Disk Operating System Monitor Programmer's Handbook

DEC-11-OMONA-A-D

Disk Operating System Monitor Programmer's Handbook

PDP-11

D I S K O P E R A T I N G S Y S T E M M O N I T O R

P R O G R A M M E R ' S H A N D B O O K

Monitor Version VØ8-Ø2

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SOFTWARE SUPPORT CATEGORY

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Your attention is invited to the last two pages of this document. The "How to Obtain Software Information" page tells you how to keep up-to-date with DEC's software. The "Reader's Comments" page, when filled in and mailed, is beneficial to both you and DEC; all comments received are acknowledged and are considered when documenting subsequent documents.

NOTE

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Associated Documents:

PDP-11 FORTRAN IV
Programmer's Manual, DEC-11-LFIVA-A-D

PDP-11 MACRO-11 Assembler,
Programmer's Manual, DEC-11-OMACA-A-D

PDP-11 Edit-11 Text Editor,
Programmer's Manual, DEC-11-EEDA-A

PDP-11 ODT-11R Debugging Program,
Programmer's Manual, DEC-11-OODA-D

PDP-11 Link-11 Linker and Libr-11 Librarian
Programmer's Manual, DEC-11-ULLMA-A-D

PDP-11 PIP, File Utility Package,
Programmer's Manual, DEC-11-UPUPA-A-D

PREFACE

This document contains a comprehensive description of the PDP-11 Disk Operating System Monitor. The document is written for the PDP-11 programmer -- it assumes familiarity with the contents of the PDP-11 Handbook 1971 and the MACRO-11 Assembler (see document number DEC-11-OMACA-A-D). Previous experience with monitor or executive systems would be helpful.

The document is separated into three chapters: Chapter 1 is an introduction to the DOS Monitor, and provides general information about the disk operating system. Chapter 2 describes the keyboard commands available to the system operator through the Monitor; concepts and operation of each command are also explained. Chapter 3 describes the programmed requests that are available to the programmer through the Monitor. This chapter also explains the concepts and operation of each programmed request. The entire document is summarized in the appendices. Appendices D (Monitor Commands) and E (Monitor Programmed Requests) should prove to be invaluable to the DOS user.

In addition to the DOS Monitor, the PDP-11 Disk Operating System Software includes:

FORTRAN IV
MACRO-11 Assembler
Edit-11 Text Editor
ODT-11R Debugging Program
PIP, File Utility Package
Link-11 Linker
Libr-11 Librarian

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CHAPTER 1
INTRODUCTION

1.1 THE DOS MONITOR

The PDP-11 Disk Operating System (DOS) Monitor is a powerful, keyboard-oriented, program development system designed for use on PDP-11 computers. The DOS Monitor facilitates use of a wide range of peripherals available for use with the PDP-11.

The DOS Monitor supports the PDP-11 user throughout the development and execution of his program by:

- providing convenient access to system programs and utilities such as the FORTRAN Compiler[1], the MACRO-11 Assembler[1], a Linker, a debugging package, an Editor, a file utility package, etc.;
- performing input/output transfers at four different levels, ranging from direct access of device drivers to full formatting capabilities, while providing the convenience of complete device independence;
- providing a file system for management of secondary storage; and
- providing a versatile set of keyboard commands for use in controlling the flow of programs.

System programs and utilities can be called into core from disk, DECtape or magtape with Monitor commands issued directly at the keyboard. This feature eliminates the need to manipulate numerous paper tapes, and provides the user with an efficient and convenient programming tool.

DOS gives the user program the capability of complete device independence. Programs can be written without concern for specific I/O devices. When the program is run, the user can select the most effective or convenient I/O device available for the function to be performed. In addition, if the system configuration is altered, many programs can take advantage of the new configuration without being rewritten. Logical names can be assigned to devices

[1] Available only on 12K or larger systems. The 8K assembler does not support macros.

within the system enabling symbolic referencing of any device. No concern need be given to I/O buffer size within the user program yet the user can alternatively retain direct control of I/O buffers.

All input/output (I/O) transfers are handled by the Monitor in any of three user-selected levels called READ/WRITE, RECORD/BLOCK, and TRAN. READ/WRITE is a formatted level of I/O in which the user can specify any one of nine options. RECORD/BLOCK is a file-structured, random-access I/O level with no formatting. TRAN does basic I/O operations at the device driver level. All I/O is concurrent and interrupt driven.

The file system on secondary storage uses two types of files: linked and contiguous. Linked files can grow serially and have no logical limit on their size. Contiguous files must have their lengths declared before use but can be randomly accessed by RECORD or BLOCK level I/O requests. All blocks in a contiguous file are physically adjacent, while blocks in a linked file are typically not adjacent (the first word of each block contains the address of the next block). Files can be deleted or created at any time, and are referenced by name. Table 1-1 summarizes the features and benefits of the DOS Monitor.

The user communicates with the Monitor in two ways: through keyboard instructions called commands, and through programmed instructions called requests.

Keyboard commands enable the user to load and run programs; assign I/O devices or files; start or restart programs at specific addresses; modify the contents of memory locations; retrieve system information such as time of day and date; and dump core. Users with more than 8K of memory[1] can utilize programmed requests, which are macros assembled into the user's program and through which the user specifies the operation to be performed by the Monitor. Some programmed requests are used to access input/output transfer facilities, and to specify where the data is, where it is going, and what format it is in. In these cases the Monitor will take care of bringing drivers in from disk, performing the data transfer, and notifying the user of the status of the transfer.

[1]8K users must include the code generated by such an assembly (the assembly language expansion shown in Appendix E and in the explanation of each programmed request in Chapter 3) in their programs to utilize the Monitor functions. See the MACRO manual (DEC-11-OMACA-A-D) for other differences in the 8K Assembler.

Table 1-1

PDP-11 DOS Monitor Features and Benefits

Feature	Benefits to User
Files are catalogued in multi-level file directories.	No file naming conflicts among users.
Files are referred to by name.	Files do not have to be remembered by number.
Files can grow serially.	Files can be created even when their final size is not known.
Files can be as large as the storage device can accept.	No logical limit on the size of files.
File storage is allocated dynamically on any bulk-storage device.	Files can be deleted or created even at run time for maximum storage efficiency.
Monitor subroutines can be swapped into core when needed. Routines need not permanently tie up an area of core.	Much more efficient use of core space for user programs. Free core expands and contracts as Monitor subroutines are used. Space can be reclaimed for user programs. The user can determine which Monitor subroutines will be in core, and when.
Monitor subroutines can be made permanently core resident before or during run time.	The user can tailor the Monitor for his particular needs.
The Monitor is divided into logical modules.	The user can easily and efficiently use the logical pieces of the Monitor for his own needs. He can also easily add his own specialized drivers to the system by following a simple set of rules, and still use the rest of the Monitor with these drivers.
All I/O is interrupt-driven.	Such specialized equipment as communications modems and A/D converters which must be interrupt driven can be run under the Monitor. Several I/O calls can be handled concurrently.
Device independence.	Any device can be specified by the user in his program, and another device can be substituted by him when his program is being run.
Devices are assigned to one or more datasets.	The user may reassign a device which is used for one purpose (dataset) without changing its assignment for all other purposes (datasets).

Other requests access Monitor facilities to query system variables such as time of day, date, and system status, and to specify special functions for devices.

Programs supported by DOS, and hence accessible through the Monitor, are listed in Table 1-2.

Table 1-2

Principal DOS System Programs

System Program	Document Number
FORTRAN IV	DEC-11-LFIVA-A-D
MACRO-11 Assembler	DEC-11-OMACA-A-D
EDIT-11 Text Editor	DEC-11-EEDA-D
ODT-11R Debugging Program	DEC-11-OODA-D
PIP, File Utility Package	DEC-11-UPUPA-A-D
Link-11 Linker and Libr-11 Librarian	DEC-11-ULLMA-A-D

1.2 MONITOR CORE ORGANIZATION

Core memory is divided into:

- a user area where user programs are located;
- the stack where parameters are stored temporarily during the transfer of control between routines;
- the free core or buffer area which is divided into 16-word blocks assigned by the Monitor for temporary tables, for Monitor routines called in from disk, and for data buffering between devices and user programs;
- the resident Monitor itself which includes all permanently resident routines and tables;
- The interrupt vectors.

Figure 1-1 is a map of core as organized by the Monitor.

The DOS Monitor dynamically acquires and releases core on the basis of system requirements.

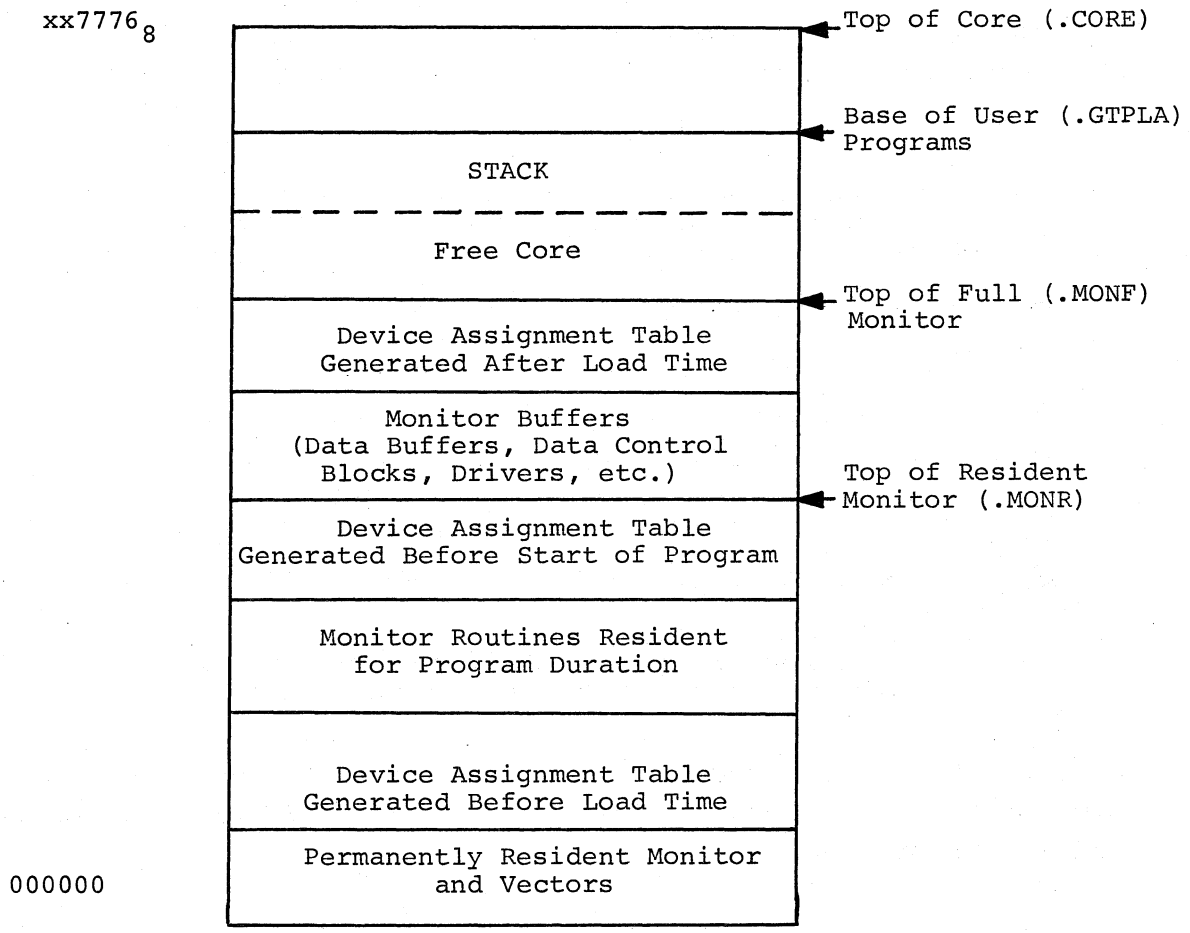


Figure 1-1 The Monitor Core Map

1.3 HARDWARE CONFIGURATIONS

Many minimum hardware configurations for use by the disk operating system may be derived by choosing one item from each of the five following sets.

- PDP-11 System Building Block with 900 nsec. Core Memory and a Terminal (DECwriter [LA30], Alphanumeric CRT [VT05-B], or Teletype[1] [LT33]).
- Cabinets and all Mounting Hardware.
- Bootstrap Loader (BM792-YB or MR-11).
- Choice of Disks (Control Logic Included)

  64K word Fixed Head Disk (RS64/RC11)
  256K word Fixed Head Disk (RF11/RS11)
  1.2 word Interchangeable Cartridge Disk (RK05/RK11)

- Choice of Tape Devices (Control Logic Included)

  Dual Drive DECtape (TU56/TC11)
  7- or 9-track Industry Standard Magnetic Tape (TU10/TM11)
  High-Speed Paper Tape Reader/Punch (PC11)

Specific details are available from a sales representative. Note that 12K of core is required with the RK disk and DECtape is required with the RC disk.

1.4 MONITOR MESSAGE

When a message-producing situation (such as a system error) occurs, an error code and an additional word of information are displayed on the teleprinter. There are five types of messages:

- Informational
- Action required by the operator
- Warning to the operator
- Fatal
- System Program error

The type of message is identified by being preceded by the letter I, A, W, F or S respectively. If the system disk should fail and the error message cannot be brought into core, the Monitor halts.

Monitor messages are described in detail in Appendix F.

---

[1]Teletype is a registered trademark of the Teletype Corporation.

1.5 STARTING THE MONITOR

The Monitor is called into core from disk by performing the following procedure for systems with the BM792YB:

1. If the system device is an RK11 Disk, turn WRITE ENABLE off;
2. Move HALT/ENABLE switch to HALT position;
3. Load the processor switch register with 173100;
4. Depress LOAD ADDRESS processor switch;
5. Load the switch register with,

   177462 if the system device is RF11 disk,
   177406 if the system device is RK11 disk,
   177450 if the system device is RC11 disk;

6. Move HALT/ENABLE processor switch to ENABLE position;
7. Depress START processor switch.

With the MR11 Bootstrap Loader, the procedure is:

1. Load the processor switch register with:

   173100 if the Monitor storage device is RF11 disk,
   173110 if the Monitor storage device is RK11 disk,

2. Move HALT/ENABLE switch to HALT position;
3. Move HALT/ENABLE switch to ENABLE position;
4. Depress LOAD ADDRESS processor switch;
5. Depress START processor switch.

The Monitor will load into core and identify itself by printing:

```
DOS  Vxx
```

on the teleprinter, where Vxx represents the version number of the Monitor being used. The Monitor is now ready to accept an operator command (see Chapter 2).

1.6 A GUIDE TO THIS HANDBOOK

1.6.1 Terminology

The reader should understand the following terms as they apply to the PDP-11 Disk Operating System. An expanded Glossary, with abbreviations, can be found in Appendix I.

A dataset is a logical collection of data which is treated as an entity by a program. Typically, the items in a dataset have a realtionship to each other which simultaneously binds them together and distinguishes them from items in other datasets. For example, the records in the Object dataset produced by the assembler are clearly related to each other and are clearly distinct from the listing dataset produced by the same assembler. A parameter file and a source file, when presented successively to the assembler, might be viewed as a single dataset, however.

Typically, each dataset is associated with exactly one link block (see section 3.8.6.1), although a link block can be associated (successively, not simultaneously) with more than one dataset. For example, when the assembler finishes processing one dataset and returns for another command, the new input will constitute a new dataset, but the same link block will be used.

Examples of datasets are:

- all or part of a file on a file-structured device;
- one or more paper tapes in a paper tape reader;
- a deck of cards, terminated by an EOF card;
- three lines of keyboard data, a disk file, and a paper tape; which are read in sequence by the assembler and are viewed as the source input dataset.

A device is any PDP-11 peripheral supported by the Monitor.

A device controller can support one or more device units.

A file is a physical collection of data which resides on a directory device (e.g., disk or DECtape) and is referenced by its name. A file occupies one or more blocks on a directory device.

On a directory device it is possible to store data by name, rather than simply physical location; it is also called a file-structured device.

Bulk storage devices containing directories are called directory devices or file-structured devices. Devices such as paper tape equipment and the teleprinter, which cannot support a file structure, are called non-directory device or non-file structured devices.

A block is a group of adjacent words of a specified size on a device; it is the smallest system-addressable segment on the device. If the blocks comprising a file are physically adjacent to each other, the file is said to be contiguous; if the blocks of the file are not physically adjacent, the file is said to be linked.

A line is a string of ASCII[1] characters which is terminated by a LINE FEED, FORM FEED or VERTICAL TAB.

