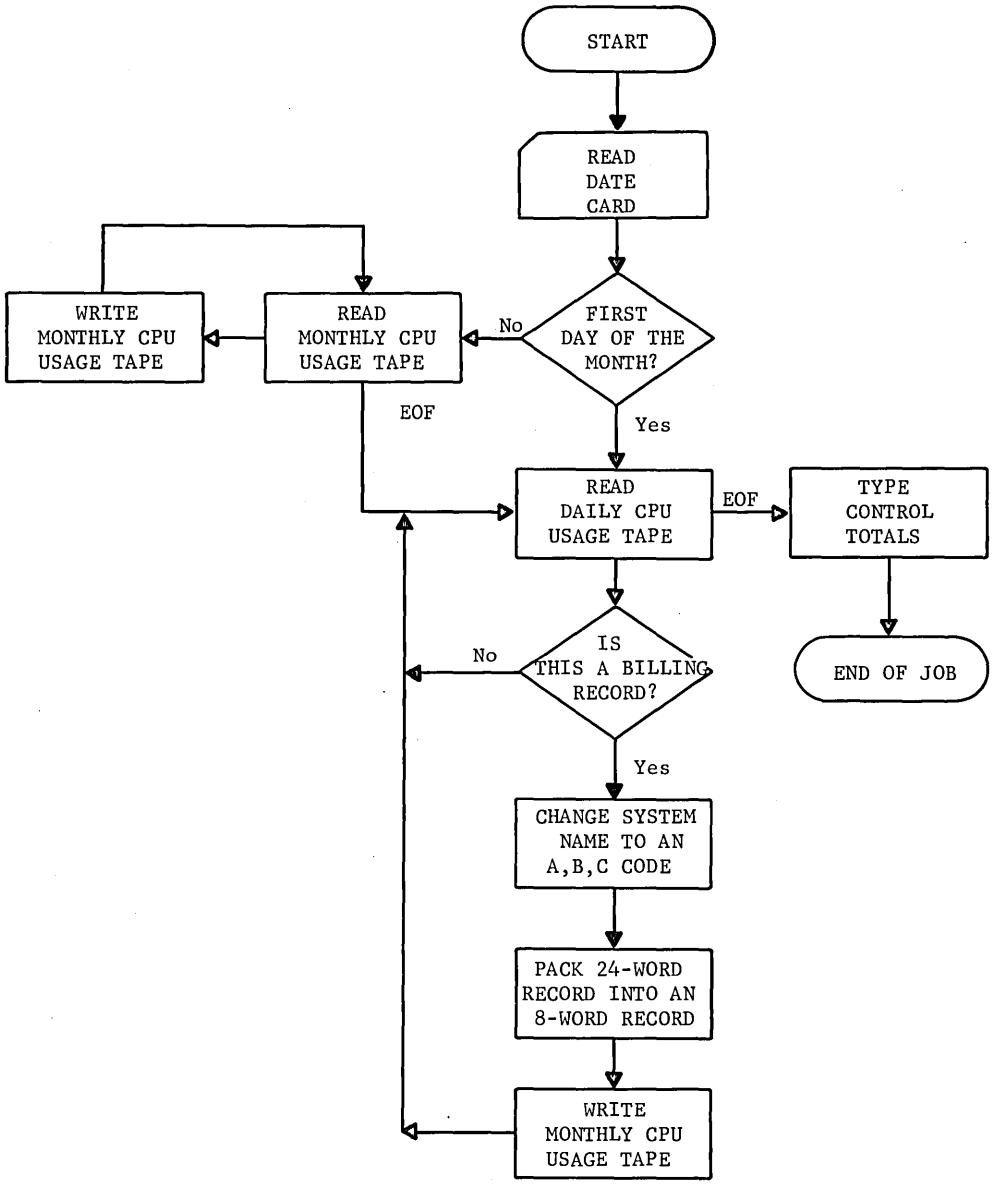
Monthly CPU Usage Record

0	1	2	3	4	5	6	7
USER NUMBER (BCD)		SYST NAME CODE	DATE (BCD)		TIME ON (1/60 SEC. BIN.)		TIME OFF (1/60 SEC. BIN.)
			MO MO / DA DA / YR YR				

CPB-1455



Top Level Flowchart of Billing Master Pack



Functional Flowchart of Billing Master Pack

CPB-1455

TERMINAL TIME RETRIEVAL

Purpose

The purpose of the Terminal Time Retrieval routine is to extract from the time-sharing disc the amount of teletypewriter time used under each user number and the number of storage units being used by each customer.

Input

The input to the Terminal Time Retrieval routine consists of the catalog and validation records from the time-sharing disc and the previous day's monthly hours and storage tape. A date card is also needed to insert in the routine.

Output

The only output from the Terminal Time Retrieval routine is the current monthly hours and storage tape.

Processing

The previous day's monthly hours and storage tape is copied onto the current monthly hours and storage tape.

The number of storage units being used by each customer for the current day is calculated from the information contained in the catalog records on the time-sharing disc. Storage units are calculated on the basis of 1 unit for each 512 words (or portion thereof) of disc storage space that is used to store a customer's program. These storage unit records (one per customer) are written on the monthly hours and storage tape.

The amount of teletypewriter time (in minutes) used under each user number during the current day is taken from the time-sharing disc. This information is carried in the user's validation record. These teletypewriter time records (one per user number) are written on the monthly hours and storage tape. After the user's teletypewriter time is taken from the disc, the accumulation area is set to zero in preparation for accumulating the next day's teletypewriter time.

Equipment Required

GE-225/235 out of time-sharing environment.

Disc loaded with time-sharing operating information. Two low density tape units on controller 1.

Operating Instructions

1. Prepare the date card in following manner:

   Columns

   1-4 Enter "DATE".

   5-6

   7-8 Enter the month in numerals. If only one digit, use a zero to fill the field.

   9-10 Enter the day. If only one digit, use a zero to fill the field.

   11-12 Enter the year.

   Example: July 8, 1967 would be punched starting in column one as DATE 070867.

2. Place date card after transfer card.
3. Place a scratch tape on unit 2.
4. If other than first day of month, place previous day's tape on tape unit 1.
5. Set console switches normal, clear the disc.
6. Load up program deck for terminal time retrieval.
7. After the typeout "SET DESIRED SWITCHES ↑ ↑ ↑ TOGGLE 0", set the following switches to required settings:

SWITCH 17 -	NORMAL	-	Terminal times in validation records are set to zero.
	DOWN	-	Terminal times are left on disc.
SWITCH 18 -	NORMAL	-	Tape records are written for information currently on disc.
	DOWN	-	Tape records are not written for current information.
SWITCH 19 -	NORMAL	-	A previous terminal time tape is mounted for copying.
	DOWN	-	Previous tape not to be copied.

8. Save the previous day's tape from tape unit 1.
9. If backup is desired, run the GET Tape Copy subroutine (GET 042).
10. Third generation tapes may be used for new first generation tapes.

Typeout

E1 No date card was inserted. Inset the card and toggle 0.

E3 An Error was detected on the catalog record of the disc address typed. Record bypassed.

E6 Bad storage information was detected in disc address typed. The routine types user number and proceeds.

E7 Same as E6.

E19 First two words of validation record for listed user number have been destroyed. Terminal times are rejected but not zeroed. Validation record should be investigated and corrected or revalidated immediately.

TAPE ERR

An error has been detected on tape. Toggle 0 to end the run. Hold switch 19, toggle 0 to try again.

DISC ERR

An error has been detected on disc. Toggle 0 to bypass record and continue the run. Hold switch 19 and toggle 0 to try again.

PREVIOUS MIN. xxxxxx

This is the total amount of teletypewriter time in minutes that is being carried forward from the previous day. This figure should agree with the MTD MINUTES typeout from the Terminal Time Retrieval run of the previous day.

TODAYS MIN. xxxxxx

This is the amount of teletypewriter access time in minutes for the current day's time-sharing operation.

MTD MINUTES xxxxxx

This is the total amount of teletypewriter time in minutes that has been used for the current month. This figure should be the sum of the PREVIOUS MIN. and TODAYS MIN. appearing immediately above. This figure should also agree with the PREVIOUS MIN. typeout from the Terminal Time Retrieval run which will be run the next day.

COPY COMPLETE With switch 19 normal, the tape on handler 1 has been copied on the tape on handler 2. (End of file and End Fence have not been written at this time.)

END PASS 1 Switch 17 was down. All other requested operations have been completed.

Possible Options

1. Write current data and zero disc.

   Leave switches 17 and 18 in normal position. If copy not required, set switch 19.

2. Copy previous tape and write current data on tape.

   Set switch 17 to avoid clearing terminal times on disc. Types "END PASS 1" and allows you to make new switch settings and continue.

3. Copy previous tape and zero times on disc.

   Set switch 18 to avoid writing current data on tape 2. Types "COPY COMPLETED" and "END".