File structure refers to the manner in which files are organized. Specifically, each of a user's files is given a unique name by the user. Each user on a file-structured device is assigned a User File Directory (UFD) in which each of his files is listed by name and location. Each UFD is then listed in a Master File Directory (MFD) which is unique to a specific device unit.

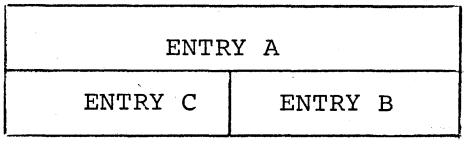
1.6.2 Standards for Tables

A table is a collection of data stored in sequential memory locations. A typical table as represented in this manual is shown below. This table is two words long, and is referenced by the symbolic address TABL:. The first entry is at location TABL and contains ENTRY A, which might be coded as .WORD AYE in the user's program. The second word of the table, at address TABL+2, is divided into two bytes. The low-order byte (address TABL+2) contains ENTRY B, and the high-order byte (address TABL+3) contains ENTRY C. They might be written into a program as .BYTE BEE,CEE.

[1]ASCII represents American Standard Code for Information Interchange.

a) Representation in manual

TABL:



b) Representation in program listing:

```
TABL:   .WORD AYE               ;ENTRY A
        .BYTE BEE,CEE           ;ENTRY B, ENTRY C
```

Note that the first byte specified is stored at the rightmost available byte.

1.6.3 Standards for Numbers

Unless otherwise stated, all numbers in the text and examples are in octal form.

CHAPTER 2
MONITOR KEYBOARD COMMANDS

2.1 INTRODUCTION

This Chapter shows how the Disk Operating System (DOS) Monitor looks to the user as he sits at the terminal (i.e., the Teletype, DECwriter, etc.). The user is communicating with the DOS Monitor while running system, utility, and user programs.

Since DOS is an interactive operating system, the primary input and output device is the user's terminal or teleprinter (keyboard and printer). Through the terminal keyboard, the user can communicate with

- the Monitor,
- a system or utility program (Macro, PIP, Editor, etc.), or
- a user program written to run under DOS.

The terminal printer is used to record user input and system output.

In communicating with the Monitor, the keyboard is used as a control device to allocate system resources, move programs into core, start and stop programs, and exchange information with the system. Data from the keyboard may be transferred to a buffer in the user program or it may be processed immediately by the DOS Command String Interpreter (CSI) as explained in Appendix I. In this Chapter, the CSI is described only as it applies to the formatting of Monitor keyboard commands.

When the system is ready for input from the keyboard, a single character is printed on the teleprinter. The following conventions apply:

Character	Meaning
$	The system is idle, waiting for a Monitor command.
.	The Monitor is waiting to continue or abort a task.
#	A system, utility, or user's program requests a command through the CSI.
*	A system program requests direct input, i.e., not through the CSI.

In this Chapter, we are concerned only with the $ and . characters. The # and * characters are explained in the individual system and utility programmer's manuals.

The $ and . indicate that the Monitor is waiting for a keyboard command from the user. Note, however, that some commands may be issued only to a $ and some only to a ., and that each command has different limitations; these are discussed with each command in Section 2.8.

2.1.1 Monitor Commands by Function

A number of keyboard commands are provided for communication with the DOS Monitor. These commands are briefly identified by function in Table 2-1 and are fully described in Section 2.8.

Table 2-1

Monitor Commands by Function

Function	Command
Establish identity of user	LOGIN
Terminate a session before leaving the system	FINISH
Enter or retrieve date	DATE
Enter or retrieve the time-of-day	TIME
Load and execute a program	RUN
Load a program	GET
Start a program which has been loaded	BEGIN
Resume a program that is waiting for user action	CONTINUE

(continued on next page)

Table 2-1 (Cont'd)

Monitor Commands by Function

Function	Command
Assign an I/O device or a file at run-time	ASSIGN
Inspect or modify individual memory locations	MODIFY
Save a program in core for later use	SAVE
Dump memory data on the teleprinter	DUMP
Suppress or resume echoing of keyboard input	ECHO
Suppress or resume teleprinter output	PRINT
Start the program just loaded at its ODT entry point	ODT
Stop a program	STOP
Suspend a program	WAIT
Restart a program that has been running	RESTART
Terminate a keyboard or paper tape dataset	END

2.1.2 When Monitor Commands are Legal

Each command performs a specific function, is legal to use under specific conditions, and often alters the state of the system, as shown in the following table.

Command	Legal When:	State Induced
ASSIGN	any time	no change
BEGIN	program loaded and stopped	program running
CONTINUE	program loaded and waiting	program running
DATE	any time	no change
DUMP	any time	no change
ECHO	program running	no change

(continued on next page)

Command	Legal When:	State Induced
END	program running	no change
FINISH	no program loaded	logged out
GET	no program loaded	program loaded and stopped
KILL	program loaded	program stopped and unloaded
LOGIN	not logged in	logged in
MODIFY	any time	no change
ODT	program loaded and stopped	program running under ODT
PRINT	program running	no change
RESTART	program loaded and stopped/waiting	program running
RUN	no program loaded	program loaded and running
SAVE	program loaded and stopped	no change
STOP	program running	program stopped
TIME	any time	no change
WAIT	program running	program waiting

A program is loaded if you have typed RUN or GET but not KILL, and as long as the program has not executed a .EXIT call (see Chapter 3).

A program is running if you have typed RUN or if it has been loaded and you have typed BEGIN, CONTINUE, RESTART, or ODT.

A program is loaded and stopped if GET but not BEGIN was typed, if it was running and a STOP was typed, or after issuing a fatal error message (see Appendix F).

A program is waiting if it was running and you typed CTRL/C followed by WAIT, or after the system issues an action error message (see Appendix F).

A program is stopped and unloaded (from core) if you have typed KILL or if the program issued an .EXIT call (see Chapter 3).

2.2 MONITOR MODE AND USER MODE

From the user's point of view, his terminal is in either Monitor mode or user mode. In Monitor mode, each line the user types is sent to the Monitor's Command String Interpreter (CSI). The execution of certain commands places the terminal in user mode. When the terminal is in user mode, it becomes simply an input/output (I/O) device for that user. In addition, user programs use the terminal for two purposes: to accept user command strings (user mode) or as a direct I/O device (data mode).

2.3 COMMAND STRING INTERPRETER (CSI)

When the terminal is in Monitor mode the user communicates with the Monitor's Command String Interpreter (CSI). The commands described in this Chapter are processed by the CSI (see Appendix I).

The CSI makes several checks before processing commands from the user. For example, if a user who has not logged in types a command that requires him to be logged in, the system responds with the message:

```
ILL CMD!
```

meaning the command was illegal and was not executed. The commands discussed in this Chapter require that the user be logged in except where explicitly stated otherwise. When a command is issued that requires the job to use more core than is available, the system responds with the message:

```
NO CORE!
```

and the user's command is not executed.

All Monitor messages are shown in Appendix F.

2.4 USER IDENTIFICATION CODE (UIC)

Each user of the system is normally assigned a User Identification Code (UIC) by the system or installation manager. The UIC is first used when logging in to the system, as explained in Section 2.7. The format of the UIC is:

```
nnn,nnn
```

where nnn represents a string of two or three octal digits, from 11 to 376 (Ø-1Ø and 377 are reserved for the system). The value to the left of the comma represents the user-group number, while the value to the right represents the user's number within the group.

For example:

67,123

specifies user group 67 and user number 123.

NOTE

Except when logging in, the UIC is always delimited by the left and right square brackets, as shown in the examples of various commands in this Chapter.

2.5 FILENAMES AND FILENAME EXTENSIONS

User program files are named with a certain convention, much the same as a person is named. For example, the first name is the filename and the second name is the filename extension. By convention, the filename and extension are separated by a period. For example:

GEORGE.DOE

could be a legal filename and extension. Note that the filename and extension cannot have embedded blanks (spaces) because a space will be interpreted as a delimiter,

Filenames can consist of from one to six alphanumerics; all after the sixth are ignored. The filename extension can consist of from one to three alphanumerics. The extension is generally used to indicate the type of information in the file. For example:

File	Could be:
MAIN.F4	a FORTRAN file named MAIN
SAMPLE.MAC	a Macro source file named SAMPLE
TEST1.TMP	a temporary file named TEST1
NAME.REL	a relocatable binary file named NAME

A list of standard extensions are shown in Appendix O

User program files are identified by the filename.extension and the UIC. Thus, different users may use the same filename.extension, and as long as they are created under different UIC's the files would remain distinct and separate.

2.6 SPECIAL KEYBOARD CHARACTERS

There are several special keyboard characters recognized by the Monitor's CSI that cause specific functions to be performed. These keyboard characters are explained below.

2.6.1. The RETURN Key

The RETURN key is used to terminate a keyboard command and to advance the teleprinter paper one line. Typing the RETURN key produces a carriage return and line feed action on the teleprinter.

As characters are typed, they are transferred into a buffer where they are stored until the RETURN key (or another special keyboard character(s)) is typed. When the RETURN key is typed, the data on that line is transferred to and processed by the CSI.

All legal command strings are terminated by the RETURN key.

2.6.2 The RUBOUT Key

The RUBOUT key is used to correct typing errors. Typing the RUBOUT key once causes the last character typed to be deleted; typing it twice causes the last two characters to be deleted; etc. The Monitor prints the deleted characters delimited by backslashes. For example, if you meant to type ASSIGN but typed ASIS instead, the error could be corrected by typing two RUBOUTs and then the correct characters. The printout would be:

```
ASIS\SI\SIGN
```

Notice that the deleted characters are shown in reverse order, i.e., in the order in which they are deleted.

2.6.3 The CTRL/C Keys

The CTRL/C key combination is typed by holding down the CTRL key while typing the C key. When CTRL/C is typed, the Monitor is

alerted to accept a command from the keyboard. CTRL/C is echoed on the teleprinter as ↑C, carriage return, line feed, and period.

CTRL/C interrupts teleprinter output or keyboard input in a user program. Monitor action on a CTRL/C is not taken until any current Monitor command is completed because the keyboard interrupt is turned off. However, except for DUMP and MODIFY, it appears to the user that action on a CTRL/C is immediate.

CTRL/C puts the Monitor in listening mode only. If it is desired to stop the function of the operating program, the STOP command should be used.

If a second CTRL/C is typed before the RETURN key terminating a command, the input so far will be erased, a fresh ↑C will be printed, and the Monitor will await a new command.

2.6.4 The CTRL/U Keys

The CTRL/U key combination is typed by holding down the CTRL key while typing the U key. When CTRL/U is typed, the line on which it is typed is deleted; the system responds with a carriage return and line feed so that the line (command) may be typed again.

CTRL/U is echoed on the teleprinter as ↑U, carriage return, and line feed.

2.6.5 The Semicolon Key

When the Monitor is in listening mode (i.e., following a CTRL/C), the semicolon (;) key causes subsequent characters on the line to be treated as a comment. It effectively puts the keyboard off-line so that all characters following the semicolon are printed on the teleprinter but no Monitor action is taken.

2.6.6 The ESCAPE Key

The ESCAPE key (ASCII Ø33 octal) may be used to pass special keyboard characters to a running user program. When the CSI detects the ESC key it passes the next character directly to the user program. The use of this feature is under programmer control.

2.6.7 How Keyboard Characters are Processed

As characters are typed they are stored in the keyboard buffer (about 85 characters capacity) pending termination of the line with a RETURN, CTRL/C, or CTRL/U, which transfers the line of characters to the Monitor buffer.

When a RUBOUT is processed, it remains in the keyboard buffer and the character which it deletes is replaced with another RUBOUT. Since RUBOUTs are not removed until the line is transferred to the user, the capacity of the keyboard buffer may be exceeded if the sum of normal characters plus RUBOUTs is greater than 85. When this occurs, only RETURN, CTRL/C, or CTRL/U is accepted; all other characters are discarded and not echoed. This is done to maintain economy of core and to ensure that characters such as CTRL/C and CTRL/U can be processed correctly, even when they appear at the end of a very long line.

CTRL/C and CTRL/U characters are processed immediately.

2.7 GETTING ON THE SYSTEM

In order to gain access to the system, the user must log in with the LOGIN command (see section 2.8.11). First, ensure that the terminal is connected to the system (see Appendix H). The LOGIN command is issued in response to the Monitor's $. If none exist on the teleprinter paper, type the RETURN key and a $ will be printed by the Monitor; if not, a new Monitor must be loaded as described in the Batch/DOS-11 System Manager's Guide.

In response to $, the user should issue the LOGIN command with his User Identification Code (UIC) (see section 2.4). For example:

```
$LOGIN 200,200
DATE:-20-OCT-72
TIME:-10:41:16
$
```

NOTE

In the examples, underscoring is used to designate system printout, whereas user input is not underscored.

In response to the LOGIN command, the Monitor prints the current calendar date and time-of-day followed by the $, indicating that the system is ready for a Monitor command from the user.

Only one user can be logged in at a time. The LOGIN command will be rejected when it is given before the previous user has logged out with the FINISH command.

2.8 MONITOR KEYBOARD COMMANDS

A keyboard command to the Monitor consists of two parts: a command name and possibly one or more command arguments. A command name is a string of two or more letters; all letters after the first two and up to a command name delimiter (space or comma) are ignored.

Monitor keyboard commands are typed in response to a dollar sign ($) or a period (.), which is printed by the system. Generally speaking, the $ indicates that the Monitor is waiting for a new task, and the . indicates that the Monitor is waiting to continue or abort a previously assumed task.

Although the commands are arranged in alphabetical order for ease of reference, they can be divided into functional groups for ease of learning. These groups with their associated commands are as follows:

- Command to allocate system resources:

  ASSIGN

- Commands to manipulate core images:

RUN	GET
DUMP	SAVE

- Commands to start a program:

BEGIN	CONTINUE
RESTART	

- Commands to stop a program:

STOP	WAIT
KILL	

- Commands to exchange information with the system:

DATE	TIME
LOGIN	MODIFY
FINISH	

- Miscellaneous commands:

ECHO	PRINT
END	ODT

The following conventions apply to all Monitor commands:

- All commands are terminated with the RETURN key.
- The command name is separated from its argument (dataset specifier, etc.) with a space.
- All characters in a command are interpreted by the CSI; thus, no embedded blanks are allowed.
- The UIC is always enclosed within square brackets, [ ], except when used with the LOGIN command.

The proper format for each command is given in the discussion of each command in this section. The following conventions apply to the command formats shown in this section.

- Brackets [ ] are used to enclose optional elements
- Braces { } are used to indicate that a choice must be made from the enclosed elements
- The symbol Δ indicates that a space must appear there.
- dev: refers to a device mnemonic (see Appendix A).
- dataset specifier may be represented by any portion of the expression:

  dev:filename.ext,[uic]

  where

dev:	is a legal device mnemonic and colon
filename	is a filename of up to six alphanumerics
.ext	is a period and filename extension of up to three alphanumerics
[uic]	is the user's identification code in the form: [group no., user no.]

- logical name is the name given by the user to the dataset in Link Block word LNKBLK+2 (see Chapter 3).

If for any reason a command cannot be executed satisfactorily, an appropriate message will be printed on the teleprinter and the command will be ignored. These messages are shown in Appendix F.

2.8.1 The ASSIGN Command

Format:

AS[SIGN]Δdev:[dataset specifier, logical name]

Purpose:

This command assigns a physical device (and a filename when the device is file-structured) to the dataset identified by "logical name". The format of "dataset specifier" is:

filenam.ext[uic]

which designates the name, extension, and uic, if any, to be assigned to the file.

Any filename specified for a nonfile-structured device is ignored.

Note that a device is assigned to a dataset, and that reassigning it for one dataset does not reassign it for all datasets.

The ASSIGN command overrides any assignment made in the program's internal control blocks (Link and Filename Blocks). The ASSIGN command is not needed if the program makes its own provisions for obtaining this information; e.g., by specifying defaults in its control blocks or by requesting a command string, as is done with the # symbol in the DOS system programs.

An ASSIGN with no argument releases (deassign) all ASSIGNments previously made by the current user, i.e., since the last LOGIN command

The ASSIGN command can be given at any time the Monitor is in core. Consider the following:

- If ASSIGN is given before a program is loaded, the device assignment will remain in effect until another ASSIGN is given with the same logical name or with no arguments, or until the Monitor itself is reloaded. ASSIGN, given at this time, enables the user to specify an assignment which will apply to several programs.

- If ASSIGN is given after a program is loaded and before it has started running (i.e., after a GET command), the assignment will remain in effect as long as the program is in core, or until another ASSIGNment is performed. When the program disappears (by an .EXIT request or a KILL command), the assignment is released.

- ASSIGN may also be given after a program is running. For example, as a recovery from an

  AØØ3 (device not ready)

  message, the user would do an ASSIGN followed by a CONTINUE. The assignment will remain in effect as long as the program is in core, or until the programmer reassigns the dataset, or until he restarts the program with a BEGIN command.

  Doing an ASSIGN in this manner is provided for such emergency situations, but is not recommended as standard practice because it causes an extra buffer to be allocated from free core, and it will be effective only if the program has not already INITed the dataset to some other device.

2.8.2 The BEGIN Command

Format:

BE[GIN]Δ[address]

Purpose:

The BEGIN command starts the execution of an already loaded program at the stated address. If no address is specified, the normal start address will be used. This command is valid only if a program is already in core.

BEGIN is used after a GET, a STOP, or following a fatal error condition. The GET command followed by a BEGIN command is equivalent to a RUN command. If given after a program has been started, a BEGIN will restore core to the state which existed immediately after the program was loaded. It will rename all core allocations to buffers, device drivers, and assignments made dynamically, and the stack will be cleared before control is passed back to the program. If any files are under creation at this time, they will be deleted (see section 2.8.15).

To start a program at its normal start address, type:

BE

To start a program at absolute address 3446, type:

BEΔ3446

After a Program Crash:

The BEGIN Command is provided not only as a means of starting a program loaded by GET but also to enable the user to try again after a program crash, hopefully with a clean slate. At the time of the crash, the program may already have opened but not closed output files and the subsequent request to reopen after a restart could then lead to other failure because these files now exist. To prevent this, the BEGIN processor tries to delete the files, but not by the normal Monitor process since this could mean writing out bit-maps which are currently in core and must be suspect because of the crash. Instead, it merely removes the names of the files from the appropriate device directory, and if these are on disk, unlinks any blocks so far allocated; for safety it does not touch the bit-maps already stored on the device. In almost all cases, this procedure suffices. However, the following implications should be noted.

1. This automatic deletion by BEGIN will not suit a user who has already amassed considerable data in one of his output files and cannot replace it if he starts over. In this case, KILLing the program to save his data under a different filename might be a more appropriate action. However, he should then realize that he might be transmitting the effects of his program failure to the device concerned.

2. It is possible that by the time of the crash the program may have produced a fairly long file. On a DECtape for which there is only one bit-map, this is no problem. A disk, however, requires several bit-maps and the allocation of some of the blocks for the file may already be permanently recorded because the appropriate bit-map has been filled and has been replaced in core by another. Since BEGIN does not change the maps, these blocks will not be freed for further use. A series of situations such as this can, after a time, result in the disk becoming full even though the known files are not seen to occupy the whole capacity. The user should in this case consider whether or not he should chance disk-corruption and use KILL rather than BEGIN. The user can then delete the file by using PIP-11 to avoid the build-up of the nonavailable blocks described.

3. Some programs cannot be restarted with BEGIN (i.e., after having been started, they cannot be restarted with BEGIN.) A FORTRAN program is an example. In general, a program must be self-initialized if BEGIN is to be used in this way. Also, since the Monitor will try to clean up core and delete files, reBEGINning a program which was badly out of control may lead to undesirable results. Thus, use BEGIN only if there is no other alternative.

2.8.3 The CONTINUE Command

Format:

CO[NTINUE]

Purpose:

This command is used after a WAIT command or a recoverable error condition (operator action message) to resume program operation at the point where it was interrupted.

CONTINUE is valid only if a program is already in core.

2.8.4 The DATE Command

Format:

DA[TE]Δ[date]

Purpose:

The DATE command may be used to obtain the current calendar date and to enter a date value from the keyboard; the date is printed in the dd-mmm-yy format.

To obtain the current calendar date, simply type the DATE command followed by the RETURN key. For example:

```
$DATE
20-OCT-72
$
```

The current calendar date is entered by the system or installation manager, and need not be reentered except when loading a new DOS Monitor.

To enter a date value from the keyboard, type the DATE command, the desired date value, and then the RETURN key. For example:

$DATE Δ dd-mmm-yy

putting the desired date value in place of dd-mmm-yy. The entered date value is returned in response to subsequent DATE commands until another date is given. If the desired date value is an invalid date, e.g., 42-BOB-A1, subsequent responses to DATE will be meaningless, e.g., ØØ-XXX-YY.

DATE is valid at any time.

DUMP

2.8.5 The DUMP Command

Format:

$$DU[MP]\Delta LP:[O],\left[\left\{\begin{matrix}\text{start addr}\\ \emptyset\end{matrix}\right\}[,\text{end addr}]\right]$$

Purpose:

The DUMP command is used to print on the Line Printer an absolute copy of the contents of the specified core area, formatted in octal. The core image is not altered.

The argument O specifies the dump to be output from core. An O is assumed on default, but the comma is required.

The argument Ø is assumed if no "start address" is specified and the highest word in core is assumed if no "end address" is specified.

DUMP is valid at any time. If given while a program is running, the operation of the program will be suspended for the time required to effect the dump.

The syntax of the DUMP command was chosen to facilitate later expansion and flexibility of the command.

2.8.6 The ECHO Command

Format:

EC[HO]

Purpose:

The ECHO command may be used to suppress and restore keyboard echo, i.e., characters typed by the user will not appear on the terminal printer. A subsequent ECHO command turns the echo feature on again. The teleprinter as an output device for the program or the Monitor is not affected by this command.

ECHO is valid only when a program is running in core and using the keyboard as an input device.

2.8.7 The END Command

Format:

$$EN[D]\Delta\left\{\begin{matrix}KB\\PT\end{matrix}\right\}$$

Purpose:

The END command is used to terminate using the console as an input device, i.e., the keyboard or low-speed paper tape reader. The command tells the Monitor "there is no more input from the device". The command effectively generates an end-of-file (EOF) from the keyboard.

When no device is specified in the command, KB is assumed.

The following actions are required with this command

1. Type CTRL/C to obtain the Monitor's attention. Since the console is being used for program input (data mode), the Monitor is not expecting a command.
2. Issue the END command (with appropriate argument).
3. Type the RETURN key twice; yes, two RETURNs. The two RETURNs are required to return to the Monitor.

For example: (where ↑C = CTRL/C, and (CR) = RETURN)

```
↑C
.END,KB     (CR)     (CR)
```

END is valid only when the console is being used as an input device.

2.8.8 The FINISH Command

Format:

FI[NISH]

Purpose:

The FINISH command informs the Monitor that the current user is leaving the system. The Monitor deletes all files which are not protected against automatic deletion on FINISH (see Section 3.9.2.2), and a new copy of the resident Monitor is "booted" into core.

FINISH is valid only when no user program is in core. Therefore, unless the last character on the teleprinter is a $, the user should precede a FINISH with CTRL/C followed by KILL. For example, the printout might be:

```
↑C
.KILL
$FINISH
TIME:-16:42:00
MONITOR VØ8-Ø2
$
```

In response to a FINISH, the Monitor prints the time and then the newly booted Monitor identifies itself. The system is now ready for a user to log in.

2.8.9 The GET Command

Format:

GE[T]Δdataset specifier

Purpose:

The GET command loads the specified file from the specified device. When a device is not specified, the system device is assumed.

GET is valid only when no program is in core.

The user should use a BEGIN or ODT command to commence execution.

2.8.10 The KILL Command

Format:

KI[11]

Purpose:

The KILL command stops the execution of the current program after closing all open files and completing any outstanding I/O. It then removes the program from core by returning control to the Monitor.

KILL is valid only when a program is in core.

To resume operations, the user must reload the program or load another with RUN or GET.

LOGIN

2.8.11 The LOGIN Command

Format:

LO[GIN]Δuic

Purpose:

The LOGIN command enables a user to gain access to the system. LOGIN requires a UIC as its argument (see section 2.4). The UIC indicates which directory (of several possible), on each file-structured device, will be directly available to the user.

Here the UIC is not enclosed within the square brackets; its format is simply

nnn,nnn

specifying group, user numbers respectively.

LOGIN is valid only when there is no program loaded in core and provided no user has logged in and not logged out (FINISHed).

2.8.12 The MODIFY Command

Format:

MO[DIFY] Δ octal address

octal address/contents: [new contents]

Purpose:

This command allows the user to display and make changes to the contents of the absolute memory location specified by "octal address" in the command line. When the RETURN key is typed at the end of the command line, the system responds by printing the contents of that address. At this point, the user can type one of the following ((CR) = RETURN key; (LF) = LINE FEED key):

(CR)	will leave the contents unmodified.
new contents (CR)	will change contents to new contents.
(LF)	will take similar action as CR and then automatically print the contents of the next memory location.

To change the contents of location 40000:

```
$MODIFYΔ40000     (CR)
40000/16406:  10406     (CR)
```

Then to examine the contents of 40000:

```
$MOΔ40000     (CR)
40000/10406:     (CR)
```

To examine the contents of locations 40000 and 40002, the sequence would be:

```
$MOΔ40000     (CR)
40000/104060:     (LF)
40002/000003:
```

Entry of an address outside the available core memory as part of the original MODIFY command will cause an error, and the command will be rejected.

MODIFY is valid at any time.

2.8.13 The ODT Command

Format:

$$OD[T]\Delta\left[\left\{\begin{matrix}R\\K\end{matrix}\right\}\right]$$

Purpose:

The ODT command starts the execution of the ODT-11R Debugging Program. The argument specifies which ODT start address is to be used:

Argument	Starts at	Action
(none)	START+Ø	Clears ODT breakpoint table without resetting breakpoints.
R	START+2	Clears ODT breakpoint table after replacing old instructions at breakpoints.
K	START+4	Leaves breakpoints exactly as they are.

This command begins execution at the ODT entry point of the user's load module. The user must have linked ODT-11R with his program and must have identified his program to the Linker with the /OD switch.

To reset all breakpoint locations at their former instructions and restart ODT, the user would type:

```
.ODΔR
```

ODT is valid only when ODT-11R is linked to a program and both are in core.

PRINT

2.8.14 The PRINT Command

Format:

PR[INT]

Purpose:

The PRINT command may be used to suppress and restore teleprinter printing when the printer is used as an output device to a user program. A subsequent PRINT command turns the printing feature on again.

PRINT is valid only when a program is running in core and is using the teleprinter as an output device.

2.8.15 The RESTART Command

Format:

RE[START]Δ[address]

Purpose:

The RESTART command permits a program to be restarted. As shown, the user may optionally supply an address at which the program is to be restarted. If no address is specified, the address set by the .RESTART programmed request is assumed if a .RSTRT request has been issued by the program (see Section 3.8.3.2).

If neither address is specified, the command is rejected.

RESTART is valid only when a program is already in core.

Before the program is restarted, the stack is cleared, any current I/O is stopped, and all internal busy states are removed. Buffers and device drivers set up for I/O operations will, however, remain linked to the program for future use.

RUN

2.8.16 The RUN Command

Format:

RU[N] Δ dataset specifier

Purpose:

The RUN command loads into core the specified program from the specified device and starts its execution at the normal start address. RUN is equivalent to a GET command followed by a BEGIN command.

The dataset specifier is of the form:

dev:filenam.ext[uic]

When no device is specified, the system device (disk) is assumed.

The sequence in which the Monitor performs its search for the specified program depends on the existence and type of filename extension and on the UIC. Various forms of the RUN command are shown below with the search sequence performed by the Monitor.

- RUNΔFILE

```
Attempt 1 -- FILE.LDA [current uic]
Attempt 2 -- FILE.LDA [1,1]
Attempt 3 -- FILE [current uic]
Attempt 4 -- FILE [1,1]
```

- RUNΔFILE.EXT

```
Attempt 1 -- FILE.EXT [current uic]
Attempt 2 -- FILE.EXT [1,1]
```

- RUNΔFILE[x,x]

  Attempt 1 -- FILE.LDA [x,x]
  Attempt 2 -- FILE [x,x]

- RUNΔFILE.EXT[x,x]

  Attempt 1 -- FILE.EXT [x,x]

If all attempts fail to find the file, a NO FILE message is printed on the teleprinter.

Searching for the LDA extension first exploits the fact that both the Linker and the SAVE command produce LDA extensions, unless the user specifies otherwise.

RUN is valid only when there is no program in core.

SAVE

2.8.17 The SAVE Command

Format:

SA[VE]Δ[dataset specifier][/RA:low:high]

Purpose:

The SAVE command writes the program in core onto the device in loader format. The core image is not altered. SAVE is valid only when a program is in core but not running, i.e., immediately after loading with a GET command or after being halted by either a STOP command or a fatal error.

If no dataset specifier is given, the SAVE processor will automatically set up a file called SAVE.LDA on the system disk after it has deleted any current file of the same name. If the user wishes to retain the current file, he must first rename it using PIP-11. If the dataset specifier is given, the file named must not already exist or the command will be rejected. System disk is assumed by default if the dataset specifier contains only a filename. When the filename is specified, the extension should also be specified.

Normally it is expected that the user will only wish to save his program area. If this is the case, the range need not be given and the new file will begin from the program's low limit and extend to the top of core. If any other area is to be saved, the user should include the following at the end of the command:

/RA:low:high

where /RA is the range switch, and low and high define the limits required (each being valid octal word-bound addresses). The saved

image will be preceded by the same communication information as that for the original program loaded, except that any information about the resident EMT modules will be lost.

The SAVE processor will endeavor to get an extra 256-word buffer in order to satisfy the command. If this request cannot be granted because of insufficient free core, the command will be rejected. The user is therefore advised to use this facility only after he has released any datasets currently established.

Once the SAVE command has been syntactically verified, any errors will be handled by the SAVE processor, which will print a relevant message and return to Monitor listening mode:

DEVICE FULL	End of output medium reached
FILE ERROR xxx	File structures error as indicated by xxx = file status byte

2.8.18 The STOP Command

Format:

ST[OP]

Purpose:

This is an emergency command to stop the program and to abort any I/O in progress (by doing a hardware reset). The program may be resumed with either the BEGIN or RESTART command.

STOP is valid only if a program is in core.

STOP differs from KILL in that KILL terminates the program in an orderly manner and removes the program from core.

2.8.19 The TIME Command

Format:

TI[ME]Δ[time]

Purpose:

The TIME command may be used to obtain the current time-of-day and to enter a time value from the keyboard. The time is printed in the following format.

hh:mm:ss

meaning hours:minutes:seconds.

To obtain the current time-of-day, simply type the TIME command followed by the RETURN key. For example:

```
$TIME
10:43:27
$
```

The current time-of-day is entered by the system or installation manager, and need not be reentered except when loading a new DOS Monitor.

To enter a time value from the keyboard, type the TIME command, the desired time value, and then the RETURN key.
For example:

$TIME Δ hh:mm:ss

putting the desired time value in place of hh:mm:ss. The entered time value is returned in response to subsequent TIME commands until another time value is given.

TIME is valid at any time.

2.8.20 The WAIT Command

Format:

WA[IT]

Purpose:

The WAIT command suspends the current program and allows any I/O in progress to finish. The program may be resumed with either the CONTINUE or RESTART command.

WAIT is valid only if a program is in core.

CHAPTER 3
PROGRAMMED REQUESTS

3.1 INTRODUCTION

The Monitor provides a number of services which are available to any user or system program. The most prominent of these are input/output (I/O) services. Other services include directory management, retrieval and modification of system parameters, various conversion routines, and a command string interpreter. The I/O services provide for linkage to device drivers, access to files in the file structure, and transfer of data to or from each device.

The user program calls for the services of the Monitor through programmed requests. Programmed requests are macro calls[1] which are assembled into the user program and interpreted by the Monitor at execution time. A programmed request consists of a macro call followed, when appropriate, by one or more arguments. For example:

```
.WAIT #LNKBLK
```

is a programmed request called .WAIT followed by an argument #LNKBLK. The macro request is expanded at assembly time by the MACRO Assembler[1] into a sequence of instructions which trap to and pass the arguments to the appropriate Monitor service routine to carry out the specified function. The assembly language expansion for .WAIT #LNKBLK is:

```
MOV #LNKBLK,-(SP)
EMT 1
```

To use the macro call, it is necessary to tell the assembler that you want the system definition for the macro. This is accomplished via the .MCALL assembler directive (Macro-11 Assembler Programmer's Manual), e.g.,

```
.MCALL     .WAIT
```

which must appear in the source prior to the first use of .WAIT. When .MCALL is encountered, the MACRO Assembler will get the definition of .WAIT from the system macro file (SYSMAC.SML) which is searched for, first in the current user's disk area, then under user identification code [1,1].

The system macros will accept most addressing modes as arguments. They will detect and announce potentially troublesome (e.g. X(SP)) or unlikely (e.g. SP) modes to protect the user.