4. Copy tape.

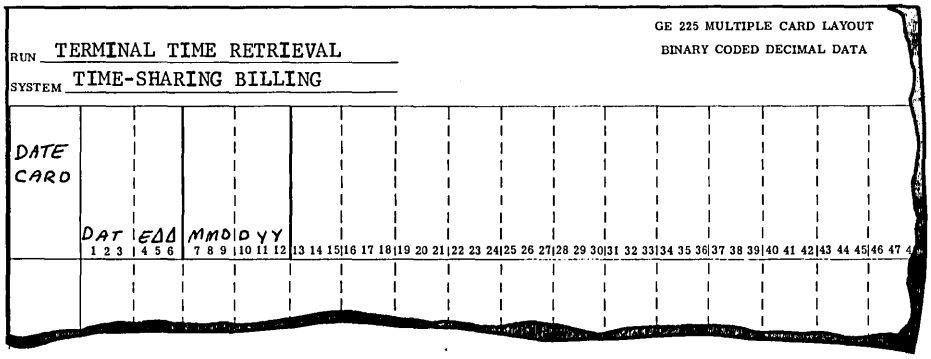
   Set switches 17 and 18 down. Copies tape from handler 1 to handler 2. Types "COPY COMPLETED" and "END".

5. Zero times on disc.

   Set switches 18 and 19 down. Types totals and "END". Totals should agree with the totals from a write tape only run (switch 17 down).

Input Card

The format for the date card required for the Terminal Time Retrieval run follows.



Magnetic Tape Layouts

The magnetic tape layouts for both input and output for Terminal Time Retrieval run are illustrated below.

INPUT

RUN: TERMINAL TIME RETRIEVAL — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS

FILE: MONTHLY HOURS & STORAGE — BLOCKING FACTOR: 20 RECORDS

RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

Tape Label

0	1	2	3	4	5	6	7
BTL001	RAWΔ	DISCΔ	000000				
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23

Storage Units Record

0 CATALOG NUMBER (BCD)	1	2	3 DATE (BCD)	4	5 STORAGE UNITS	6 NOT USED	7
	000	CCC	YRYR	MOMO	DADA		

Teletypewriter Time Record

0 USER NUMBER (BCD)	1	2	3 DATE (BCD)	4	5 "A" RATE TERMINAL TIME (MINUTES)	6 "B" RATE TERMINAL TIME (MINUTES)	7 "C" RATE TERMINAL TIME (MINUTES)
		UUU	YRYR	MOMO	DADA		

CPB-1455

OUTPUT

RUN: TERMINAL TIME RETRIEVAL — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS

FILE: MONTHLY HOURS & STORAGE — BLOCKING FACTOR: 20 RECORDS

RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

Tape Label

0			1			2			3			4			5			6			7		
B	T	L	0	0	1	R	A	W	Δ	D	1	S	C	Δ	0	0	0	0	0	0			
8			9			10			11			12			13			14			15		
16			17			18			19			20			21			22			23		

Storage Units Record

0 CATALOG NUMBER (BCD)			1			2			3 DATE (BCD) 4						5 STORAGE UNITS			6 NOT USED 7					
			0	0	0	C	C	C	Y	R	Y	R	M	O	M	O	D	A	D	A			

Teletypewriter Time Record

0 USER NUMBER (BCD) 1						2			3 DATE (BCD) 4							5 "A" RATE TERMINAL TIME (MINUTES)			6 "B" RATE TERMINAL TIME (MINUTES)			7 "C" RATE TERMINAL TIME (MINUTES)		
						U	U	U	Y	R	Y	R	M	O	M	O	D	A	D	A								

CPB-1455

Disc Storage Layout

The disc storage layouts follow.

RUN: TERMINAL TIME RETRIEVAL — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS
FILE: CATALOG RECORD — BLOCK LENGTH: VARIABLE LENGTH: NO LIMIT
RECORD TYPE: BIN — GE 200 SERIES DISC SECTOR LAYOUT SHEET — PAGE: ____ OF: ____

Catalog Record

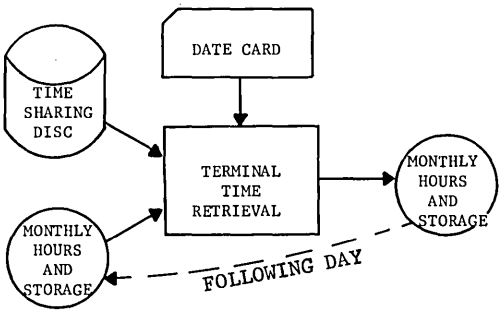
0	1	2	3	4	5	6	7
USER NUMBER (BCD)		PROGRAM NAME (BCD)		BEGINNING DISC ADDRESS	ENDING DISC ADDRESS	NOT USED	

RUN: ____ — GENERAL ELECTRIC — RECORD LENGTH: VARIABLE LENGTH: UP TO 128 WORDS
FILE: VALIDATION RECORD — BLOCK LENGTH: 1/RECORD
RECORD TYPE: BIN — GE 200 SERIES DISC SECTOR LAYOUT SHEET — PAGE: 3 OF: 3

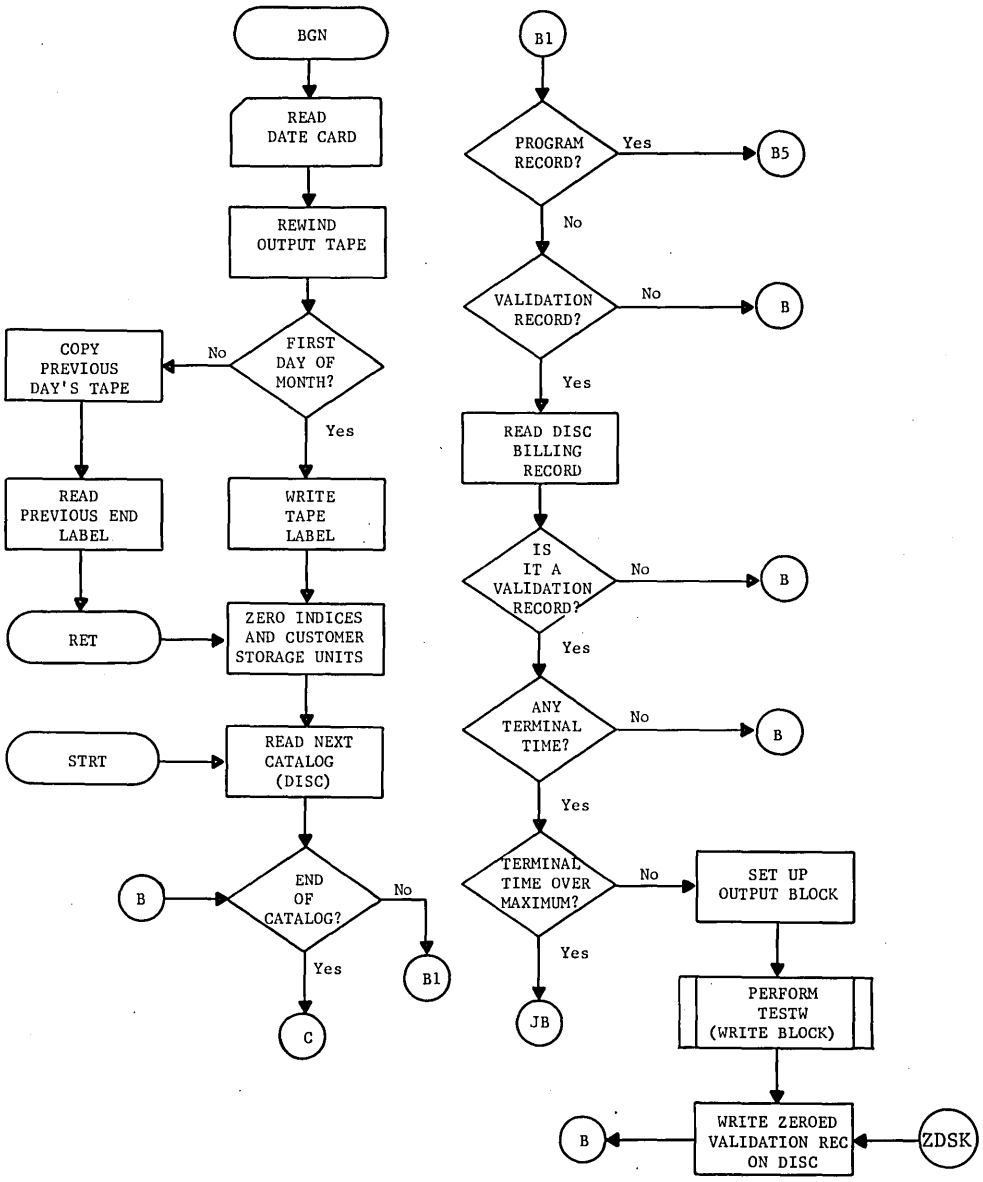
Validation Record

0	1	2	3	4	5	6	7
	OK CODE		TTY CODE		DATE OF VALIDATION		
0 1 Δ	7737	02 Δ	7737	03 Δ	MOMO	DADA	YRYR 777737
8	9	10	11	12	13	14	15
	"A" RATE TERMINAL TIME (MINUTES)	"B" RATE TERMINAL TIME (MINUTES)	"C" RATE TERMINAL TIME (MINUTES)				MESSAGE
04 Δ				777777	777737	05 Δ	
16	17	18	19	20	21	22	23
	MESSAGE (CON'T)						VALID TER-
					777737	06 Δ	
24	25	26	27	28	29	30	31
MINAL ANSWER BACK DRUM					VALID TERMINAL ANSWER BACK		
		777777	777737	07 Δ			
32	33	34	35	36	37	38	39
DRUM				etc.			
7777777737	08 Δ						

CPB-1455

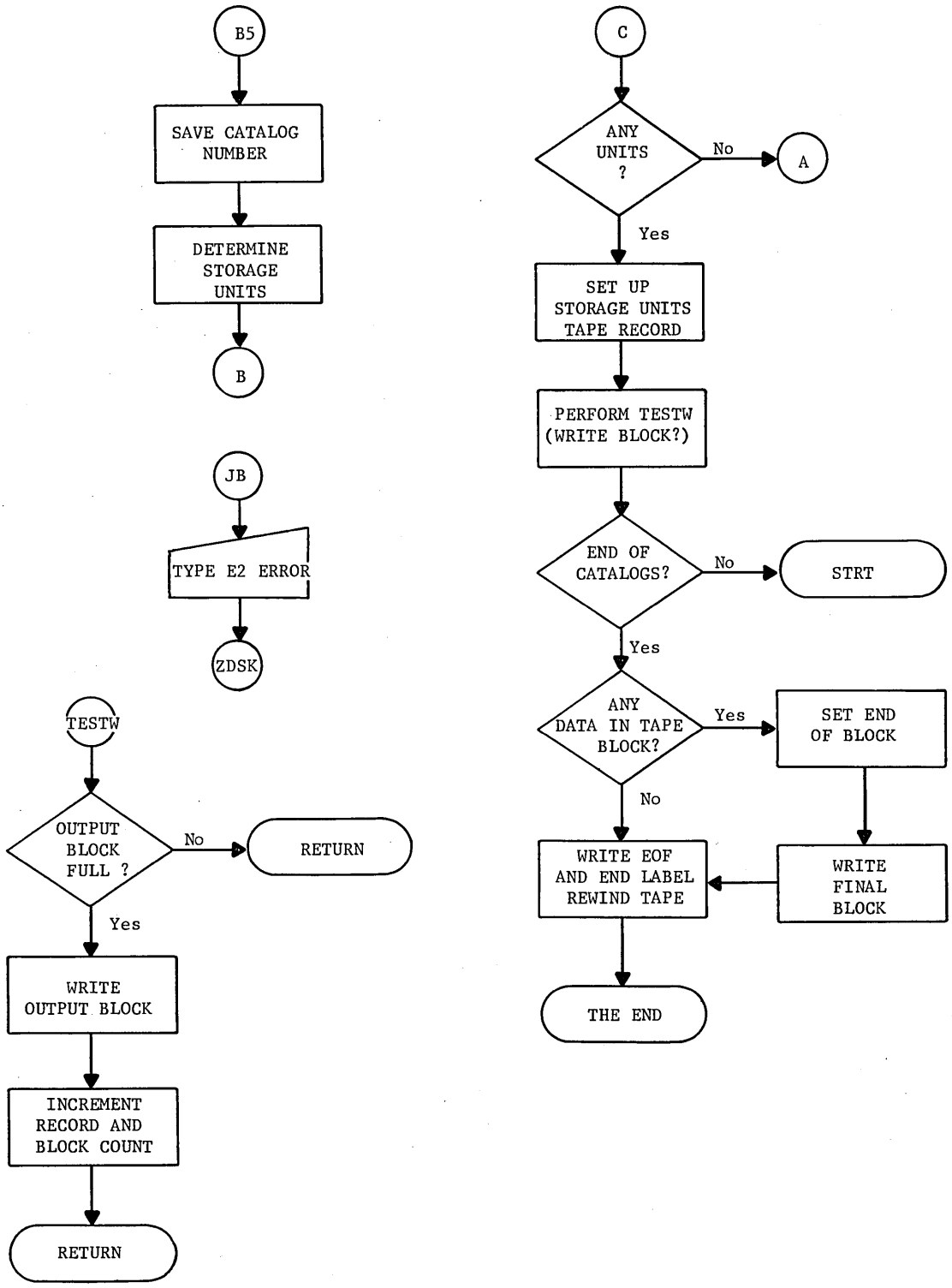


Top Level Flowchart Terminal Time Retrieval



Functional Flowchart of Terminal Time Retrieval

CPB-1455



Terminal Time Retrieval (Cont.)

CPU USAGE SORT

Purpose

The purpose of the CPU Usage Sort routine is to sort the monthly CPU usage records into user number sequence which provides a sorted input tape for the preparation of invoices and user statistics.

Input

The only input to the CPU Usage Sort routine is the monthly CPU usage tape.

Output

The only output from the CPU Usage Sort routine is the sorted and summarized monthly CPU usage tape.

Processing

The input records contain the beginning and ending times for each run. During the input coding element (ICE) of the sort the elapsed time of the run is calculated and placed in word 6 of the record. After the elapsed times have been calculated, the squeeze coding element (SCE) is used to summarize the CPU times and create only one record per day per user number. These summarized monthly CPU usage records are sorted by date within user number. The total number of seconds of CPU time used during the month is typed at end of job.

Equipment Required

GE-225 or 235 central processor.

5 magnetic tape units on controller 1.

Operating Instructions

1. Mount the monthly CPU Usage (MO CP USG) tape on unit 1.
2. Mount four work tapes on tape units 2, 3, 4, and 5.
3. Run the program using the FORWARD SORT operating instructions.
4. Label the output tape: SR CP USG.

Typeouts

xxxxxx SECS

Where xxxxxx indicates the total number of CPU time in seconds for the run.

Magnetic Tape Layouts

The magnetic tape layouts for both input and output for the CPU Usage Sort run follow.

INPUT

RUN: CPU USAGE SORT — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS

FILE: MONTHLY CPU USAGE — BLOCKING FACTOR: 60 RECORDS

RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

Tape Label

0	1	2	3	4	5	6	7
BTL OO IMO ΔCP ΔUSG	ΔΔΔΔΔΔ						
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23

Monthly CPU Usage Record

0	1	2	3	4	5	6	7
USER NUMBER (BCD)		SYST MODE CODE	DATE (BCD)		TIME ON (1/6 SEC. BIN.)		TIME OFF (1/6 SEC. BIN.)
			MO MO / DA DA / YR YR				

OUTPUT

RUN: CPU USAGE SORT — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS

FILE: SORTED MONTHLY CPU USAGE — BLOCKING FACTOR: 60 RECORDS

RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

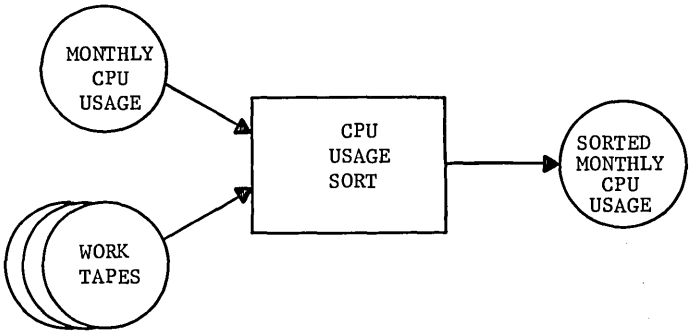
Tape Label

0	1	2	3	4	5	6	7
BTL OO ISR ΔCP ΔUSG	OOOOOO						

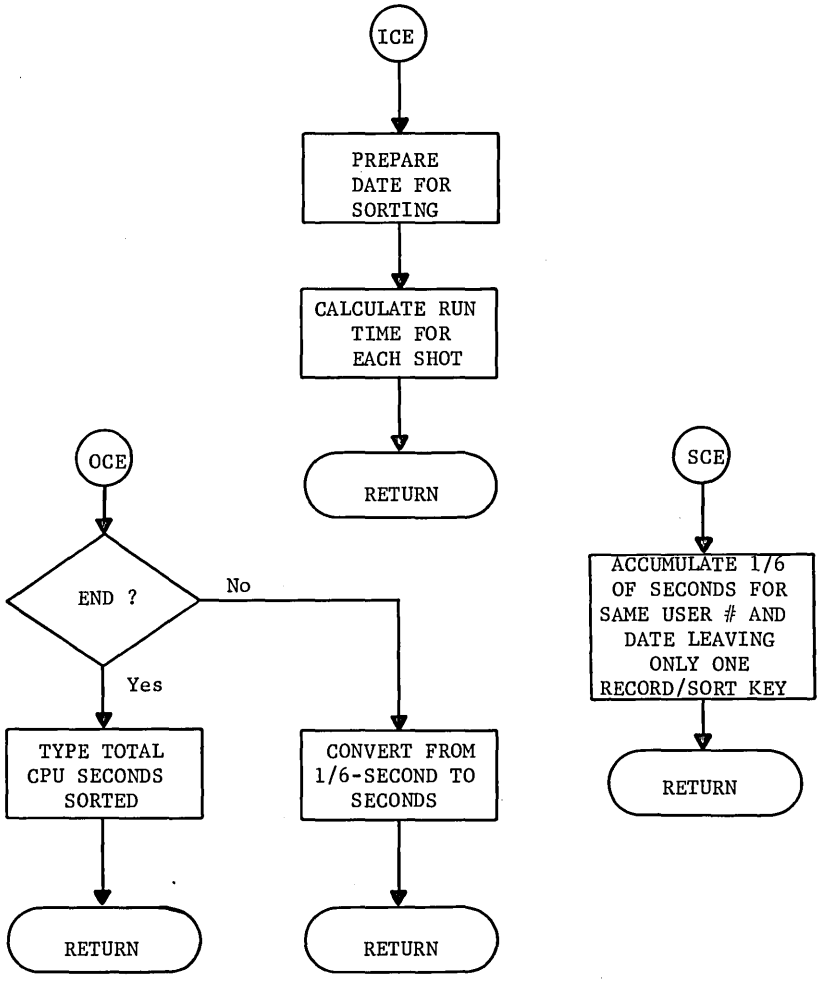
Sorted Monthly CPU Usage Record

0	1	2	3	4	5	6	7
USER NUMBER (BCD)		O MO MO / DA DA / YR YR				CPU TIME (SECONDS)	

CPB-1455



Top Level Flowchart of CPU Usage Sort



Functional Flowchart of CPU Usage Sort

DISC SORT

Purpose

The purpose of the Disc Sort routine is to sort the monthly hours and storage records into user number sequence, which provides a sorted input tape for the preparation of invoices and user statistics.