---

[1]Users with less than 12K of core cannot run MACRO and consequently must include the assembly language expansion of the programmed request in their programs instead of the request itself.

All legal addressing modes will appear without alteration in the expansion. Since the monitor expects the address of the Link Block on top of the stack at .WAIT time, any of the following macro calls might be appropriate:

```
.WAIT #LNKBLK
.WAIT RØ          ;ADDRESS OF LNKBLK
                  ;IS IN REGISTER RØ
.WAIT POINTR      ;ADDRESS OF LNKBLK IS
                  ;IN MEMORY LOCATION POINTR
```

Refer to the MACRO-11 Assembler Programmer's Manual (Order Number DEC-11-OMACA-A-D) for further details.

The programmed request arguments are parameters or addresses of tables which contain the parameters of the request. These tables are part of the user program, and are described in detail in Figures 3-6 to 3-18.

3.2 TYPES OF PROGRAMMED REQUESTS

Services which the Monitor makes available to the user through programmed requests can be classified into three groups:

- requests for input/output and related services
- requests for directory management services
- requests for miscellaneous services

Table 3-1 summarizes the programmed requests available under the Monitor. Detailed descriptions of each request can be found in the sections cited in Table 3-1.

Table 3-1
Summary of Monitor Requests

Mnemonic	Purpose	Section
Requests for Input/Output and Related Services:		
.INIT	Associates a dataset with a device driver and sets up the initial linkage.	3.6.1
.RLSE	Removes the linkage between a device driver and a dataset, and releases the driver.	3.6.2
.OPEN	Opens a dataset.	3.6.3
.CLOSE	Closes a dataset.	3.6.4
.READ	Transfers data from a device to a user's line buffer.	3.6.5
.WRITE	Transfers data from a user's line buffer to a device.	3.6.6
.RECRD	Transfers one logical record of a file between a device and a user buffer.	3.6.7
.BLOCK	Transfers one physical block of a file between device and a Monitor buffer.	3.6.8
.TRAN	Transfers data between a device and a user buffer, independent of any file structure.	3.6.9
.WAIT	Waits for completion of any action on a dataset.	3.6.10
.WAITR	Checks for completion of any action on a dataset, and provides a transfer address for a busy return.	3.6.11
.SPEC	Performs special device functions.	3.6.12
.STAT	Obtains device characteristics.	3.6.13
Requests for Directory Management Services:		
.ALLOC	Allocates a contiguous file.	3.7.1
.DELET	Deletes a file.	3.7.2
.RENAM	Renames a file. Changes a protection code.	3.7.3
.APPND	Appends one linked file to another.	3.7.4
.LOOK	Searches the directory for a particular filename and returns information about the file.	3.7.5
.KEEP	Protects a file against automatic deletion on FINISHing.	3.7.6
Requests for Miscellaneous Services:		
.RUN	Loads programs and overlays.	3.8.1.1
.EXIT	Returns control to the Monitor.	3.8.2.1

(Continued on next page)

Table 3-1
Summary of Monitor Requests (Cont.)

Mnemonic	Purpose	Section
.TRAP	Sets interrupt vector for the TRAP instruction.	3.8.3.1
.RSTRT	Sets the address used by the RESTART command.	3.8.3.2
.CORE	Obtains address of highest word in core memory.	3.8.4.1
.MONR	Obtains address of first word above the resident Monitor.	3.8.4.2
.MONF	Obtains address of first word above the Monitor's highest allocated free core buffer.	3.8.4.3
.DATE	Obtains the date.	3.8.4.4
.TIME	Obtains the time of day.	3.8.4.5
.CVTDT	Converts internal date or time to ASCII.	3.8.4.6
.GTUIC	Gets current UIC.	3.8.4.7
.SYSDV	Gets Radix-50 name of the system device.	3.8.4.8
.GTPLA	Gets the current program load address.	3.8.4.9
.STPLA	Sets the program low address.	3.8.4.10
.GTCIL	Gets the base disk address of the CIL.	3.8.4.11
.GTSTK	Gets the current stack base address.	3.8.4.12
.STSTK	Sets the current stack base address.	3.8.4.13
.STFPU	Sets the floating point exception vector.	3.8.4.14
.RADPK	Packs three ASCII characters into one Radix-50 word.	3.8.5.1
.RADUP	Unpacks one Radix-50 word into three ASCII characters.	3.8.5.2
.D2BIN	Converts five decimal ASCII characters into one binary word.	3.8.5.3
.BIN2D	Converts one binary word into five decimal ASCII characters.	3.8.5.4
.O2BIN	Converts six octal ASCII characters into one binary word.	3.8.5.5
.BIN2O	Converts one binary word into six octal ASCII characters.	3.8.5.6
.CSI1	Condenses a command string and checks for proper syntax.	3.8.6.1
.CSI2	Interprets one command string dataset specification.	3.8.6.2

3.2.1 Requests for Input/Output and Related Services

All user I/O is handled by programmed requests, which provide three different levels of transfer:

- READ or WRITE
- RECORD or BLOCK
- TRAN

Each level uses a sequence of requests to complete the transfer. Note the distinction between READ/WRITE, RECORD/BLOCK, and TRAN as names of transfer levels, and .READ, .WRITE, .RECRD, .BLOCK, and .TRAN as specific programmed requests within these levels.

Requests for I/O related services perform special device functions (such as rewinding a tape) and obtain device characteristics from device status words.

Each request related to I/O services is described in Section 3.6.

3.2.1.1 READ or WRITE Level Requests - Most input and output is done at this level. Processing is sequential, in that each read or write is applied to the next record or line in the file. Records may be in either ASCII or binary mode, and a number of formats are handled by the monitor. Records may also be of variable length: ASCII records usually contain line terminators while formatted binary records contain byte counts.

READ or WRITE I/O under the Monitor consists of transferring the contents of a dataset between a device and a line buffer via a buffer in the Monitor (Figure 3-1a). A line buffer is an area set up by the user in his program, into which he (or the Monitor) places data for output (or input). The line buffer is usually preceded by the line buffer header, in which the user specifies the size and location of the line buffer and the mode (format) of the data.

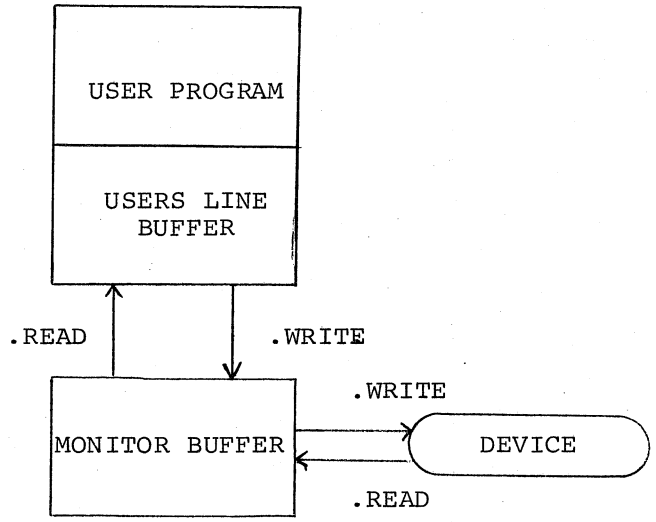


Figure 3-1a The Transfer Path

```
        .INIT   #LNKBLK
        MOV     #FILBLK,RØ
                                    ;FOR OUTPUT, REPLACE .OPENI
        .OPENI  #LNKBLK,RØ          ; WITH .OPENO
                                    ;ADDRESS OF FILBLK IS IN RØ
    -->.READ    #LNKBLK,#BUFHDR     ;FOR OUTPUT, REPLACE .READ
                                    ; WITH .WRITE
        .WRITE  #LNKBLK             ;COULD BE REPLACED BY .WAITR
                :
        (Process Data)
    No      End
          Of Data
            ?
           Yes
        .CLOSE  #LNKBLK
        .RLSE   #LNKBLK

    LNKBLK:         (entries)
    FILBLK:         (entries)       Tables in User's Program
    BUFHDR:         (entries)
```

Figure 3-1b Sequence of Requests for READ/WRITE

Figure 3-1 .READ/.WRITE Input/Output Transfers

When using READ or WRITE one can specify nine different modes of transfer, in two categories: ASCII and Binary. Details are presented in Section 3.6.1 and Figure 3-11.

ASCII Modes:	Formatted ASCII Parity - Special
	Formatted ASCII Parity - Normal
	Formatted ASCII Nonparity - Special
	Formatted ASCII Nonparity - Normal
	Unformatted ASCII Parity - Normal
	Unformatted ASCII Nonparity - Normal
Binary Modes:	Formatted Binary - Special
	Formatted Binary - Normal
	Unformatted Binary - Normal

To implement a READ or WRITE transfer, the programmer follows the sequence of requests shown in Figure 3-1b. First, the programmer associates the device with the dataset via the .INIT request. The argument of this request is the address of a table called the Link Block. Entries in this table specify the device involved in the approaching transfer so that the Monitor may eventually establish a link between that device and the dataset. The Link Block is described in detail in Figure 3-6. The .INIT request loads the appropriate device driver into the Monitor's free core area, if it is not already there.

Following the .INIT request, the programmer opens a dataset with an .OPENx request. This need be done only if the device being used is a file-structured device. However, it is advisable to use an .OPENx even for a non-file-structured device to preserve the device independence of the program, since it may be desirable to assign the transfer to a file-structured device later. The arguments of this request are the address of the Link Block and a register into which the user has moved the address of a table called the Filename Block (Figure 3-7). Entries in this table describe the file involved in the transfer.

A dataset can be opened for input, for output, for update, or for extension. The last letter of the .OPENx request specifies which type of open is desired.

A .READ (for input) or a .WRITE (for output) follows the .OPENx. Either request causes a transfer to take place between the line buffer and the device via a buffer allocated by the Monitor in its free core area. The arguments of either request are the address

of the Link Block for the dataset and the address of the Line Buffer Header (Figure 3.9). The Line Buffer Header specifies the area in the user's core area to or from which the data is to be transferred. During the transfer, the Monitor formats the data according to the transfer mode and formatting characters in the data itself. In most modes, terminating characters indicate the end of a line.

.READ or .WRITE is followed by .WAIT, which tests for the completion of the last transfer, and passes control to the next instruction when the transfer is complete. Typically, what follows a .WAIT on an input is a subroutine to process the portion of data just read. When the process has been completed, the program checks to see if there is more data; if there is, the program transfers control back to the .READ request and the process is repeated. If all data has been transferred, the .CLOSE request follows to complete any pending action, update any directories affected, and release to free core any buffer space the Monitor has allocated from free core for this dataset. Finally, action on the dataset is formally terminated with the .RLSE request, which disassociates the device from the dataset, and releases the driver. Releasing the driver frees core provided there is no other claim to the driver from another dataset.

3.2.1.2 RECORD Level Requests - The Record Level request is used for random access to the records in a file. A program which uses Read or Write Level requests can only read or write the next record in the dataset being processed. When Record Level requests are used, the program always has access to any record in the file.

Record Level requests may be used only with file-structured devices and only with contiguous files (not with linked files). Each of the records in the file must contain the same numbers of bytes. No formatting is done and no line terminating characters are needed. The length of a record is independent of the block size of the device (may be the same or smaller or larger; neither record length nor block size need divide the other, but processing may be faster if this is arranged, since it can reduce the number of multi-block transfers).

Some consideration must be given to the manner in which a Record Level file is created. Perhaps the most common way to create such a file is by doing an .OPENC (after the file has been allocated) and using the .WRITE request to enter data. Unformatted ASCII and unformatted binary are the suggested transfer modes, since they do not require terminators and do not perform formatting; recall that all records must be the same length. When such a file is .CLOSED, a logical end-of-file is established following the last record written. Subsequent processing of the file by .READ or .RECRD will be confined to the area just written. At some later time, the file may be opened for extension (.OPENE) and more data can be written (.WRITE), provided the original space allocated to the file is sufficient to contain it. A second way to create a Record Level file is to start with .OPENU (again the file must have been allocated previously) and to use .RECRD to do the writing. In this mode, the logical end-of-file corresponds to the end of the allocated area). Note also that, unless the program writes in every record of the file, that some records will be left with meaningless contents.

Before issuing Record Level requests, the program must issue an .INIT request to associate the dataset with a file-structured device. It must then open the dataset; .OPEN is not optional as with .READ and .WRITE. The dataset may be opened in two ways:

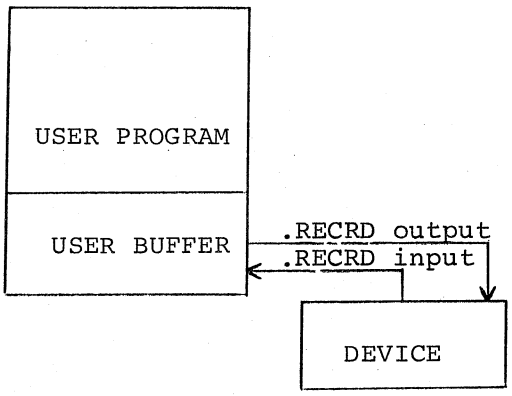


Figure 3-2a The Transfer Path

```
                    .INIT   #LNKBLK             ;INIT THE DATASET
                    MOV     #FILBLK,R1
                    .OPENU  #LNKBLK,R1          ;OPEN THE FILE
Request next    ->  .RECRD  #LNKBLK,#RECBLK     ;INPUT THE RECORD
record for          .WAIT   #LNKBLK
update if           (Process Data)
more
                    .RECRD  #LNKBLK,#RECBLK     ;OUTPUT THE RECORD
                    .WAIT   #LNKBLK
                  Yes  More ?
                       No
                    .CLOSE  #LNKBLK             ;CLOSE THE FILE
                    .RLSE   #LNKBLK             ;RELEASE THE DATASET

LNKBLK:
FILBLK:   }  Tables in User Program
RECBLK:
```

Figure 3-2b Sequence of Requests for .RECRD

Figure 3-2 .RECRD Input/Output Transfers.

- OPENU - This mode is used if the program will write in the dataset. Reading is also permitted. In fact, quite often the program will read a record, update it, and write it back.
- OPENI - This mode is used if no writing will be done. Only reading will be permitted.

The dataset may then be processed using .RECRD requests. If updating is being done, there will generally be two such requests in each cycle. Otherwise, there will be only one. Each .RECRD request should be followed by a .WAIT (or .WAITR) request. When processing is completed, a .CLOSE request should be issued to ensure that the last record is actually written to the device (for output) and that the directory is updated (if necessary). A .RLSE request is also required, so that the driver can be removed from core (if not still in use by another dataset). The .RECRD request has a Link Block and a Record Block as arguments. The Record Block specifies function (input/output), buffer address, record length, and record number (see Figure 3-12).

3.2.1.3. BLOCK Level Requests - The Block Level request is used for random access to the physical blocks in a file. The Block Level is similar to the Record Level. However, at the Block Level, each request always reads or writes exactly one physical block of data instead of a user-defined quantity of data, as is true at the Record Level. In addition, data transfer is to and from a buffer provided by the monitor, rather than a buffer provided by the user. The user may do his processing in the monitor buffer or he may transfer data to his own area. As with Record Level requests, Block Level requests may be used only with file-structured devices and only with linked files (not with contiguous files).

To implement a BLOCK transfer, the programmer follows the sequence of requests shown in Figure 3-3b. Notice that the transfer must use .INIT, .OPEN, .WAIT, .CLOSE and .RLSE following the same rules as the READ or WRITE level. The .BLOCK request has the address of the Link Block and the BLOCK block for its arguments.

The BLOCK block specifies the function (INPUT, GET, or OUTPUT), the relative number of the block being transferred to or from, the Monitor buffer address (supplied by the Monitor), and the length of the Monitor buffer (supplied by the Monitor). See section 3.6.8.