Input

The only input to the Disc Sort routine is the monthly hours and storage tape.

Output

The only output from the Disc Sort routine is the sorted monthly hours and storage tape.

Processing

During the input coding element (ICE) of the sort, all records having %%% in the user number field are discarded. These are fill records. The monthly hours and storage records are sorted by date within user number.

Equipment Required

GE-225 or 235 central processor.

5 magnetic tape handlers on controller 1.

Operating Instructions

1. Mount the RAW DISC tape on handler 2.
2. Mount four work tapes on handlers 3, 4, 5, and 6.
3. Run the routine using FORWARD SORT operating instructions.
4. Label the output tape: SR HR ST.

Magnetic Tape Layouts

The magnetic tape layouts for both input and output for the Disc Sort run follow.

INPUT

RUN: DISC SORT — GENERAL ELECTRIC — RECORD LENGTH: 8 WORDS

FILE: MONTHLY HOURS & STORAGE — BLOCKING FACTOR: 20 RECORDS

RECORD TYPE: BIN — GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET — PAGE: ____ OF: ____

Tape Label

0	1	2	3	4	5	6	7
BTL00	IRAWA	DISKA	00000	00			
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23

Storage Units Record

0 CATALOG NUMBER (BCD)	1	2	3 DATE (BCD)	4	5 STORAGE UNITS	6 NOT USED	7
	000	CCC	YRYR	MOMO	DADA		

Teletypewriter Time Record

0 USER NUMBER (BCD)	1	2	3 DATE (BCD)	4	5 "A" RATE TERMINAL TIME (MINUTES)	6 "B" RATE TERMINAL TIME (MINUTES)	7 "C" RATE TERMINAL TIME (MINUTES)
		UUU	YRYR	MOMO	DADA		

CPB-1455

OUTPUT

RUN: DISC SORT

GENERAL ELECTRIC

RECORD LENGTH: 8 WORDS

FILE: SORTED MONTHLY HOURS & STORAGE

BLOCKING FACTOR: 20 RECORDS

RECORD TYPE: BIN

GE 200 SERIES MAGNETIC TAPE RECORD LAYOUT SHEET

PAGE: _____ OF: _____

Tape Label

0	1	2	3	4	5	6	7
BTL	OOISRΔ	HRΔST	Δ	OOOOOO			
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23

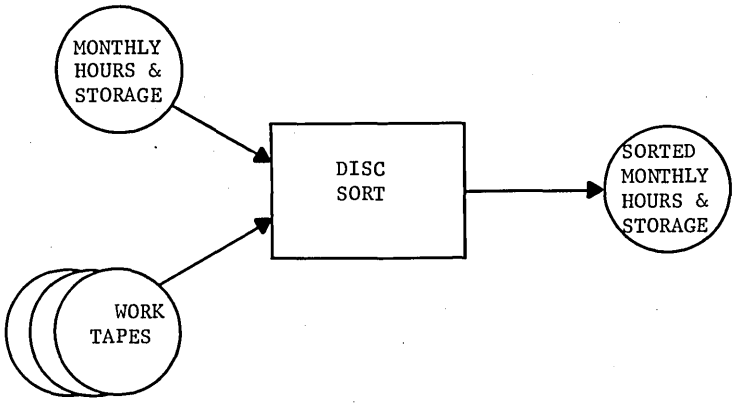
Storage Units Record

0	1	2	3	4	5	6	7
CATALOG NUMBER (BCD)			DATE (BCD)		STORAGE UNIT	NOT USED	
	OOO	CCC	YRYRMOMODADA				

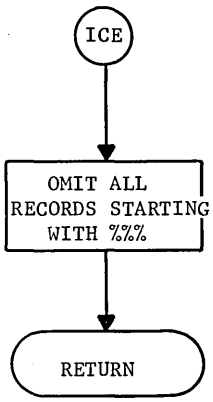
Teletypewriter Time Record

0	1	2	3	4	5	6	7
USER NUMBER (BCD)			DATE (BCD)		"A" RATE TERMINAL TIME (MINUTES)	"B" RATE TERMINAL TIME (MINUTES)	"C" RATE TERMINAL TIME (MINUTES)
		UUU	YRYRMOMODADA				

CPB-1455



Top Level Flowchart of Disc Sort



Functional Flowchart of Disc Sort

APPENDIX A.
MAILBOX CONFIGURATION

This appendix outlines the regular Mailbox configuration for communication between the DATANET-30 and the GE-225/235

Function	From DATANET-30 To GE-225/235	MBX	From GE-225/235 To DATANET-30
EDIT	Message + 0	MBX0	Message = + 2 (Read Done)
	System name	1	2 x Program Length
	TTY 3k area starting disc address	2	Starting disc address
	TTY 3k area ending disc address	3	Selective list disc address*
	Selective line number*(MSH)**	4	Selective list word count in disc record*
	Selective line number*(LSH)**	5	
		6	
		7	
		8	
START	Message + 1	MBX0	No message for DATANET-30
	System name	1	until some action is necessary
	Starting disc address in TTY 6k area on disc	2	
	Ending disc address in 3k area	3	
	User number (MSH)	4	
	User number (LSH)	5	
		6	
		7	
		8	

* If a selective LIST has been requested

** MSH - most significant half of the user number; LSH - least significant half of the user number.

CPB-1455

Function	From DATANET-30 To GE-225/235	MBX	From GE-225/235 To DATANET-30
CONTINUE	Message = 2	MBX0	No message for DATANET-30
	System name	1	until some action is necessary
	Starting disc address in 6k area	2	
	Swap length	3	
	User number (MSH)	4	
	User number (LSH)	5	
		6	
		7	
	217	8	
DUMP	Message = 3	MBX0	Message = 5 (Terminal dump)
		0	" = 6 (Intermediate dump)
		0	" = 7 (Real time input)
	System name	1	Running time - seconds
	TTY 6k area SDA	2	Intermediate output flag
	Swap length	3	Dump length
	User number (MSH)	4	
	User number (LSH)	5	
	Problem name (MSH)	6	
	Problem name (LSH)	7	
		8	

Function	From DATANET-30 To GE-225/235	MBX	From GE-225/235 To DATANET-30
DISC READ	Message = 4	MBX0	Message = 2 (Read Done)
		1	2 x program length
	TTY 3k area starting disc address	2	TTY 3k area SDA
	TTY 3k area ending disc address	3	
		4	
		5	
		6	
		7	
		8	
DISC WRITE	Message = 5	MBX0	Message = 3 (Write Done)
		1	2 x program length
	TTY 3k area starting disc address	2	TTY 3k area SDA
	TTY 3k area ending disc address	3	
		4	
		5	
		6	
		7	
		8	

Function	From DATANET-30 To GE-225/235	MBX	From GE-225/235 To DATANET-30
UNUSED	Message = 6		
START BATCHMODE	Message = 7	MBX0 1 2 3 4 5 6 7 8	Message sent via special Mailbox
UNUSED	Message = 8		
STOP BATCHMODE	Message = 9	MBX0 1 2 3 4 5 6 7 8	Message sent via special Mailbox

NOTE: Items in Mailbox are noted only when they have been specially set up in either processor. In some cases other portions of the Mailbox may contain information, but it is not relevant to the particular operation.

Special Mailbox

Messages from GE-225/235 to DATANET-30

Message = +1 - Disc request by GE-225/235
+2 - GE-225/235 finished with disc
+3 - request DATANET-30 to stop time count
+4 - DATANET-30 may resume time count
+5 - not used
+6 - off (put the system in the OFF mode)
+7 - on (turn the system back on)
-0 - acknowledge by DATANET-30 and normal status
+10 - start batch
+11 - stop batch
Special requests by a running system (EDIT)
+12 - transfer new ending disc address for the current source program

APPENDIX B.
INPUT/OUTPUT CODE CONVERSION

Teletypewriter Character	ASCII Octal	DATANET-30 Octal	DATANET-30 BCD
BREAK (Control-Shift-P)	000	None	
SOH (Control-A)	201	"	
STX (Control-B)	202	"	
ETX (Control-C)	003	"	
EOT (Control-D)	204	"	
ENQ (Control-E)	005	Special	
ACK (Control-F)	006	None	
BELL	207	32	Bell
BS (Control-H)	210	None	
H. TAB (Control-I)	011	"	
Line Feed (Control-J)	012	"	
V. TAB (Control-K)	213	"	
FORM FEED (Control-L)	014	"	
RETURN (Control-M)	215	Special	
SO (Control-N)	216	None	
SI (Control-O)	017	"	
DLE	220	21	A*
DC1 (X-ON)	021	None	
DC2	222	"	
DC3 (X-OFF)	023	"	
DC4	224	"	
NAK (Control-U)	025	"	
SYNC (Control-V)	026	"	
ETB (Control-W)	227	22	B*
CAN (Control-X)	030	Special	
EM (Control-Y)	231	23	C*
SS (Control-Z)	232	24	D*
ESC (Control-Shift-K)	033	Special	
FS (Control-Shift-L)	234	25	E*
GS (Control-Shift-M)	035	26	F*
RS (Control-Shift-N)	036	27	G*
US (Control-Shift-O)	237	30	H*
SPACE	240	60	Space
!	041	33	.
"	042	34	"
#	243	Special	
$	044	53	$
%	245	17	*
&	246	20	+*
'	047	12	'
(	050	14	(
)	251	74	)
*	252	54	*
+	053	20	+
,	254	73	,
-	055	40	-
.	056	33	.
/	257	61	/
0	060	00	0
1	261	01	1
2	262	02	2
3	063	03	3
4	264	04	4
5	065	05	5
6	066	06	6
7	267	07	7
8	270	10	8
9	071	11	9
:	072	13	:
;	273	15	;
<	074	36	<
=	275	16	=
>	276	56	>
?	077	35	?
@	300	Special	
A	101	21	A
B	102	22	B
C	303	23	C
D	104	24	D
E	305	25	E
F	306	26	F
G	107	27	G
H	110	30	H
I	311	31	I
J	312	41	J
K	113	42	K
L	314	43	L
M	115	44	M
N	116	45	N
O	317	46	O
P	120	47	P
Q	321	50	Q
R	322	51	R
S	123	62	S
T	324	63	T
U	125	64	U
V	126	65	V
W	327	66	W
X	330	67	X
Y	131	70	Y
Z	132	71	Z
[	333	75	[
\	134	17	\
]	335	76	]
↑	336	57	↑
←	137	Special	

CPB-1455

Teletypewriter Character	ASCII Octal	DATANET-30 Octal	DATANET-30 BCD	Teletypewriter Character	ASCII Octal	DATANET-30 Octal	DATANET-30 BCD
@	140	None		o	317	46	O*
a	101	21	A*	p	120	47	P*
b	102	22	B*	q	321	50	Q*
c	303	23	C*	r	322	51	R*
d	104	24	D*	s	123	62	S*
e	305	25	E*	t	324	63	T*
f	306	26	F*	u	125	64	U*
g	107	27	G*	v	126	65	V*
h	110	30	H*	w	327	66	W*
i	311	31	I*	x	330	67	X*
j	312	41	J*	y	131	70	Y*
k	113	42	K*	z	132	71	Z*
l	314	43	L*	(ALT. MODE)	175	Special	
m	115	44	M*	|	176	None	
n	116	45	N*	DEL (Rub-Out)	377	None	

* Note: These translations are Input translations only. For instance, if the DLE is input, it will be translated to an A, but if it is output, an A will be printed at the terminal.

KEYWORD INDEX

The keyword index is formed by permuting titles, paragraph names, descriptive phrases, and figure names, putting each keyword in the index position in the center of the page. The rest of the phrase appears on either side of the keyword.

TITLES

DISC LAYOUT - DISC 15 139

GE 200 SERIES GENERAL ASSEMBLY PROGRAM 104
GE 225 235 BINARY OCTAL CARD LOADERS 100
FUNCTIONS OF THE GE 225/235 EXECUTIVE 111

FIGURE 21 MODEL 33 CONTROLS 162
FIGURE 22 MODEL 33 KEYBOARD ARRANGEMENT 162

+ADD CARD 96
+CON CARD 92
+DEL CARD 93
+DIS CARD 97
+END CARD 96
+FIN CARD 91
+INS CARD 92
+MAK CARD 89
+MER CARD 94
+MOV CARD 94
+PRI CARD 97
+PUN CARD 98
+REM CARD 88
+REP CARD 93
+REW CARD 87

SYSTEM ACCOUNTING 67
MEMORY ALLOCATION 113
DISC STORAGE ALLOCATION - DISC 0 134
MEMORY ALLOCATION MAPS 134
FIGURE 20 PROPOSED REVISED AMERICAN STANDARD CODE (ASCII) 159
EXECUTION OF SYSTEM API PROGRAM SUBROUTINE 84
API PROGRAMS 15
MODEL 33 KEYBOARD ARRANGEMENT 162
MODEL 35 KEYBOARD ARRANGEMENT 166
GE 200 SERIES GENERAL ASSEMBLY PROGRAM 104
DATANET-30 GENERAL ASSEMBLY PROGRAM 105
BACKGROUND ASSEMBLY PROGRAMS 103
FIGURE-16 CHANNEL ASSIGNMENT 151
INTERFACE CONNECTOR PIN ASSIGNMENT (103F2) 154
INTERFACE CONNECTOR PINS ASSIGNMENTS (103A2) 148

BACKGROUND AND SERVICE PROGRAMS 69
BACKGROUND ASSEMBLY PROGRAMS 103
BACKGROUND EXECUTIVE 70
BACKGROUND EXECUTIVE 79
BACKGROUND EXECUTIVE SERVICE SUBROUTINES 70
BACKGROUND PROGRAM HEADER INFORMATION 86
BACKGROUND PROGRAMS 15
PROGRAMMING CONVENTIONS FOR BACKGROUND PROGRAMS 79
BACKGROUND SUBROUTINES 80
USE OF MEMORY BY BASIC 119
BAT CARD 59

	BATCH BINARY CARD LOADER	102
INTERNAL PROCESSING OF	BATCHMODE	33
	BILLING MASTER PACK	172
	BILLING MASTER PACK FUNCTIONAL FLOWCHART	177
	BILLING MASTER PACK INPUT CARD	174
	BILLING MASTER PACK - TYPEWRITER MESSAGES	174
	BILLING MASTER PACK MAGNETIC TAPE LAYOUTS	175
BATCH	BINARY CARD LOADER	102
GE 225 235	BINARY OCTAL CARD LOADERS	100
DATANET-30 PPT	BOOTSTRAP LOADER	101
	BUILDING TAPES BY USE OF SYMMAINT	89
GE-255 TIME-SHARING SYSTEM	CABLING	4
GE-265 TIME-SHARING SYSTEM	CABLING	5
SYSTEM OVERLAY	CALL	115
OVERLAY OR NEW PROGRAM	CALL SUBROUTINE	83
*BACK	CARD	72
DUMP	CARD	53
*REM	CARD	88
DBGCOM	CARD	54
DBGOUT	CARD	55
S	CARD	51
*TYPE	CARD	75
S U	CARD	60
*MAK	CARD	89
OFF	CARD	52
*REWINDI	CARD	76
CAT	CARD	53
BAT	CARD	59
*CARDTODISK	CARD	76
G P	CARD	58
*FIN	CARD	91
DBGTIM	CARD	56
SYS	CARD	52
*LISTDECK	CARD	73
C P	CARD	56
*FRONT	CARD	71
*CARDTOTAPE	CARD	74
*CON	CARD	92
C PST	CARD	57
*INS	CARD	92
*REPRODUCE	CARD	74
*REP	CARD	93
NAME	CARD	71
*DEL	CARD	93
*TYPENOHALT	CARD	75
*MOV	CARD	94
C PDN	CARD	57
*MER	CARD	94
DBGOCT	CARD	55
*END	CARD	96
*TYPEANDHALT	CARD	75
*ADD	CARD	96
*SYMXXXXXXXXX	CARD	77
*DIS	CARD	97

C C CARD 58
*LISTDECK T CARD 73
*XXXXXXXXXXX CARD 78
*REW CARD 87
C T CARD 59
*PRI CARD 97
*SLEW CARD 76
*PUN CARD 96
*BINARY CARD 77
LOAD CARD 54
TIME RETRIEVAL INPUT CARD 181
BILLING MASTER PACK INPUT CARD 174
OCTAL CORRECTION CARD FORMAT 107
SYMMAINT CONTROL CARD FORMATS 87
DISC CARD IMAGE LOADER 101
GE-225 CARD INPUT COMMANDS 51
BATCH BINARY CARD LOADER 102
GE 225 235 BINARY OCTAL CARD LOADERS 100
CARD READING OVERLAY 69
CARD TO DISC PROGRAM 106
OPERATIONS ON SYMBOLIC END CARDS 98
PREPARATION OF CONTROL CARDS 71
SYMMAINT OUTPUT CONTROL CARDS 97
CAT CARD 53
CATALOGS 15
CENTRAL PROCESSOR TIME 67
FIGURE 16 CHANNEL ASSIGNMENT 151
INPUT/OUTPUT CODE CONVERSION CHART 201
C C CARD 58
C P CARD 56
C PDN CARD 57
C PSI CARD 57
C T CARD 59
INPUT OUTPUT CODE CONVERSION CHART 201
FIGURE 12 INPUT OUTPUT CODE CONVERSON 120
REVISED AMERICAN STANDARD CODE (ASCII) 159
CONTROL TELETYPEWRITER COMMANDS 49
SYSTEM OPERATION COMMANDS 51
DEBUGGING OR DEVELOPMENT COMMANDS 49
COMMUNICATIONS COMMANDS 50
SYSTEM FUNCTIONS COMMANDS 50
GE-225 CARD INPUT COMMANDS 51
INPUT COMMANDS 51
PERIPHERAL TASK COMMANDS 61
GE-235 CONSOLE TYPEWRITER COMMANDS 60
DEBUGGING COMMANDS 54
SYSTEM OPERATION COMMANDS 60
DEBUGGING COMMANDS 61
PERIPHERAL TASK COMMANDS 56
COMMUNICATIONS COMMANDS 50
COMMUNICATIONS HARDWARE 143
FIGURE 13 INTERFACE COMMUNICATIONS HARDWARE 143
COMPILER PROGRAMMING CONVENTIONS 112
COMPILER SYSTEM LOADER 117