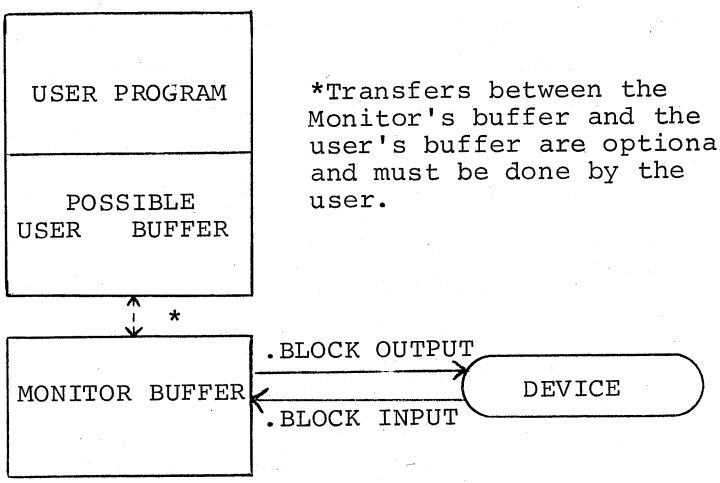
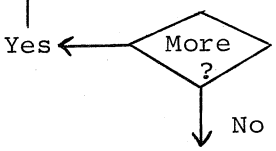


Figure 3-3a The Transfer Path

```
        .INIT   #LNKBLK
        MOV     #FILBLK,R1
        .OPENU  #LNKBLK,R1
        .BLOCK  #LNKBLK,#BLKBLK      ;INPUT DESIRED BLOCK
        .WAIT   #LNKBLK              ;COULD BE REPLACED BY .WAITR

        (Process Data)               ;UPDATE DATA

        .BLOCK  #LNKBLK,#BLKBLK      ;WRITE UPDATED BLOCK
        .WAIT   #LNKBLK
```




```
        .CLOSE  #LNKBLK
        .RLSE   #LNKBLK
        LNKBLK:         (entries)
        FILBLK:         (entries)
        BLKBLK:         (entries)
```

Figure 3-3b The Sequence of Requests For .BLOCK

Figure 3-3 .BLOCK Input/Output Transfers

3.2.1.4 TRAN Level Requests - A TRAN level request is a basic input/output operation. No services are provided for the user other than to pass his request to the appropriate driver. .TRAN ignores any file-structure on the device. .TRAN does not operate within a particular file as do .READ, .WRITE, .RECRD, and .BLOCK; hence no .OPEN or .CLOSE is used. Because .TRAN does not respect file structures, the user is strongly cautioned against using it with file-structured devices, since he can easily do irreparable damage to information on such a device. Omitting the dataset name from the Link Block will prevent a file-structured device from being assigned.

Data is transferred directly between the device and a buffer provided by the user (Figure 3-4a), with no formatting performed.

.TRAN is generally used in 2 situations:

1. When the file structure does not allow the desired operation (e.g., PIP uses .TRAN to read a directory block for the directory listing operation).
2. When one does not need or cannot afford the overhead of doing READ/WRITE processing on a non-file structured device (e.g, a program to read data arriving at random intervals from an A/D converter might use .TRAN to read the data and .BLOCK to buffer the data on a disk for processing as time permits.

To implement a TRAN transfer, the programmer follows the sequence of requests shown in Figure 3-4b. Notice that the transfer must use .INIT and .RLSE, but must not use .OPEN or .CLOSE. The .TRAN request has the address of the TRAN Control Block (TRNBLK) as its argument. This block contains entries which specify the core starting address of the user's buffer, the device block address, the number of words to be transferred, and the function to be performed. TRAN is therefore a device dependent request.

Table 3-2

Transfer Levels for Types of Datasets

Type of Transfer	Type of Data: Linked File	Contiguous File	Nonfile-Structured Device
READ/WRITE	Yes	Yes	Yes
RECORD	No	Yes	No
BLOCK	No	Yes	No
TRAN	*	*	Yes

* indicates that TRAN may be used on a file-structured device if the warnings mentioned are observed. Usage in these cases is not advised.

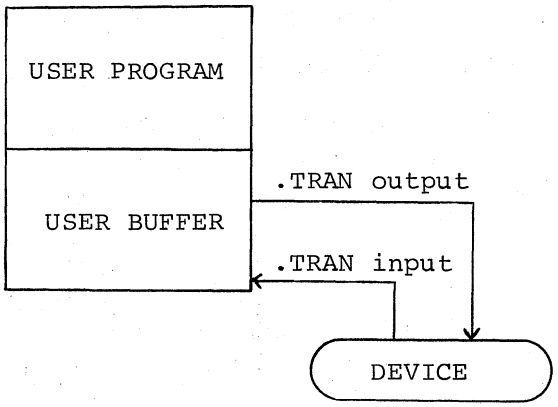


Figure 3-4a The Transfer Path

```
          .INIT #LNKBLK

          .TRAN #LNKBLK,#TRNBLK
          .WAIT #LNKBLK                ;COULD BE REPLACED BY .WAITR
           (Process Data)
Yes <-    More ?
          No
          .RLSE #LNKBLK
          LNKBLK:        (entries)
                                       Tables and parameters
          TRNBLK:        (entries)     in User Program
```

Figure 3-4b The Sequence of Requests For .TRAN

Figure 3-4 .TRAN Input/Output Transfers

3.2.2 Requests for Directory Management Services

Directory management requests are used to enter filenames into directories, search for files, update filenames, and protect files against deletion.

Each directory management request is described in Section 3.7.

3.2.3 Requests for Miscellaneous Services

Requests for miscellaneous services include:

- Requests to Load programs and overlays.
- Requests to return control from a running program to the Monitor.
- Requests to set Monitor parameters such as the TRAP vector or a program's restart address.
- Requests to obtain Monitor parameters such as the size of the Monitor, the date, the time, and the current user's UIC.
- Requests to perform conversions between ASCII and Radix-50 packed ASCII, binary and ASCII decimal, and binary and ASCII octal.
- Requests to access the Command String Interpreter.

Each miscellaneous service request is described in Section 3.8.

3.3 DEVICE INDEPENDENCE

It is generally preferable to write programs so that each dataset may be associated with the widest possible variety of devices. This makes it easier to move a program from one configuration to another. It also makes it possible to use the program with a variety of different media. For example, the Assembler accepts input from disk, paper tape, DECtape, and other devices.

The monitor makes it relatively easy to achieve this objective. Most I/O operations are completely device independent (i.e., no special actions by the user are required to accommodate the operation to the device, specifically .READ, .WRITE, .OPEN, .CLOSE, .WAIT, .WAITR, .INIT, and .RLSE. In addition, .RECRD and .BLOCK require only that the device be file structured. Only .TRAN and .SPEC are typically device dependent.

In all cases, no device is associated with a dataset until an .INIT request is made. The device name may be specified in any of the following ways:

- the programmer may specify the name in his Link Block;
- the program can obtain a device name by requesting the user to enter a command string (section 3.8.6);this will override any device specified in the Link Block;

- the user can use the ASSIGN command (see Chapter 2) to associate a device (and file name) with the dataset, this option overrides both preceding options.

Note that when a command string is solicited by the program, it will always override the link block specification, no matter what is entered. However, when ASSIGN is not solicited but is entered at the operator's discretion, it will override the Link Block only when specified. In the latter case, it is best to supply a default in the Link Block.

Note that the substituted devices must be compatible. For example, the user may initially specify a BLOCK transfer from disk and later change the assignment to input from DECtape instead. But, he cannot later specify a paper tape reader as the input device, since BLOCK level requests do not apply to nonfile-structured devices.

It is important to note that a device is assigned in a program to a dataset logical name and that reassigning a device at run time for one dataset logical name does not reassign that device for all dataset logical names to which it was originally assigned.

The only transfer requests which are not device independent are .TRAN and .SPEC.

3.4 SWAPPING ROUTINES INTO CORE

Except for a small, permanently resident portion, the Monitor routines which process most programmed requests are potentially swappable. They are normally disk resident and are swapped into core by the Monitor only when needed. The user may, however, specify that one or more of these potentially swappable routines be made permanently core resident or core resident only for the duration of his program's run.

Making a potentially swappable routine core resident ties up core space, but speeds up operation on the associated request. The user may, for example, be collecting data via a .TRAN request in a real-time environment. In such a case, even the short time needed to swap in the .TRAN request processor could cause him to lose data.

Any routine which services a programmed request (other than .READ or .WRITE) may be made core resident by one of the following methods:

- Routines may be made permanently core resident at Monitor Generation time (see the DOS System Manager's Guide).

- Routines may be made core resident for the duration of a program's run by declaring the appropriate global name (as specified in the definition of each request in Sections 3.6 through 3.8) in a .GLOBL assembler directive in the user program. For example, to make the .TRAN processor resident while program FROP is being run, the following directive would be included in program FROP:

```
.GLOBL TRA
```

Device drivers are swapped into the Monitor's free core area on an .INIT call and are freed from core on the occurrence of a .RLSE, provided no other dataset is INITed to that device.

3.5 MONITOR RESTRICTIONS ON THE PROGRAMMER

In return for the services provided by the Monitor, the programmer must honor certain restrictions:

- The programmer should not use either the EMT or the IOT instructions for communication within his program.
- It is recommended that the user not raise his interrupt priority level above 3, since it might lock out a device that is currently trying to do input/output.
- HALTS are not recommended. If a HALT is executed during an I/O operation, most devices will stop, and only recovery from the console (pressing the CONTinue switch on the console) will be effective (recovery from the keyboard will not be immediately possible, since a HALT inhibits the keyboard interrupt). Some devices, such as DECtape, will not see the HALT and will continue moving, will lose their positions over the block under transfer, and may even run the tape off the reel.
- The RESET instruction should not be used because it forces a hardware reset; clearing all buffer registers, and status flags and disabling all interrupts, including keyboard interrupts. Since all I/O is interrupt driven, RESET will disable the system.
- The user must not penetrate the Monitor when he is using the stack. The stack is set by the RUN time loader just below the lowest address of the program loaded. The Monitor checks to see that the stack is not overflowing each time it honors a request.
- The user may allocate temporary storage areas on the stack by simply subtracting the size of the area needed from the current stack pointer value. When doing so, he should use a .MONF (Section 3.8.4.3) to determine the highest address being used by the Monitor. It is generally wise to leave some space for future Monitor expansion (as a consequence of programmed requests) and for stack extension (as a consequence of subroutine calls, Monitor requests, device interrupts, etc.). Consult Figure 3-5 for more information about monitor core usage.

- The user should be aware that certain requests, such as .INIT, may change the amount of available free core, since the instructions may call in drivers and establish data blocks. Such requests affect the result of MONF requests.
- Certain requests return data to the user on the stack. The user must clear the stack himself before the stack is used again. The Monitor clears the stack after it honors requests that do not return data to the user on the stack.
- The user should not use global names that are listed in Appendix E.
- The Link pointer in the Link Block is set by the Monitor and must not be altered by the user.

.INIT

3.6 REQUEST FOR INPUT/OUTPUT SERVICES

3.6.1 .INIT - Associate a dataset with a device driver and set up the initial linkage.

Macro Call: .INIT #LNKBLK
where LNKBLK is the address of the Link Block.

Assembly Language Expansion:

```
MOV #LNKBLK,-(SP)
EMT 6
```

Global Name: INR

Description: Assigns a device to a dataset and assures that the appropriate driver exists and is in core. If the driver is not in core, it is loaded. The device assigned is that specified in the associated Link Block, unless assignment has been made to the logical name specified in the Link Block with the ASSIGN command or via the Command String Interpreter. After the .INIT has been completed, control is returned to the user at the instruction following the assembly language expansion. The argument is removed from the stack.

Rules: The user must set up within his program a Link Block of the format explained in section 3.9.1 for each dataset to be INITed. A dataset which has been .INITed should be .RLSEd prior to any further .INIT request for any Link Block.

Errors: A nonfatal error message, A003, is printed on the teleprinter if no assignment has been made through the ASSIGN command, and the DEFAULT DEVICE is either not specified in the Link Block or has been specified illegally (i.e., no such device on the system). The user may type in an assignment (ASSIGN) and give the CONTINUE console command to resume operation.

Control is transferred to the address specified by the error return address in the Link Block if at any time during an operation there is not enough space in free core for the necessary drivers, buffers, or tables. If no address (i.e., a zero) is specified in the Link Block's ERROR RETURN ADDRESS, a fatal (F007) error is printed and the program stops.

Example: (see .RLSE).

3.6.2 .RLSE - Remove the linkage between a device driver and a dataset and release the driver.

Macro Call: .RLSE #LNKBLK
where LNKBLK is the address of the Link Block previously INITed.

Assembly Language Expansion:

```
MOV #LNKBLK,-(SP)
EMT 7
```

Global Name: RLS

Description: Dissociates the device from the dataset and releases the dataset's claim to the driver. Releasing the driver frees core provided no other dataset has claimed the driver, and provided that the driver is not permanently core resident.

Rules: The device to be released must have been previously INITed to the dataset.

If the dataset has been OPENed on a directory device, it must be CLOSEd before the device is released. On a nondirectory device, a .RLSE will ensure that any data remaining in the Monitor buffer for output is dispatched to the device and will return any buffer still associated with the dataset to free core.

After the release has been completed, control is returned to the user at the instruction following the assembly language expansion; the argument is removed from the stack.

Errors: If the dataset has been OPENed to a file-structured device, a .RLSE not preceded by a .CLOSE will be treated as a fatal error, F005. A .RLSE error (F005) may also occur if the link pointer in the Link Block is invalid, indicating probable corruption of the Monitor or its control blocks.

Example:

```
            .
            .
            .
        .INIT   #LNK1     ;ASSOCIATE A DATASET WITH A DEVICE
            .
            .
            .
        .RLSE   #LNK1
            .
            .
            .
        .WORD   ERR1      ;ERROR RETURN ADDRESS
LNK1:   .WORD   0         ;POINTER FOR MONITOR
        .RAD50  /DSI/     ;LOGICAL NAME OF DATASET
        .BYTE   1,0       ;DEVICE SPECIFIED, UNIT
        .RAD50  /KB/      ;SPECIFY KEYBOARD
            .
            .
            .
ERR1:                     ;ERROR PROCESSING LOGIC
```

.OPEN

3.6.3 .OPEN - Prepare a device (which has been .INITed) for data transfer and associate the dataset with a file (if the device is file-structured).

Macro Call: .OPEN #LNKBLK,#FILBLK

This form assumes that the File Block contains a code indicating how the file is to be opened (see Description below).

Assembly Language Expansion:

```
MOV #FILBLK,-(SP)
MOV #LNKBLK,-(SP)
EMT 16
```

Alternate Form of Macro Call:

```
.OPENx #LNKBLK,Rn
```

where Rn is a register containing the address of the File Block and x indicates the type of .OPEN (see Description below).

Assembly Language Expansion:

```
MOVB #CODE,-2(Rn)       (see Description below)
MOV  Rn,-(SP)
MOV  #LNKBLK,-(SP)
EMT  16
```

Global Name: OPN (See Appendix C for subsidiary routines.)

Description: When used, .OPEN follows .INIT or .CLOSE (if more than one file is to be opened on the same dataset). When the device being used is file-structured, .OPEN associates a specific file with the dataset. .OPEN also acquires a data buffer and prepares the device or the file for the ensuing data transfers. See Appendix C for details about specific .OPEN actions for particular devices. .OPEN has five forms; the desired form may be specified by inserting the proper HOW OPEN code in the File Block (see Figure 3-7) or by selecting one of the alternate forms of the Macro Call. The different .OPEN forms are described below:

Form	HOW OPEN Code	Description
.OPENU	1	opens a previously created contiguous file for input and output by .RECRD or .BLOCK request; .OPENU is rejected if the device is not file-structured.
.OPENO	2	a. creates a new linked file and prepares it for output via .WRITE; the file must not already exist. b. prepares a nonfile-structured device for output via .WRITE (see Appendix C).

Form	HOW OPEN Code	Description
.OPENE	3	opens a previously created linked or contiguous file to make it longer via .WRITE; note that a contiguous file may only be extended within the area already allocated; although additional blocks may be added to a linked file, no additional blocks may be added to a contiguous file (see .CLOSE); .OPENE is treated like .OPENO if the device is not file-structured.
.OPENI	4	a. opens a previously created linked or contiguous file for input via .READ, .RECRD, or .BLOCK. b. prepares a nonfile-structured device for input via .READ (see Appendix C).
.OPENC	13	opens a previously created contiguous file for output via .WRITE; when a contiguous file is first opened for writing (via .WRITE), .OPENC must be used; subsequent opens for output (via .WRITE) must be .OPENE's; .OPENC is treated like .OPENO if the device is not file-structured.

At this point, the user should note the difference between linked files and contiguous files. A linked file has records allocated to it one at a time, as they are needed. Each record in the file contains a pointer to its successor, the User File Directory (UFD) points to the first record. Because records are allocated as needed, the user need not concern himself at all with the size of the file nor with the allocation of any records. Furthermore, a linked file can easily be extended in the future. However, because records are scattered about on the disk and because the system must read all intermediate records to move from one record to another (forward only), linked files can only be used for sequential processing (.READ or .WRITE).