COMPILER SYSTEMS 121
COMPILER SYSTEMS 111
COMPILER SYSTEMS HEADER INFORMATION 114
CONDENSED OPERATING INSTRUCTIONS 104
HARDWARE CONFIGURATIONS 3
INTERFACE CONNECTOR PIN ASSIGNMENT (103F2) 154
FIGURE 14 INTERFACE CONNECTOR PINS ASSIGNMENTS (103A2) 148
GE-235 CONSOLE TYPEWRITER COMMANDS 60
CONSOLE TYPEWRITER MESSAGES 47
SYMMAINT CONTROL CARD FORMATS 87
SYMMAINT OUTPUT CONTROL CARDS 97
PREPARATION OF CONTROL CARDS 71
FIGURE 11 SAMPLE SYMMAINT CONTROL DECK 90
CONTROL TELETYPEWRITER COMMANDS 49
FIGURE 21 MODEL 33 CONTROLS 162
FIGURE 23 MODEL 35 CONTROLS 166
INTERFACE AND PROGRAMMING CONVENTIONS 111
COMPILER PROGRAMMING CONVENTIONS 112
PROGRAMMING CONVENTIONS FOR BACKGROUND PROGRAMS 79
INPUT OUTPUT CODE CONVERSION CHART 201
INPUT OUTPUT CODE CONVERSON 120

OCTAL CORRECTION CARD FORMAT 107
CPU USAGE SORT FUNCTIONAL FLOWCHART 189
CPU USAGE SORT MAGNETIC TAPE LAYOUTS 186
CPU USAGE SORT ROUTINE 187

DAILY SHUTDOWN PROCEDURE 45
DAILY STARTUP 44
SUMMARY OF DATA SERVICES 144
FIGURE 17 DATA SET 103A SPACE DISCONNECT SEQUENCE 153
DATA SET 103A2 147
FIGURE 19 DATA SET 103F TIMING SEQUENCE 157
DATA SET 103F2 154
DATANET-30 EXECUTIVE 8
DATANET-30 EXECUTIVE 140
DATANET-30 EXECUTIVE LOADER 100
DATANET-30 GENERAL ASSEMBLY PROGRAM 105
DATANET-30 PPT BOOTSTRAP LOADER 101
FIGURE 3 INITIAL DATANET-30 SEQUENCE PROCESSING 19
DBGCOM CARD 54
DBGOCT CARD 55
DBGOUT CARD 55
DBGTIM CARD 56
DEBUGGING COMMANDS 54
DEBUGGING COMMANDS 61
DEBUGGING OR DEVELOPMENT COMMANDS 49
SAMPLE SYMMAINT CONTROL DECK 90
SOFTWARE SYSTEMS DESCRIPTION 7
DEBUGGING OR DEVELOPMENT COMMANDS 49
DISC STORAGE ALLOCATION - DISC 0 134
DISC LAYOUT - DISC 15 139
DISC CARD IMAGE LOADER 101
DISC EDIT ROUTINE 109
DISC LAYOUT - DISC 15 139

DISC LAYOUT - DISC-1 135
DISC LAYOUT - DISCS 2-14 138
DISC OPERATION SUBROUTINE 82
CARD TO DISC PROGRAM 106
DISC SORT FUNCTIONAL FLOWCHART 193
DISC SORT MAGNETIC TAPE LAYOUT 191
DISC SORT ROUTINE 190
DISC STORAGE ALLOCATION - DISC 0 134
TERMINAL TIME RETRIEVAL DISC STORAGE LAYOUTS 184
DISC USAGE 116
DISC LAYOUT - DISC-1 135
DATA SET-103A SPACE DISCONNECT SEQUENCE 153
DISC LAYOUT - DISCS 2-14 138
DUMP CARD 53

INTERNAL PROCESSING OF EDIT 26
DISC EDIT ROUTINE 109
OPERATIONS ON SYMBOLIC END CARDS 98
TERMINAL EQUIPMENT 158
ERROR MESSAGES IN SYMMAINT 99
EXAMPLE OF A SYSTEM 119
EXECUTION OF SYSTEM API PROGRAM SUBROUTINE 84
DATANET-30 EXECUTIVE 8
GE225 235 EXECUTIVE 12
BACKGROUND EXECUTIVE 79
BACKGROUND EXECUTIVE 70
UNCTIONS OF THE GE 225/235 EXECUTIVE 111
GE-235 EXECUTIVE 142
DATANET-30 EXECUTIVE 140
DATANET-30 EXECUTIVE LOADER 100
BACKGROUND EXECUTIVE SERVICE SUBROUTINES 70
EXECUTIVE SYSTEM 7

FIGURE 1 GE-255 TIME-SHARING SYSTEM CABLING 4
FIGURE 10 INTERNAL PROCESSING OF BATCHMODE 33
FIGURE 11 SAMPLE SYMMAINT CONTROL DECK 90
FIGURE 12 INPUT OUTPUT CODE CONVERSON 120
FIGURE 13 INTERFACE COMMUNICATIONS HARDWARE 143
FIGURE 14 INTERFACE CONNECTOR PINS 146
FIGURE 15 TRANSMISSION FREQUENCIES (CPS) 150
FIGURE 16 CHANNEL ASSIGNMENT 151
FIGURE 17 DATA SET-103A SPACE DISCONNECT SEQ 153
FIGURE 19 DATA SET-103F TIMING SEQUENCE 157
FIGURE 2 GE-255 TIME-SHARING SYSTEM CABLING 5
FIGURE 20 PROPOSED REVISED AMERICAN STANDARD 159
FIGURE 21 MODEL 33 CONTROLS 162
FIGURE 22 MODEL 33 KEYBOARD ARRANGEMENT 162
FIGURE 23 MODEL 35 CONTROLS 166
FIGURE 24 MODEL 35 KEYBOARD ARRANGEMENT 166
FIGURE 3 INITIAL DATANET-30 SEQUENCE PROCESS 19
FIGURE 4 INTERNAL PROCESSING OF OLD 23
FIGURE 5 INTERNAL PROCESSING OF LIST 24
FIGURE 6 INTERNAL PROCESSING OF SAVE 25
FIGURE 7 INTERNAL PROCESSING OF EDIT 26
FIGURE 18 INTERFACE CONNECTOR PINS ASSIGNMENT 154

FIGURE 8 INTERNAL PROCESSING OF START 27
FIGURE 9 INTERNAL PROCESSING OF RUN 29
MAINTAINING TAPE FILES BY USE OF SYMMAINT 92
SYSTEM FLOWCHART 123
MASTER PACK FUNCTIONAL FLOWCHART 177
TIME RETRIEVAL FUNCTIONAL FLOWCHART 185
DISC SORT FUNCTIONAL FLOWCHART 193
CPU USAGE SORT FUNCTIONAL FLOWCHART 189
OCTAL CORRECTION CARD FORMAT 107
SYMMAINT CONTROL CARD FORMATS 87
FIGURE 15 TRANSMISSION FREQUENCIES (CPS) 150
BILLING MASTER PACK FUNCTIONAL FLOWCHART 177
DISC SORT FUNCTIONAL FLOWCHART 193
TERMINAL TIME RETRIEVAL FUNCTIONAL FLOWCHART 185
CPU USAGE SORT FUNCTIONAL FLOWCHART 189
SYSTEM FUNCTIONS COMMANDS 50
FUNCTIONS OF THE GE 225/235 EXECUTIVE 111

GE 200 SERIES GENERAL ASSEMBLY PROGRAM 104
GE 225 235 BINARY OCTAL CARD LOADERS 100
FUNCTIONS OF THE GE 225/235 EXECUTIVE 111
GE225 235 EXECUTIVE 12
GE-225 CARD INPUT COMMANDS 51
GE-235 CONSOLE TYPEWRITER COMMANDS 60
GE-235 EXECUTIVE 142
GE 255 NEW SYSTEM STARTUP 36
FIGURE 1 GE-255 TIME-SHARING SYSTEM CABLING 4
FIGURE 2 GE-265 TIME-SHARING SYSTEM CABLING 5
GE 265 NEW SYSTEM STARTUP 40
DATANET-30 GENERAL ASSEMBLY PROGRAM 105
GE 200 SERIES GENERAL ASSEMBLY PROGRAM 104
GENERATED OUTPUT 116
G P CARD 56

COMMUNICATIONS HARDWARE 143
INTERFACE COMMUNICATIONS HARDWARE 143
HARDWARE CONFIGURATIONS 3
BACKGROUND PROGRAM HEADER INFORMATION 86
COMPILER SYSTEMS HEADER INFORMATION 114

DISC CARD IMAGE LOADER 101
BACKGROUND PROGRAM HEADER INFORMATION 86
COMPILER SYSTEMS HEADER INFORMATION 114
FIGURE 3 INITIAL DATANET-30 SEQUENCE PROCESSING 19
BILLING MASTER PACK INPUT CARD 174
TERMINAL TIME RETRIEVAL INPUT CARD 181
INPUT COMMANDS 51
GE-225 CARD INPUT COMMANDS 51
INPUT OUTPUT CODE CONVERSION CHART 201
FIGURE 12 INPUT OUTPUT CODE CONVERSON 120
CONDENSED OPERATING INSTRUCTIONS 104
SYSTEM INTERFACE AND PROGRAMMING CONVENTIONS 111
FIGURE 13 INTERFACE COMMUNICATIONS HARDWARE 143
FIGURE 18 INTERFACE CONNECTOR PIN ASSIGNMENT (103F2) 154
FIGURE 14 INTERFACE CONNECTOR PINS ASSIGNMENTS (103A2) 148

FIGURE 10 INTERNAL PROCESSING OF BATCHMODE 33
FIGURE 7 INTERNAL PROCESSING OF EDIT 26
FIGURE 5 INTERNAL PROCESSING OF LIST 24
FIGURE 4 INTERNAL PROCESSING OF OLD 23
FIGURE 9 INTERNAL PROCESSING OF RUN 29
FIGURE 6 INTERNAL PROCESSING OF SAVE 25
FIGURE 8 INTERNAL PROCESSING OF START 27
PROGRAM INTERRUPT 116

DISC STORAGE ALLOCATION - DISC 0 134
DISC LAYOUT - DISC 15 139
DISC LAYOUT - DISC-1 135
DISC LAYOUT - DISCS-2-14 138
BILLING MASTER PACK - TYPEWRITER MESSAGES 174

FIGURE 24 MODEL 35 KEYBOARD ARRANGEMENT 166
FIGURE 22 MODEL 33 KEYBOARD ARRANGEMENT 162

DISC SORT MAGNETIC TAPE LAYOUT 191
DISC LAYOUT - DISC 15 139
DISC LAYOUT - DISC-1 135
DISC LAYOUT - DISCS-2-14 138
MASTER PACK MAGNETIC TAPE LAYOUTS 175
RETRIEVAL MAGNETIC TAPE LAYOUTS 182
RETRIEVAL DISC STORAGE LAYOUTS 184
USAGE SORT MAGNETIC TAPE LAYOUTS 186
SYSTEM LIBRARY 49
INTERNAL PROCESSING OF LIST 24
LOAD CARD 54
BATCH BINARY CARD LOADER 102
DATANET-30 PPT BOOTSTRAP LOADER 101
DATANET-30 EXECUTIVE LOADER 100
DISC CARD IMAGE LOADER 101
COMPILER SYSTEM LOADER 117
LOADERS 100
225 235 BINARY OCTAL CARD LOADERS 100

DISC SORT MAGNETIC TAPE LAYOUT 191
TERMINAL TIME RETRIEVAL MAGNETIC TAPE LAYOUTS 182
BILLING MASTER PACK MAGNETIC TAPE LAYOUTS 175
CPU USAGE SORT MAGNETIC TAPE LAYOUTS 188
MAILBOX 8
MAILBOX CONFIGURATION 195
MAINTAINING TAPE FILES BY USE OF SYMMAINT 92
SYMMAINT SYMBOLIC MAINTENANCE PROGRAM 87
TIME SHARING MANUALS 2
MEMORY ALLOCATION MAPS 134
BILLING MASTER PACK 172
BILLING MASTER PACK FUNCTIONAL FLOWCHART 177
BILLING MASTER PACK INPUT CARD 174
BILLING MASTER PACK - TYPEWRITER MESSAGES 174
BILLING MASTER PACK MAGNETIC TAPE LAYOUTS 175
MEMORY ALLOCATION 113
MEMORY ALLOCATION MAPS 134

USE OF	MEMORY BY BASIC	119
TELETYPEWRITER	MESSAGES	45
CONSOLE TYPEWRITER	MESSAGES	47
MASTER PACK - TYPEWRITER	MESSAGES	174
ERROR	MESSAGES IN SYMMAINT	99
FIGURE 21	MODEL 33 CONTROLS	162
FIGURE 22	MODEL 33 KEYBOARD ARRANGEMENT	162
	MODEL 33 TELETYPE UNIT	161
FIGURE 23	MODEL 35 CONTROLS	166
FIGURE 24	MODEL 35 KEYBOARD ARRANGEMENT	166
	MODEL 35 TELETYPE UNIT	165
	NAME CARD	71
OVERLAY OR	NEW PROGRAM CALL SUBROUTINE	83
STARTUP PROCEDURES FOR	NEW SYSTEM	35
GE-255	NEW SYSTEM STARTUP	36
GE-265	NEW SYSTEM STARTUP	40
USER	NUMBER	16
GE 225 235 BINARY	OCTAL CARD LOADERS	100
	OCTAL CORRECTION CARD FORMAT	107
	OFF CARD	52
	OFF-LINE REPORTING ROUTINES	171
INTERNAL PROCESSING OF	OLD	23
CONDENSED	OPERATING INSTRUCTIONS	104
SYSTEM	OPERATION COMMANDS	51
SYSTEM	OPERATION COMMANDS	60
DISC	OPERATION SUBROUTINE	82
TAPE	OPERATION SUBROUTINE	80
SYSTEM	OPERATIONS	35
	OPERATIONS ON SYMBOLIC END CARDS	96
DEBUGGING	OR DEVELOPMENT COMMANDS	49
OVERLAY	OR NEW PROGRAM CALL SUBROUTINE	83
SYSTEM	ORGANIZATION	123
GENERATED	OUTPUT	118
SYMMAINT	OUTPUT CONTROL CARDS	97
CARD READING	OVERLAY	69
SYSTEM	OVERLAY CALL	115
	OVERLAY OR NEW PROGRAM CALL SUBROUTINE	83
BILLING MASTER	PACK	172
BILLING MASTER	PACK FUNCTIONAL FLOWCHART	177
BILLING MASTER	PACK INPUT CARD	174
BILLING MASTER	PACK - TYPEWRITER MESSAGES	174
BILLING MASTER	PACK MAGNETIC TAPE LAYOUTS	175
	PERIPHERAL TASK COMMANDS	56
	PERIPHERAL TASK COMMANDS	61
INTERFACE CONNECTOR	PIN ASSIGNMENT (103F2)	154
INTERFACE CONNECTOR	PINS ASSIGNMENTS (103A2)	148
DATANET-30	PPT BOOTSTRAP LOADER	101
	PREPARATION OF CONTROL CARDS	71
DAILY SHUTDOWN	PROCEDURE	45
STARTUP	PROCEDURES FOR NEW SYSTEM	35
DATANET-30 SEQUENCE	PROCESSING	19
SOURCE PROGRAM	PROCESSING	117

FIGURE 10 INTERNAL PROCESSING OF BATCHMODE 33
FIGURE 7 INTERNAL PROCESSING OF EDIT 26
FIGURE 5 INTERNAL PROCESSING OF LIST 24
FIGURE 4 INTERNAL PROCESSING OF OLD 23
FIGURE 9 INTERNAL PROCESSING OF RUN 29
FIGURE 6 INTERNAL PROCESSING OF SAVE 25
FIGURE 8 INTERNAL PROCESSING OF START 27
CENTRAL PROCESSOR TIME 67
CARD TO DISC PROGRAM 106
200 SERIES GENERAL ASSEMBLY PROGRAM 104
SYMBOLIC MAINTENANCE PROGRAM 87
DATANET-30 GENERAL ASSEMBLY PROGRAM 105
OVERLAY OR NEW PROGRAM CALL SUBROUTINE 83
BACKGROUND PROGRAM HEADER INFORMATION 86
PROGRAM INTERRUPT 118
SOURCE PROGRAM PROCESSING 117
EXECUTION OF SYSTEM API PROGRAM SUBROUTINE 84
COMPILER PROGRAMMING CONVENTIONS 112
SYSTEM INTERFACE AND PROGRAMMING CONVENTIONS 111
PROGRAMMING CONVENTIONS FOR BACKGROUND PROG 79
BACKGROUND PROGRAMS 15
API PROGRAMS 15
BACKGROUND AND SERVICE PROGRAMS 69
SERVICE PROGRAMS 100
CONVENTIONS FOR BACKGROUND PROGRAMS 79
BACKGROUND ASSEMBLY PROGRAMS 103
FIGURE 20 PROPOSED REVISED AMERICAN STANDARD CODE 159

CARD READING OVERLAY 69
OFF-LINE REPORTING ROUTINES 171
TERMINAL TIME RETRIEVAL DISC STORAGE LAYOUTS 184
TERMINAL TIME RETRIEVAL FUNCTIONAL FLOWCHART 185
TERMINAL TIME RETRIEVAL INPUT CARD 181
TERMINAL TIME RETRIEVAL MAGNETIC TAPE LAYOUTS 182
TERMINAL TIME RETRIEVAL ROUTINE 176
TERMINAL TIME RETRIEVAL ROUTINE TYPEOUT 180
FIGURE 20 PROPOSED REVISED AMERICAN STANDARD CODE (ASCII) 159
DISC EDIT ROUTINE 109
DISC SORT ROUTINE 190
TERMINAL TIME RETRIEVAL ROUTINE 178
CPU USAGE SORT ROUTINE 187
TERMINAL TIME RETRIEVAL ROUTINE TYPEOUT 180
OFF-LINE REPORTING ROUTINES 171
INTERNAL PROCESSING OF RUN 29