A contiguous file has all of its records allocated at once in a contiguous area of the disk which is reserved for the file. Since any record in the file can easily be located relative to the first record in the file, random (or direct) access (.RECRD or .BLOCK) is possible in addition to sequential access. However, it is now necessary to know in advance how much space will be needed, since no more space can be added later. Since this may be difficult, one often has to guess and space is often wasted. Note, however, that a contiguous file can be extended within the space already allocated, i.e., if the area was not filled when the file was first written (or extended), more data can be added. Because the user is responsible for determining the size of a contiguous file, he is required to allocate it before opening it (compare .OPENC and .OPENO). This may be done with PIP, using the ALLOCATE command or with the .ALLOC programmed request.

After the open request has been processed, control is returned to the user at the instruction following the assembly language expansion; the arguments are removed from the stack. At this time, however, the device concerned may still be completing operations required by the request. A summary of transfer requests which may legally follow .OPEN requests is illustrated in Table 3-3.

Table 3-3
Transfer Requests Which May Follow Open Requests

Type of File / Type of Transfer / Transfer Request	Linked File		Contiguous File				
	Input	Output	Input		Output		
Type of Open	.READ	.WRITE	.READ	.RECRD .BLOCK	.WRITE	.RECRD .BLOCK	File Already Exist ?
.OPENU				Yes		Yes	Must
.OPENO		Yes					Must Not
.OPENE		Yes					Must
.OPENI	Yes		Yes	Yes			Must
.OPENC					Yes		Must

Rules: a. General Rules for All .OPENx Requests - The user must set up a Filename Block in his program (see Figure 3-7). If the dataset is a file, the Filename Block must contain a legal filename (see Section 2.3). If the dataset is not a file, or if it will be specified by an .ASsign or via the Command String Interpreter, the Filename Block need not contain any FILENAME or EXTENSION entries.

All datasets must have been INITed before they are OPENed. The .OPEN must be applicable to the type of device (e.g., .OPENI to the line printer is illegal).

For datasets on directory devices, the User Identification Code (UIC) in the Filename Block (if specified) must be in the directory of the device. If the UIC is not specified, the user must have logged in with a UIC that appears on the device.

The .OPENx request must not violate the protect code of the file.

If a dataset is opened for any output, it cannot be opened again until it has been closed.

b. Rules for .OPENO - The .OPENO request is applicable only for outputs to nonfile-structured devices or to a linked file on a file-structured device. It is not applicable to contiguous files.

The .OPENO request creates a linked file on a directory device; hence, the file referenced in the corresponding Filename Block cannot exist prior to the .OPENO request.

The .OPENO request will return an error if the disk is full.

c. Rules for .OPENI - .OPENI may be used for inputs from contiguous or linked files, or nondirectory devices.

The file referenced in the corresponding Filename Block must exist in the directory.

If a file is open for input (.OPENI), it cannot be opened for output, but it may be opened for extension or update.

At any one time, a file can be opened for input to a maximum of 62_{10} or 76_{8} datasets.

d. Rules for .OPENU, OPENE, and .OPENC - The file must exist and cannot currently be opened for output.

The file cannot currently be opened by another .OPENU, .OPENE, or .OPENC.

A contiguous file can be opened for extension, provided that the area already allocated to the file does not need to be enlarged, which is not possible.

A linked file cannot be opened with .OPENC, which is applicable only to contiguous files.

Errors: If any of the preceding rules are violated, the Monitor places an error code in the STATUS byte of the Filename Block (see Table 3-7) and transfers control via the pointer in the ERROR RETURN ADDRESS of the Filename Block. If this address is 0, a fatal error message is printed on the teleprinter. Fatal error messages are listed in Appendix F.

Example: (See .CLOSE)

.CLOSE

3.6.4 .CLOSE - Close a dataset.

Macro Call: .CLOSE #LNKBLK
where LNKBLK is the address of the Link Block (see Figure 3-7).

Assembly Language Expansion:

```
MOV #LNKBLK,-(SP)
EMT 17
```

Global Name: CLS (See Appendix C for subsidiary routines.)

Description: The .CLOSE request indicates to the Monitor that no more I/O requests will be made on the dataset. .CLOSE completes any outstanding processing on the dataset (e.g., on output, it writes the last buffer; on extension, it links the extension to the old file; etc.), updates any directories affected by the processing, and releases to free core any buffer space established for the processing. When a file which has been opened for output is closed, the last block written and the last byte written are recorded in the directory to indicate end-of-data. This eliminates the need to pad out blocks with nulls and allows the written data within a contiguous file to be extended at a later time.

After the .CLOSE request has been completed, control is returned to the user at the instruction following the assembly language expansion; the argument is removed from the stack. As with .OPEN, some appropriate device action may still be in progress at this point (see Appendix C).

Rules: The dataset to be closed must have previously been opened if it was a file on a file-structured device.

As with .OPENx, a .CLOSE is not required if the dataset is not a file, but it is strongly recommended in order to maintain device independence.

Errors: Dataset Not Inited - Fatal Error F000;
Device Parity Error - Fatal Error F017
All error messages are explained in Appendix F.

Example: Open for input a dataset named IMP, which is file PROG1.BIN on DECtape unit 3. After the data transfer is complete, close the file.

```
            .INIT #SET1
               :
            .OPEN  #SET1,#FILE1   ;OPEN SET1 FOR INPUT (OPEN CODE
               :                  ;IS IN FILE BLOCK)
            (Input is
             Performed
             Here)
               :
            .CLOSE #SET1          ;CLOSE SET1
               :
            .RLSE  #SET1
               :
            .WORD  ERR1
SET1:       .WORD  0
            .RAD50 /IMP/          ;DATASET NAME
            .BYTE  1,3
            .RAD50 /DT/           ;PHYSICAL DEVICE NAME
               :
            .WORD  ERF1           ;ADDR OF ERROR RTN
            .WORD  4              ;OPEN FOR INPUT
FILE1:      .RAD50 /PRO/          ;FILENAME
            .RAD50 /G1/
            .RAD50 /BIN           ;EXTENSION
            .BYTE   PROG,PROJ
            .BYTE   177
            .EVEN
               :
ERR1:                             ;HERE FOR .INIT, .OPENI, .CLOSE,
                                  ;OR .RLSE ERRORS (DEVICE)
               :
ERF1:                             ;HERE FOR .OPENI ERRORS
                                  ;(DATA FILE)
               :
```

3.6.5 .READ - Read the next record in the dataset.

Macro Call: .READ #LNKBLK,#BUFHDR
where LNKBLK is the address of the Link Block, and BUFHDR is the address of the line buffer header.

Assembly Language Expansion:

```
MOV #BUFHDR,-(SP)
MOV #LNKBLK,-(SP)
EMT 4
```

Global Name: RWN (Routine is permanently core resident).

Description: The .READ request transfers the data from the device to the user's line buffer as specified in the line buffer header. The transfer is done via a buffer in the Monitor, into which an entire device block is read, and from which the desired data is transferred to the user's line buffer. Each read causes the user to receive the next record in the data set. Block boundaries are ignored and new blocks are read as needed. After any I/O transfer has been started, control is returned to the user at the next instruction, with the arguments removed from the stack.

Refer to Section 3.9.3.2 for more details on transfer modes.

Rules: If the device is file structured, the .READ request must be preceded by an .OPENI. The user must provide in his program a line buffer and line buffer header (see Figure 3-9). Further actions on the dataset by the Monitor will be automatically postponed until the .READ processing has completed. The user program should, however, perform a .WAIT or .WAITR to ensure proper completion of transfer before attempting to use the data in the line buffer. Otherwise, he might find that he is processing before the data he wants has arrived.

Errors: Specification of a transfer mode which is inappropriate for the device assigned to the dataset, attempting to .READ from or .WRITE to a file-structured device for which no file has been .OPENed or for which the type of .OPEN is incorrect will be treated as fatal errors and will result in a F010 message.

Note: A dataset can only support transfers in one direction at one time, i.e., READ only or WRITE only. If the same device is to be used for both operations, spearate datasets must be used for each.

3.6.6 .WRITE - Write the next record in the dataset.

Macro Call: .WRITE #LNKBLK,#BUFHDR
where LNKBLK is the address of the Link Block, and BUFHDR is the address of the line buffer header.

Assembly Language Expansion:

```
MOV #BUFHDR,-(SP)
MOV #LNKBLK,-(SP)
EMT 2
```

Global Name: RWN (Routine is permanently core resident).

Description: The .WRITE request initiates the transfer of data from the user's line buffer to the device assigned. The data is first transferred to a buffer in the Monitor, where it is accumulated until a buffer of suitable length for the device is filled.[1] The data in the Monitor buffer is then transferred to the next device block, and any data remaining in the user's line buffer is moved to the (now emptied) Monitor buffer. After any I/O transfer to the device has been started, control is returned to the user at the next sequential instruction. The arguments are removed from the stack upon return.

Refer to Section 3.9.3.2 for more details on transfer modes and the like.

Rules: If the requested device is file structured, the dataset must have been opened by an .OPENO or .OPENE for a linked file, or .OPENC for a contiguous file. The user must provide a line buffer and its header in his program (Figure 3-9).

Further actions on the dataset by the Monitor after .WRITE will be automatically postponed until the .WRITE processing has been completed. Before refilling the line buffer, however, the user program should perform a .WAIT or .WAITR to ensure proper completion of the transfer. Otherwise, it might store new data on top of data which has not yet been written.

Errors: See .READ for errors.

[1]For terminal devices, data transfer also occurs when a line terminator is seen (see Section 3.9.3.2).

.RECRD

3.6.7 .RECRD - Read or write a specific record in a file.

Macro Call: .RECRD #LNKBLK,#RECBLK
where LNKBLK is the address of the Link Block, and RECBLK is the address of the Record Block (see Figure 3-12).

Assembly Language Expansion:

```
MOV #RECBLK,-(SP)
MOV #LNKBLK,-(SP)
EMT 25
```

Global Name: REC

Description: The .RECRD request causes a specific record to be transferred to (or from) the user's record buffer. Each record in the file may be individually addressed, and the user is not restricted to reading or writing the next record. Data transfer is by way of a buffer in the Monitor which will contain exactly one physical block of information. There is no rule concerning the relative sizes of records and blocks; however, efficiency may be improved if one is a multiple of the other. The Record Block specifies record number (starting at Ø), buffer address and length, and transfer direction (read or write). .RECRD requests require the use of the .INIT, .RLSE, .OPEN, .CLOSE, and .WAIT (or .WAITR) requests. After the transfer has started, control is returned to the user at the instruction following the assembly language expansion with arguments removed from the stack.

Rules: The requested device must be file-structured and the file must be contiguous.

The user must set up a Record Block in his program and must provide a buffer.

All records must have the same length.

The user should perform a .WAIT or .WAITR to ensure that processing has completed.

The associated file must have been opened with .OPENU or .OPENI.

Errors: An error causes a return to the user with the type of error indicated in the FUNCTION/STATUS word of the RECORD BLOCK. The user should perform the following test after his request to ensure that the request completed normally.

```
TSTB  RECBLK+1
BNE   ERROR
```

3.6.8 .BLOCK - Read or write a specific block in a file.

Macro Call: .BLOCK #LNKBLK,#BLKBLK
where LNKBLK is the address of the Link Block, and BLKBLK is the address of the BLOCK block (see Figure 3-13).

Assembly Language Expansion:

```
MOV #BLKBLK,-(SP)
MOV #LNKBLK,-(SP)
EMT 11
```

Global Name: BLO

Description: BLOCK requests provide for random access to the blocks of files stored on disk or DECtape.

In this mode, data is transmitted to or from a specified block in a file with no formatting performed. Transfers take place between the device block and a Monitor buffer. The user may process the data in the Monitor buffer or he may transfer the block to and from his own area. BLOCK requests require the use or the .INIT, .OPEN, .CLOSE and .WAIT (or .WAITR) requests.

The user must specify one of three functions in the BLOCK block: INPUT, GET, or OUTPUT (see Figure 3-13). After the transfer has started, control is returned to the user at the instruction following the assembly language expansion with arguments removed from the stack.

INPUT: During an INPUT request, the requested block of the requested file is read into a Monitor buffer, and the user is given in the BLOCK block (see Figure 3-11) the address of the buffer and the physical length of the block transferred.

GET: During a GET request, the Monitor returns in the BLOCK Block the address and length of a buffer within the Monitor that he can fill for subsequent output. Only one GET is required for each time the file is OPENed and CLOSEd (i.e., once a buffer has been located, it may be used repeatedly). The user must assure that he does not over-run the buffer. This request is unnecessary if an INPUT request has occurred.

OUTPUT: During an OUTPUT request, the contents of the buffer assigned is written on the device in the requested relative position in the requested file.

Rules: The associated file must be opened by .OPENI for input or .OPENU for input or output.

Access to linked files or nondirectory devices is illegal.

The user must set up the BLOCK block in his program according to the format of Figure 3-13.

Errors: Error processing causes a normal return to the user, with the type of error indicated in the FUNCTION/STATUS word of the BLOCK block. The user should perform

```
TSTB BLKBLK+1
BNE ERROR
```

after a .WAIT to assure that his request was error free.

3.6.9 .TRAN - Read or write the specified block (file-structured device) or the next block (non-file-structured device).

Macro Call: .TRAN #LNKBLK,#TRNBLK
where LNKBLK is the address of the Link Block, and TRNBLK is the address of the TRAN block (see Figure 3-14).

Assembly Language Expansion:

```
MOV #TRNBLK,-(SP)
MOV #LNKBLK,-(SP)
EMT 10
```

Global Name: TRA

Description: .TRAN provides nearly direct access to the device on which the dataset resides. No file processing is done and any file structure is ignored. Therefore, writing with .TRAN on a file-structured device is especially risky and many lead to the corruption of all data on the device. If .BLOCK request can be used instead of .TRAN, it is recommended. Each .TRAN will transfer one or more blocks, depending upon the word count in the TRAN Block. Blocks on file-structured devices are referenced by absolute block number, while blocks on non-file-structured devices are processed in sequence. .INIT, .RLSE and .WAIT (or .WAITR) must be used. .OPEN and .CLOSE must not. After the transfer has started, control is returned to the user at the instruction following the assembly language expansion. The arguments are removed from the stack.

Rules: .TRAN must be preceded by an .INIT request on the associated dataset. .OPEN must not be used. For each .TRAN request, the user must provide a transfer control block, as shown in Figure 3-12. Further actions on the dataset by the Monitor will be automatically postponed until the .TRAN processing has been completed. The user program should perform a .WAIT or .WAITR to ensure proper completion of the transfer before attempting to reference any location in the data buffer.

Errors: An invalid function code in the transfer control block will result in an error diagnostic message on the teleprinter at run time.

Errors in the transfer will be shown in the FUNCTION/STATUS word of the TRAN block; the last word of the block will be set to show how many data words have not been transferred.

Example: Transfer 200_8 words of data from DECtape unit 3, starting at block 100_8 to core starting at location BUFFER.

```
            .INIT #TAPE1
              .
              .
              .
            .TRAN #TAPE1, #BIN40
              .
              .
              .
            .RLSE #TAPE1
              .
              .
              .
            .WORD ERR1
TAPE1:      .WORD 0
            .RAD50 /TP1/
            .BYTE 1,3
            .RAD50 /DT/
              .
              .
BIN40:      .WORD 100           ;STARTING BLOCK #
            .WORD BUFFER        ;STARTING ADDRESS IN CORE
            .WORD 200           ;NUMBER OF WORDS
            .WORD 4             ;INPUT
            .WORD 0             ;FOR MONITOR USE
              .
              .
              .
ERR1:                           ;ERROR ROUTINE FOR DECTAPE
              .
              .
              .
BUFFER:     .WORD 0
BUFEND:     .BLKW 200
              .
              .
              .
            .END
```

3.6.10 .WAIT - Wait for completion of process on dataset.

Macro Call: .WAIT #LNKBLK
where LNKBLK is the address of the Link Block (see Figure 3-6).

Assembly Language Expansion:

```
MOV #LNKBLK,-(SP)
EMT 1
```

Global Name: (Routine is embedded in the resident Monitor.)

Description: .WAIT tests for completion of the last requested action on the dataset represented by the referenced Link Block. If the action is complete (that is, if the request has completed all its action), control is returned to the user at the next sequential instruction following the assembly language expansion; otherwise, the Monitor retains control until the action is complete. A .WAIT or .WAITR should be used to ensure the integrity of data transferred to or from a line buffer. The argument is removed from the stack.

Rules: The dataset must be INITed.

Errors: If the dataset is not INITed, a fatal error occurs and F000 is printed on the teleprinter.

.WAITR

3.6.11 .WAITR - Check for completion of processing on dataset and return or transfer.