*BACK CARD 72
*BINARY CARD 77
*CARDTODISK CARD 78
*CARDTOTAPE CARD 74
*FRONT CARD 71
*LISTDECK CARD 73
*LISTDECK T CARD 73
*REPRODUCE CARD 74
*REWINDI CARD 76

*SLEW CARD 76
*SYMXXXXXXXXX CARD 77
*TYPE CARD 75
*TYPEANDHALT CARD 75
*TYPENOHALT CARD 75
*XXXXXXXXXXXX CARD 78

S CARD 51
FIGURE 11 SAMPLE SYMMAINT CONTROL DECK 90
INTERNAL PROCESSING OF SAVE 25
DATA SET-103F TIMING SEQUENCE 157
SET-103A SPACE DISCONNECT SEQUENCE 153
INITIAL DATANET-30 SEQUENCE PROCESSING 19
GE 200 SERIES GENERAL ASSEMBLY PROGRAM 104
BACKGROUND AND SERVICE PROGRAMS 69
SERVICE PROGRAMS 100
BACKGROUND EXECUTIVE SERVICE SUBROUTINES 70
SUMMARY OF DATA SERVICES 144
FIGURE 17 DATA SET-103A SPACE DISCONNECT SEQUENCE 153
DATA SET-103A2 147
FIGURE 19 DATA SET-103F TIMING SEQUENCE 157
DATA SET-103F2 154
TIME SHARING MANUALS 2
DAILY SHUTDOWN PROCEDURE 45
S O CARD 60
SOFTWARE SYSTEMS DESCRIPTION 7
CPU USAGE SORT FUNCTIONAL FLOWCHART 189
DISC SORT FUNCTIONAL FLOWCHART 193
DISC SORT MAGNETIC TAPE LAYOUT 191
CPU USAGE SORT MAGNETIC TAPE LAYOUTS 188
DISC SORT ROUTINE 190
CPU USAGE SORT ROUTINE 187
SOURCE PROGRAM PROCESSING 117
FIGURE 17 DATA SET-103A SPACE DISCONNECT SEQUENCE 153
PROPOSED REVISED AMERICAN STANDARD CODE (ASCII) 159
INTERNAL PROCESSING OF START 27
GE-255 NEW SYSTEM STARTUP 36
GE-265 NEW SYSTEM STARTUP 40
DAILY STARTUP 44
STARTUP PROCEDURES FOR NEW SYSTEM 35
DISC STORAGE ALLOCATION - DISC 0 134
TIME RETRIEVAL DISC STORAGE LAYOUTS 184
SYSOUT SUBROUTINE 85
TYPE SUBROUTINE 83
DISC OPERATION SUBROUTINE 82
SYSTEM API PROGRAM SUBROUTINE 84
TAPE OPERATION SUBROUTINE 80
OVERLAY OR NEW PROGRAM CALL SUBROUTINE 83
BACKGROUND EXECUTIVE SERVICE SUBROUTINES 70
BACKGROUND SUBROUTINES 80
SUMMARY OF DATA SERVICES 144
OPERATIONS ON SYMBOLIC END CARDS 98
SYMMAINT SYMBOLIC MAINTENANCE PROGRAM 87
BUILDING TAPES BY USE OF SYMMAINT 89
TAPE FILES BY USE OF SYMMAINT 92

ERROR MESSAGES IN SYMMAINT 99
SYMMAINT CONTROL CARD FORMATS 87
FIGURE 11 SAMPLE SYMMAINT CONTROL DECK 90
SYMMAINT OUTPUT CONTROL CARDS 97
SYMMAINT SYMBOLIC MAINTENANCE PROGRAM 87
SYS CARD 52
SYSOUT SUBROUTINE 85
EXECUTIVE SYSTEM 7
STARTUP PROCEDURES FOR NEW SYSTEM 35
EXAMPLE OF A SYSTEM 119
SYSTEM ACCOUNTING 67
EXECUTION OF SYSTEM API PROGRAM SUBROUTINE 84
GE-255 TIME-SHARING SYSTEM CABLING 4
GE-265 TIME-SHARING SYSTEM CABLING 5
SYSTEM FLOWCHART 123
SYSTEM FUNCTIONS COMMANDS 50
SYSTEM INTERFACE AND PROGRAMMING CONVENTIONS 111
SYSTEM LIBRARY 49
COMPILER SYSTEM LOADER 117
SYSTEM OPERATION COMMANDS 60
SYSTEM OPERATION COMMANDS 51
SYSTEM OPERATIONS 35
SYSTEM ORGANIZATION 123
SYSTEM OVERLAY CALL 115
GE-255 NEW SYSTEM STARTUP 36
GE-265 NEW SYSTEM STARTUP 40
COMPILER SYSTEMS 111
COMPILER SYSTEMS 121
SOFTWARE SYSTEMS DESCRIPTION 7
COMPILER SYSTEMS HEADER INFORMATION 114

*LISTDECK T CARD 73
MAINTAINING TAPE FILES BY USE OF SYMMAINT 92
DISC SORT MAGNETIC TAPE LAYOUT 191
TIME RETRIEVAL MAGNETIC TAPE LAYOUTS 182
MASTER PACK MAGNETIC TAPE LAYOUTS 175
CPU USAGE SORT MAGNETIC TAPE LAYOUTS 188
TAPE OPERATION SUBROUTINE 80
BUILDING TAPES BY USE OF SYMMAINT 89
PERIPHERAL TASK COMMANDS 56
PERIPHERAL TASK COMMANDS 61
MODEL 33 TELETYPE UNIT 161
MODEL 35 TELETYPE UNIT 165
CONTROL TELETYPEWRITER COMMANDS 49
TELETYPEWRITER MESSAGES 45
TELETYPEWRITER TIME 67
TERMINAL EQUIPMENT 158
TERMINAL TIME RETRIEVAL DISC STORAGE LAYOUTS 184
TERMINAL TIME RETRIEVAL FUNCTIONAL FLOWCHART 185
TERMINAL TIME RETRIEVAL INPUT CARD 181
TERMINAL TIME RETRIEVAL MAGNETIC TAPE LAYOUT 182
TERMINAL TIME RETRIEVAL ROUTINE TYPEOUT 180
TERMINAL TIME RETRIEVAL ROUTINE 178
CENTRAL PROCESSOR TIME 67
TELETYPEWRITER TIME 67

TERMINAL TIME RETRIEVAL DISC STORAGE LAYOUTS 184
TERMINAL TIME RETRIEVAL FUNCTIONAL FLOWCHART 185
TERMINAL TIME RETRIEVAL INPUT CARD 181
TERMINAL TIME RETRIEVAL MAGNETIC TAPE LAYOUTS 182
TERMINAL TIME RETRIEVAL ROUTINE 178
TERMINAL TIME RETRIEVAL ROUTINE TYPEOUT 180
TIME SHARING MANUALS 2
FIGURE 1 GE-255 TIME-SHARING SYSTEM CABLING 4
FIGURE 2 GE-265 TIME-SHARING SYSTEM CABLING 5
FIGURE 19 DATA SET-103F TIMING SEQUENCE 157
FIGURE 15 TRANSMISSION FREQUENCIES (CPS) 150
TROUBLESHOUTING 45
TYPE SUBROUTINE 83
TIME RETRIEVAL ROUTINE TYPEOUT 180
GE-235 CONSOLE TYPEWRITER COMMANDS 60
CONSOLE TYPEWRITER MESSAGES 47
BILLING MASTER PACK - TYPEWRITER MESSAGES 174

MODEL 33 TELETYPE UNIT 161
MODEL 35 TELETYPE UNIT 165
DISC USAGE 116
CPU USAGE SORT FUNCTIONAL FLOWCHART 189
CPU USAGE SORT MAGNETIC TAPE LAYOUTS 188
CPU USAGE SORT ROUTINE 187
USE OF MEMORY BY BASIC 119
BUILDING TAPES BY USE OF SYMMAINT 89
MAINTAINING TAPE FILES BY USE OF SYMMAINT 92
USER NUMBER 16
USER VALIDATION 63

USER VALIDATION 63

Please cut along this line

DOCUMENT REVIEW SHEET

TITLE: GE-200 Series Time-Sharing Operating System

CPB #: 1455

FROM:

Name: _____

Position: _____

Address: _____

_____

Comments concerning this publication are solicited for use in improving future editions. Please provide any recommended additions, deletions, corrections, or other information you deem necessary for improving this manual. The following space is provided for your comments.

COMMENTS: _____

NO POSTAGE NECESSARY IF MAILED IN U.S.A.
Fold on two lines shown on reverse
side, staple, and mail.

STAPLE

STAPLE

FOLD

FIRST CLASS
PERMIT, No. 4332
PHOENIX, ARIZONA

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

GENERAL ELECTRIC COMPANY
COMPUTER EQUIPMENT DEPARTMENT
13430 NORTH BLACK CANYON HIGHWAY
PHOENIX, ARIZONA - 85029

ATTENTION: DOCUMENTATION STANDARDS AND PUBLICATIONS B-90

FOLD

INFORMATION SYSTEMS

GENERAL ELECTRIC

LITHO U.S.A.