Macro Call: .WAITR #LNKBLK,#ADDR
where LNKBLK is the address of the Link Block, and ADDR is the address to which control is transferred if the processing is not complete.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
MOV #LNKBLK,-(SP)
EMT 0
```

Global Name: (Routine is imbedded in the resident Monitor.)

Description: .WAITR tests for completion of the last requested action on the specified dataset. If all actions are complete, control is returned to the user at the next sequential instruction following the assembly language expansion. If all actions are not complete, control is given to the instruction at location ADDR. The arguments are removed from the stack. It is the user's responsibility to return to the .WAITR to check again.

Rules: The user should use a .WAIT or a .WAITR request to assure the completion of data transfer to the user's line buffer before processing the data in the buffer, or moving data into it. The dataset must be INITed.

Errors: If the dataset is not INITed, a fatal error occurs and F000 is printed on the teleprinter.

3.6.12 .SPEC - Special functions.

Macro Call: .SPEC #LNKBLK,#SPCARG

where LNKBLK is the address of the Link Block, and SPCARG may be either a special function code or the address of a special function block containing the code (see Figure 3-15), depending upon the function.

Assembly Language Expansion:

```
MOV #SPCARG,-(SP)
MOV #LNKBLK,-(SP)
EMT 12
```

Global Name: SPC

Description: This request is used to specify a special function (action) to a device, such as rewind magnetic tape. A code identifies the function and must be in the range $0\text{-}255_{10}$. When the function requires no supporting data, the code itself is the first parameter to be placed upon the processor stack in the assembly language call sequence. However, if the user must supply additional information or if the function expects to return data to the user, the code is passed within a special function block and the address of the block is the call parameter. The format of this block is shown in Figure 3-15.

If a .SPEC request is made to a device which has no special function code, an immediate return is made showing that the function has been complete. After the request has been started, control is returned to the user at the instruction following the assembly language expansion. The stack is cleared.

Rules: The dataset must be INITed.

Errors: Fatal error F000 is returned if the dataset has not been INITed.

.STAT

3.6.13 .STAT - Obtain device status.

Macro Call: .STAT #LNKBLK

where LNKBLK is the address of the Link Block.

Assembly Language Expansion:

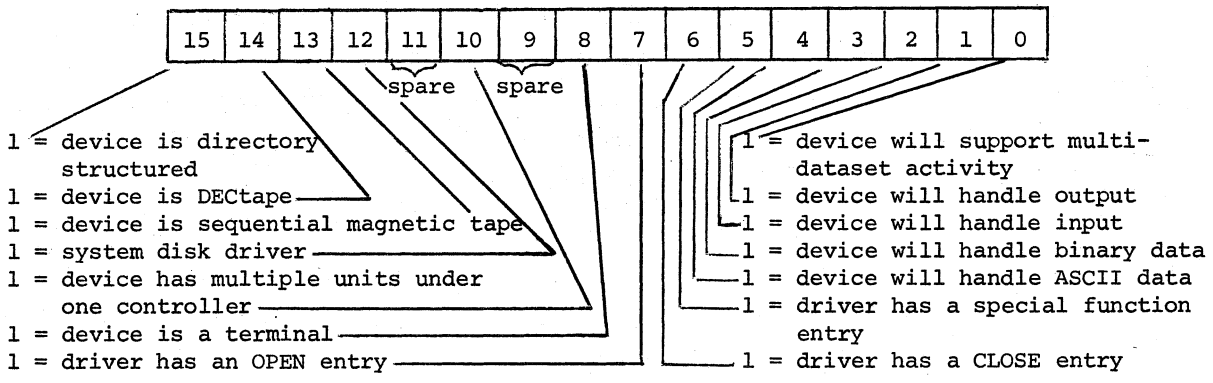
```
MOV #LNKBLK,-(SP)
EMT 13
```

Global Name: STT

Description: Determine for the user the characteristics of the device specified in the Link Block. After the request has been completed, control is returned to the user at the instruction following the assembly language expansion. This request returns to the user with the following information at the top of the stack.

SP	Driver Facilities Word
SP+2	Device Name (Packed Radix-50)
SP+4	Device Standard Buffer Size (in words)

where Driver Facilities Word has the following format;



Device Name is the Radix-50 packed ASCII standard mnemonic for the device (Appendix A); and, Device Standard Buffer Size is the block size (in words) on a blocked device or an appropriate grouping size on a character device.

Rules: The dataset must be INITed. The user must clear the stack upon return.

3.7 REQUESTS FOR DIRECTORY MANAGEMENT SERVICES

3.7.1 .ALLOC - Allocate (create a contiguous file).

Macro Call: .ALLOC #LNKBLK,#FILBLK,#N

where LNKBLK is the address of the Link Block, FILBLK is the address of the Filename Block, and N is the number of 64-word segments requested.

Assembly Language Expansion:

```
MOV #N,-(SP) or MOV #N+1ØØØØØ,-(SP)
MOV #FILBLK,-(SP)
MOV #LNKBLK,-(SP)
EMT 15
```

Global Name: ALO (See Appendix C for subsidiary routines.)

Description: Searches the device for a free area equal to N 64-word segments, and creates a contiguous file in the area if it is found, by making an appropriate entry in the User File Directory (UFD). If the sign bit (bit 15) of N is set, the UFD pointer will point to the beginning of the allocated area thereby indicating that the file is empty. This enables partial filling of the file space and later extension of the file. If the sign bit of N is not set, the UFD pointer will point to the end of the allocated area and thereby indicate that the file area is full and may not later be extended. (Linked files are created by an .OPENO request.) Search begins at the high end of the device. The number of blocks allocated will be the minimum number required to contain N segments, i.e.,

$$\left\lceil \frac{N}{B} \right\rceil$$

where B is the number of 64-word segments per block. For example, if N=9 and the device specified is DECtape, then $B=\frac{256}{64} = 4$. Therefore, $\frac{N}{B} = \frac{9}{4} = 3$, and 3 blocks will be allocated.

After the request has been completed, control is returned to the user at the instruction following the assembly language expansion. The arguments are removed from the stack, and the top word of the stack will be set to -1 to indicate the successful completion of the request, or to the largest number of segments currently available if this is less than the called request. The value will be meaningless if the call cannot be met by reason of any other error.

Rules: Must be preceded by an .INIT request on the dataset. A Filename Block must be set up by the user in his program.

Errors: Control is returned either to the ERROR RETURN ADDRESS in the Filename Block if it is specified, or to the teleprinter for an error message if it is not. Possible errors are shown below:

Error Condition	Error Code Returned To Filename Block	Error Message On Default
Device Not Ready	--	A002
Dataset Not INITed	--	F000
File Exists	2	F024
Directory Full	12	F024
UIC Not In Directory	13	F024
Illegal Filename	15	F024

If the error address in the Filename Block is taken, the top word of the stack is meaningless.

Example: Create a contiguous file of four 256_{10} word blocks on DECtape unit 4. Name the file FREQ.DAT.

```
                    .
                    .
                    .
                .ALLOC  #FRQ,#FREQIN,#20
                INC     @SP
                BNE     NOROOM
                    .
                    .
                    .
                .WORD   ERR1
FRQ:            .WORD   0
                .RAD50  /DTA/
                .BYTE   1,4
                .RAD50  /DT/
                    .
                    .
                    .
                .WORD   ERR2
                .WORD   0
FREQIN:         .RAD50  /FRE/
                .RAD50  /Q/
                .RAD50  /DAT/
                .WORD   UIC,PROT1
                    .
                    .
                    .
ERR1:                               ;TO HERE IF NO BUFFER AVAILABLE
                    .               ;FOR DRIVER
                    .
ERR2:                               ;TO HERE IF FILE STRUCTURED ERROR
                    .
                    .
                    .
NOROOM:                             ;TO HERE IF NOT ENOUGH CONTIGUOUS
                    .               ;BLOCKS ON DEVICE
                    .
                    .
```

3.7.2 .DELET - Delete a file.

Macro Call: .DELET #LNKBLK,#FILBLK
where LNKBLK is the address of the Link Block, and FILBLK is the address of the Filename Block.

Assembly Language Expansion:

```
MOV #FILBLK,-(SP)
MOV #LNKBLK,-(SP)
EMT 21
```

Global Name: DEL (See Appendix C for subsidiary routines.)

Description: Deletes from directory-oriented device the file named in the Filename Block. After the request has been completed, control is returned to the user at the instruction following the assembly language expansion. The arguments are removed from the stack.

Rules: .DELET operates on both contiguous and linked files. If the file has been OPENed, it must be CLOSEd before it is deleted.

Errors: Control is returned either to the ERROR RETURN ADDRESS in the Filename Block if it is specified, or to the teleprinter for an error message if it is not. Possible errors are shown below:

Error Condition	Error Code Returned To Filename Block	Error Message On Default
Device Not Ready	--	A002
Dataset Not INITed	--	F000
Nonexistent File	2	F024
Protect Code Violation	6	F024
File Is Open	14	F024

.RENAM

3.7.3 .RENAM - Rename a file. Change protection code.

Macro Call: .RENAM #LNKBLK,#OLDNAM,#NEWNAM

where LNKBLK is the address of the Link Block, OLDNAM is the address of the Filename Block representing the file, and NEWNAM is the address of the Filename Block containing the new information.

Assembly Language Expansion:

```
MOV #NEWNAM,-(SP)
MOV #OLDNAM,-(SP)
MOV #LNKBLK,-(SP)
EMT 20
```

Global Name: REN (See Appendix C for subsidiary routines.)

Description: Allows the user to change the name and protection code (see Section 3.8.6.3) of a file. After the request has been completed, control is returned to the user at the instruction following the assembly language expansion. The arguments are removed from the stack.

Rules: Dataset must be INITed, and file must not be OPENed. The user must specify two Filename Blocks: one contains the name and protection code of the file as it presently is before the .RENAM request, and the other contains the name and protection code of the file as it should be after the .RENAM request. The two filenames must be different. To change just the protection for a file, two .RENAMs must be requested.

The new filename must not already exist, and the new filename must be legal. The old file must exist.

NOTE

Renaming a file assigned from the keyboard to the dataset will effectively be a NOP.

Errors: Control is returned either to the ERROR RETURN ADDRESS in the offending Filename Block if it is specified and applicable, or to the Monitor for an error message if it is not. Possible errors are shown below:

Error Condition	Error Code Returned To Filename Block	Error Message On Default
Dataset Not INITed	--	F000
File Exists (new name)	2	F024
File Nonexistent (old file)	2	F024
Protection Violation	6	F024
File Is Open	14	F024
Illegal Filename	15	F024

3.7.4 .APPND - Append one linked file to another.

Macro Call: .APPND #LNKBLK,#FIRST,#SECOND

where LNKBLK is the address of the Link Block, FIRST is the address of the Filename Block for the first file (file to be appended to), and SECOND is the address of the Filename Block for the second file (file to be appended).

Assembly Language Expansion:

```
MOV #SECOND,-(SP)
MOV #FIRST,-(SP)
MOV #LNKBLK,-(SP)
EMT 22
```

Global Name: APP (See Appendix C for subsidiary routines.)

Description: Makes one linked file out of two by appending the SECOND to the FIRST. The directory entry of the SECOND file is deleted. When the request is completed, control is returned to the user at the instruction following the assembly language expansion. The arguments are removed from the stack. No attempt is made to pack the two files together, the physical blocks are merely linked together.

Errors: Control is returned either to the ERROR RETURN ADDRESS in the offending Filename Block if it is specified, or to the teleprinter for an error message if it is not. Possible errors are shown below:

Error Condition	Error Code Returned To Filename Block	Error Message On Default
Device Not Ready	--	A002
Dataset Not INITed	--	F000
First File Nonexistent	2	F024
Contiguous File	5	F024
Protect Code Violated	6	F024
File Opened	14	F024

NOTE

Since the last block of a file is typically not full, there will be a gap (null characters) in the new file at the junction point. This causes no problem in ASCII files but might cause confusion in binary files.

3.7.5 .LOOK - Search the device directory for a specified filename.

Macro Call: .LOOK #LNKBLK,#FILBLK[,1]
where LNKBLK is the address of the Link Block, and FILBLK is the address of the Filename Block.

Assembly Language Expansion:

a. If the optional argument is not specified:

```
MOV #FILBLK,-(SP)
MOV # LNKBLK,-(SP)
EMT 14
```

b. If the optional argument is specified:

```
MOV #FILBLK,-(SP)
CLR -(SP)
MOV #LNKBLK,-(SP)
EMT 14
```

Global Name: DIR (See Appendix C for subsidiary routines.)

Description: The primary purpose of this routine is to search through a specified directory for a specified file and return with the current parameters of the file. However, this routine can also be used to indicate (bits 0-3) the permissible functions for a nondirectory device (i.e., input, output, update, etc.). By specifying the optional argument, the user indicates whether he requires two or three parameters be returned.

The device to be searched is specified in the Link Block, and the file is specified in the Filename Block. The request returns to the user with the top elements of the stack as follows

	2 Arg. Call	3 Arg. Call
START BLOCK		SP
# OF BLOCKS	SP	SP+2
INDICATOR WORD	SP+2	SP+4

where # OF BLOCKS is the number of blocks in the file, and the INDICATOR WORD is coded as follows:

```
Bit 0=1     .OPENC allowed
Bit 1=1     .OPENI allowed
Bit 2=1     .OPENE allowed
Bit 3=1     .OPENU allowed
Bit 4=0     File is not in use
    4=1     File is being used by another dataset
Bit 5=1     Dataset already has a file open
              (no search has been performed)
Bit 6=0     File is linked
    6=1     File is contiguous
Bit 7=0     File nonexistent (OPENO allowed)
    7=1     File exists or .OPENO not allowed
Bits 8-15   Protection Code
```

After the request has been completed, control is returned to the user at the instruction following the assembly expansion. The stack must be cleared by the user. If a file is protected against READ access, it will be signaled as nonexistent.

Rules: The dataset must be INITed.

Errors: Control is returned either to the ERROR RETURN ADDRESS in the Filename Block if it is specified, or to the teleprinter for an error message if it is not. Possible errors are shown below:

Error Condition	Error Code Returned To Filename Block	Error Message
Device Not Ready	--	A002
A File Is Open On Requesting Dataset	14	F024
Illegal Filename	15	F024

Note that it is possible to .LOOK for a file and be told that it does not exist. A subsequent attempt to open the nonexistent file may lead to an OPEN error (code=2). Hence, it may be more efficient to simply attempt the .OPEN and check for an error (see Section 3.6.3).

3.7.6 .KEEP - Protect file from automatic deletion.

Macro Call: .KEEP #LNKBLK,#FILBLK
where FILBLK is the address of the Filename Block of the file to be protected and LNKBLK is the address of the Link Block.

Assembly Language Expansion:

```
MOV #FILBLK,-(SP)
MOV #LNKBLK,-(SP)
EMT 24
```

Global Name: PRO

Description: Protects the named file from being deleted by the Monitor upon a FInish Keyboard command (see Chapter 2). It does this by setting bit 7 of the PROTECT byte in the Filename Block. Automatic deletion upon FInish is not currently implemented.

3.8.1 Load a Program or an Overlay

3.8.1.1 .RUN

Macro Call: .RUN #RUNBLK
where RUNBLK is the address of the user's Run Block (see Figure 3-16).
Assembly Language Expansion:

```
MOV #RUNBLK,-(SP)    ;PUSH ADDRESS OF THE RUN BLOCK
EMT 65               ;ONTO THE STACK
```

Global Name: RUN

Description: The RUN request may be used to load an entire program or a program overlay. It has several options, among which are:

- load a program or load an overlay - when an overlay is loaded, the existing program environment is not disturbed; one section of the program is simply replaced by another. When a new program is loaded, the old program and its effects (except for data on the stack) are purged from core, and the new program takes over; for example, FORTRAN can use the RUN request to load LINK and LINK can use it to load and execute the user's program;
- load a core image or a load module;
- return of control:

  instruction following .RUN;

  transfer address of load module or core image;

  transfer address plus offset (word F);

  alternate return address (word G);

- stack movement:

  leave as is;

  move the stack down if it would otherwise be destroyed by the entity being loaded;

- load address:

  as specified in file,

  as specified by user.

The RUN request requires the following control blocks:

Run Block: A variable length control block whose address is passed on the stack. It contains a function word and various optional parameters. It is described in Section 3.9.8.

Link Block: The standard Link Block (section 3.9.1). It describes the device from which the entity is to be loaded. It is required unless bit 15 of the function word in the Run Block is 1.

File Block: The standard File Block (section 3.9.2). It describes the file from which the entity is to be loaded: either an .LDA file or a CIL. It is required unless bit 15 of the function word in the Run Block is 1.

The Link Block should not be .INITed, nor should the File Block be .OPENed, when .RUN is called. RUN will perform .OPEN, .CLOSE, .INIT and .RLSE processing. The lookup sequence is as follows:

First an extension of LDA is attempted, then no extension, unless an extension is specified, in which case it alone is used;

For each extension, the current UIC, then [1,1] is tried, unless a UIC is specified, in which case it alone is used;

The .RUN request always removes the Run Block address from the stack. If bit Ø is Ø, the following information will be returned upon the stack:

(SP) - transfer address of loaded module,
2(SP) - size of loaded module in bytes,
4(SP) - low address of loaded module.

Aside from this, the stack is not disturbed, although it may be moved. This means that the stack may be used for passing arguments.

Rules: The Link Block should not be .INITed.

The File Block should not be .OPENed.

If an overlay is being loaded, it must not extend above the bottom of the resident program section, nor below the top of the Monitor.

If a new program is to be loaded, all datasets used by the current program must be RLSEd.

The user must be sure that his stack is not inadvertently destroyed.

When options are requested through the function word, the appropriate supporting data must be present in the Run Block.

If the stack might be moved, it must not contain absolute pointers to locations within the stack. For example:

```
MOV  SP,RØ
MOV  RØ,-(SP)
```

produces a stack which should not be moved. The user can assure that such a stack will not be moved by setting bit 1 of the Function word in the RUN Block to Ø (see Section 3.9.8).

Errors: Errors F007, F012, F021, F022, F024, F045, F054, F274, F276, and F277 are all possible. All but F007 and F021 are nonfatal, provided that an error return is provided in the File Block (see Table 3-4).

3.8.2 Request to Return Control to the Monitor

3.8.2.1 .EXIT - Exit from a user program to Monitor.

Macro Call: .EXIT

Assembly Language Expansion:

EMT 60

Global Name: XIT

Description: This is the last statement executed in a user's program. It returns control to the Monitor, assures that all of the program's data files have been closed and, in general, prepares for the next keyboard request. After the exit, all Monitor buffer space reserved for the program, such as Device Assignment Tables (DAT) established during program execution, are returned to free core.

3.8.3 Requests to Set Monitor Parameters

In addition to the above programmed requests, the user can provide the Monitor with data to be stored in Monitor Tables or can request information on the content of those tables via the EMT level 41 instruction. The user communicates his request to the Monitor by pushing the necessary parameters and an identifier code onto the stack. If the code is outside the ranges of those currently established, a fatal error (F002) will result.

3.8.3.1 .TRAP - Set interrupt vector for the trap instruction.

Macro Call: .TRAP #STATUS,#ADDR
where STATUS is the desired status for the trap, and ADDR is the address for the trap.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
MOV #STATUS,-(SP)
MOV #1,-(SP)        ;1 is the identifier code for .TRAP
EMT 41
```

Global Name: GUT

Description: Sets the STATUS and ADDR into trap vector 34. After the request is completed, control is returned to the user at the instruction following the assembly language expansion. The stack is cleared. The user may then use the trap instruction.

Rules: STATUS must be a valid Status Byte.
ADDR must specify an address within the user's core area.

Errors: If an invalid code is specified, a fatal (FØØ2) error will result.

3.8.3.2 .RSTRT - Set the default address for use by the REstart keyboard command.

Macro Call: .RSTRT #ADDR

where ADDR is the restart address.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
MOV #2,-(SP)        ;2 is the identifier code for .RSTRT
EMT 41
```

Global Name: GUT

Description: Sets the address where the program should restart in response to the keyboard command REstart. This is the assumed address in the absence of an address in the REstart command. It can be reset as often as requested by the program. After the request is completed, control is returned to the user at the instruction following the assembly language expansion. The stack is cleared.

Rules: ADDR must be an address within the user's core area.

.CORE

3.8.4 Requests to Obtain Monitor Parameters

3.8.4.1 .CORE - Obtain address of the highest word in core memory.

Macro Call: .CORE

Assembly Language Expansion:

```
MOV #100,-(SP)     ;CODE
EMT 41
```

Global Name: GUT

Description: Determines the address of the highest word in core memory (core size minus 2) and returns it on the top of the stack. For an 8K machine, it would return 37776. The user must clear the stack.

Errors: No errors are possible.

3.8.4.2 .MONR - Obtain the address of the first word not within the resident Monitor.

Macro Call: .MONR

Assembly Language Expansion:

```
MOV #101,-(SP)
EMT 41
```

Global Name: GUT

Description: Determines the first word above the top of the currently resident Monitor (see Figure 3-5) and returns it to the user at the top of the stack. This value does not reflect any area allocated by the Monitor for control blocks, device drivers, data buffers, etc. (see .MONF, Section 3.8.4.3). After the request is completed, control is returned to the user at the instruction following the assembly language expansion. The user must clear the stack.

Errors: No errors are possible.

.MONF

3.8.4.3 .MONF - Obtain the address of the first word above the Monitor's highest allocated free core buffer.

Macro Call: .MONF

Assembly Language Expansion:

```
MOV #102,-(SP)
EMT 41
```

Global Name: GUT

Description: The address of the first word above total Monitor area (see Figure 3-5), including the buffer and transient areas current at the time of the request, is returned to the user at the top of the stack. After the request is completed, control is returned to the user at the instruction following the assembly language expansion. The user must clear the stack.

Rules: Since buffers are allocated by the Monitor in its processing of certain requests, .MONF should be placed in the program at the point where the information is actually required.

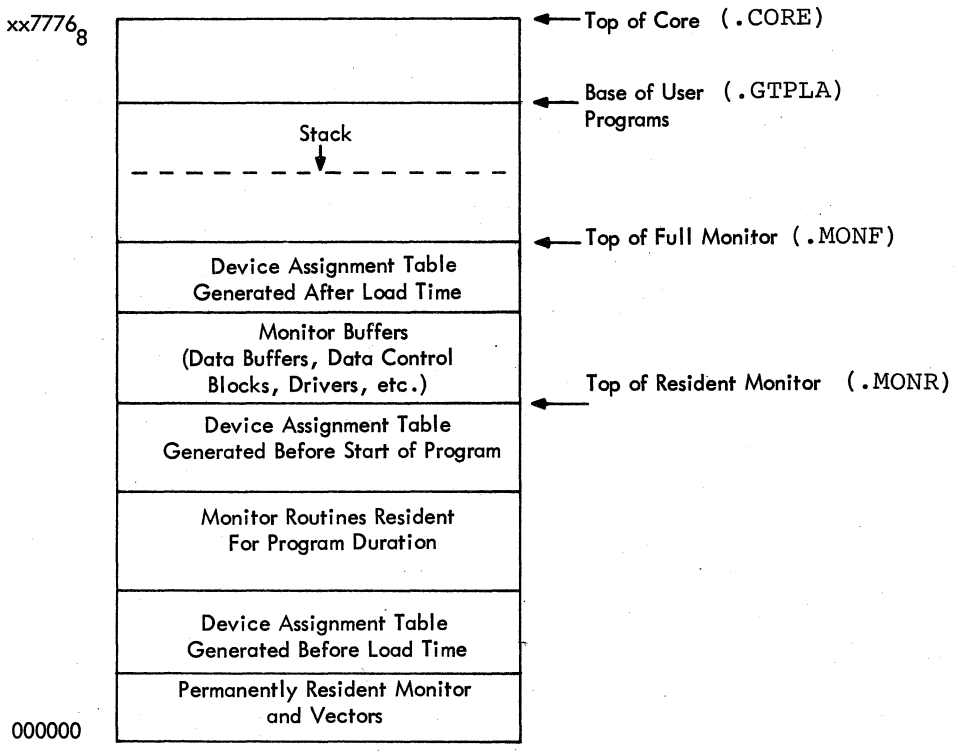


Figure 3-5 Core Map of Resident Monitor and Full Monitor.

3.8.4.4 .DATE - Obtain current date.

Macro Call: .DATE

Assembly Language Expansion:

```
MOV #103,-(SP)
EMT 41
```

Global Name: GUT

Description: The current date word is returned to the user at the top of the stack. The user must clear the stack. The date format is a binary number equal to Julian-$70{,}000_{10}$. If the user requires the ASCII representation of the date, he should use the .CVTDT request (see 3.8.4.6).

Errors: No errors are possible.

.TIME

3.8.4.5 .TIME - Obtain current time of day.

Macro Call: .TIME

Assembly Language Expansion:

```
MOV #104,-(SP)
EMT 41
```

Global Name: GUT

Description: The two current time words are returned to the user at the top of the stack.

SP:	LOW-ORDER TIME IN TICKS
SP+2:	HIGH-ORDER TIME

where a TICK is 1/60 of a second (1/50 second for 50-cycle lines).

The words are 15-bit unsigned numbers. The user must clear the stack. See the CVTDT request for how to obtain the ASCII representation of current time value.

Errors: No errors are possible.

3.8.4.6 .CVTDT - Convert binary representation of date or time to ASCII character string.

Macro Call: .CVTDT #CODE, #ADDR[,VALUE]

where CODE identifies the conversion to be done;

CODE = Ø Current date as stored by monitor,
CODE = 1 Current time as stored by monitor,
CODE = 2 Date supplied as VALUE,
CODE = 3 Time supplied as VALUE (and VALUE+2)

ADDR is the address of the first byte of the user buffer into which the ASCII string is to be stored, and VALUE is the address of user supplied Date or Time (used with CODEs 2 and 3 only).

Assembly Language Expansion:

```
MOV VALUE+2,-(SP): Code 3 only
MOV VALUE,-(SP); Codes 2 and 3 only

MOV #ADDR,-(SP)
MOV #CODE,-(SP)
EMT 66
```

Global Name: CDT

Description: This request converts either a date or a time from internal (binary) representation into an ASCII string suitable for display. The user may specify that the current system value (of date or time) is to be used for conversion or he may supply his own value. The string returned has the format of the Date and Time returned by the Keyboard DATE and TIME commands (see Chapter 2). Upon return, the call arguments have been removed from the stack and condition codes N, Z and V are cleared to Ø.

Rules:

1. The buffer area supplied by the user program (starting at ADDR) must provide sufficient room for the text returned as no check is made. Nine bytes are required for Date, eight bytes are required for Time.
2. User-supplied VALUEs for Date or Time must comply with the internal storage format of those values, that is:
   a. Date; 1 word containing (year-197Ø)*1ØØØ + day of the year (Julian).
   b. Time; 2 unsigned integer words for high-order and low-order time in clock ticks.

Errors: 1. Specification of an illegal CODE (i.e., > 3) causes fatal error message:

FØ34 Call address

2. If the currently stored Date or Time is out of range (i.e., Date > 366 (Modulo 1ØØØ) or Time > 47:59:59), an operator action message

AØ11 CODE(Ø = Date, 1 = Time)

is printed. The operator should enter the desired value via the appropriate **DAt**e or TIme keyboard command and type COntinue to proceed. If 23:59:59 < Time < 48:00:00, Date is incremented and Time is reduced by 24:00:00.

3. If a user supplied Date or Time is out of range as above, the conversion routine will return without attempting conversion and the condition code V will be set to 1. Thus the program should follow the .CVTDT request with the check:

BVS (error routine).

3.8.4.7 .GTUIC - Get the current user's UIC.

Macro Call: .GTUIC

Assembly Language Expansion:

```
MOV #105,-(SP)      ;CODE
EMT 41
```

Global Name: GUT

Description: The current user's UIC is returned at the top of the stack. The user must clear the stack.

Errors: No errors are possible.

.SYSDV

3.8.4.8 .SYSDV - Get name of the system device.

Macro Call: .SYSDV

Assembly Language Expansion:

```
MOV #106,-(SP)
EMT 41
```

Global Name: GUT

Description: The name of the system device in Radix-50 notation is returned to the user at the top of the stack.

Errors: No errors are possible.

3.8.4.9 .GTPLA - Return the current program low address.

Macro Call: .GTPLA

Assembly Language Expansion:

```
CLR -(SP)
MOV #5,-(SP)
EMT 41
```

Global Name: GUT

Description: The program low address is the address of the first (lowest) word of the current program. In the case of a program with overlays, the PLA is the address of the first word of the resident section. PLA is established when the keyboard RUN command is executed or when the .RUN request is used to load a new program (not an overlay, e.g., when MACRO calls CREF, which then replaces MACRO). Because the .RUN processor will not load an overlay which extends above this address, the PLA is also called the Protection Boundary.

.GTPLA allows the user to retrieve this value (see Figure 3-5), which is returned to the top of the stack. .STPLA allows the user to set it.

Rules: The user must clear the stack.

Errors: No errors are possible.

.STPLA

3.8.4.10 .STPLA - Set the program low address.

Macro Call: .STPLA #ADDR
where ADDR is the desired new program low address.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
MOV #5,-(SP)
EMT 41
```

Global Name: GUT

Description: This request allows the user to establish a new program low address. This is done if the user wants part of his resident code overlayed or if he wants to reserve additional space between his resident code and his overlays. Consult the .GTPLA description for more details.

The old program low address (or a zero) will be returned on top of the stack upon return from this macro call.

Rules: The user is required to clear the returned address from the stack.

Errors: The address returned on top of the stack will be zero when the call is unsuccessful. This occurs when the address is outside of available memory.

3.8.4.11 .GTCIL - Return the address of the first block of the Monitor core image library (CIL).

Macro Call: .GTCIL

Assembly Language Expansion:

```
MOV #111,-(SP)
EMT 41
```

Global Name: GUT

Description: This request returns the address of the first block of the Monitor core image library to the top of the stack.

Rules: The user is required to clear the disk address returned on the stack.

Errors: No errors are possible.

.GTSTK

3.8.4.12 .GTSTK - Return the current stack base entry.

Macro Call: .GTSTK

Assembly Language Expansion:

```
CLR -(SP)
MOV #4,-(SP)
EMT 41
```

Global Name: GUT

Description: The stack base is the highest core address used for stack storage plus two. A RUN Keyboard command clears the stack and sets the stack base address to the program low address. A user .RUN request does not clear the stack (to allow inter-program communication via the stack) but the stack may be relocated. This request may be used to determine the stack base. Following the request the current stack base entry is returned on top of the stack.

Rules: The user is required to clear the returned value from the stack.

Errors: No errors are possible.

3.8.4.13 .STSTK - Modify the stack base entry.

Macro Call: .STSTK #ADDR
where ADDR is the desired new stack base address entry.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
MOV #4,-(SP)
EMT 41
```

Global Name: GUT

Description: This request is used when the stack is to be relocated. It does not relocate the stack, but it does record its new base (the address of the word immediately above the stack; see section 3.8.4.12), and it returns the old stack base on the stack. EXTREME CAUTION should be used when moving the stack; it is not recommended as a standard procedure. Note that the .RUN request may be used to move the stack when that is appropriate.

Rules: The user must clear the old base value from the stack when control is returned.

The user is responsible for moving the stack.

Caution should be used when moving the stack, since the new and old stack areas may overlap and since Monitor interrupt routines may use the stack while it is being moved. Let:

```
SB1 = old stack base (returned on stack)
SB2 = new stack base (supplied by user)
SP1 = old stack pointer (current value of SP)
SP2 = new stack pointer (SB2 - SB1 + SP1)
```

First, set SP=min (SP1,SP2) to protect against interrupts. Then if SB1<SB2, move the stack starting from the base (SB1 to SB2), If SB1>SB2, move the stack starting from the top (SP1 to SP2). This strategy prevents the stack from being corrupted during the move (since the two stack areas might overlap). Finally, set SP to SP2.

Errors: If the new stack base ADDR is outside available memory or inside the Monitor, the request is not honored and a zero is returned on the stack.

.STFPU

3.8.4.14 .STFPU - Initialize the floating-point exception vector.

Macro Call: .STFPU #PSW,#ADDR

Assembly Language Expansion:

```
MOV #ADDR,-(SP)     ;ADDRESS OF EXCEPTION ROUTINE
MOV #PSW,-(SP)      ;PROGRAM STATUS WORD FOR
                    ;EXCEPTION RTN
MOV #3,-(SP)        ;REQUEST CODE
EMT 41
```

Global Name: GUT

Description: This request initializes the exception interrupt vector for the floating-point processor on the PDP-11/40 or PDP-11/45. Any floating-point exception for which interrupt is enabled will cause a trap to location ADDR with a new program status word of PSW. The interrupt vector is at location 244_8.

Rules: None.

Errors: None.

3.8.5 Requests to Perform Conversions

Using the EMT level 42 instruction the user can request data conversions between binary and some external form such as decimal ASCII or Radix-50. He communicates his request by pushing the necessary parameters and an identifier code onto the stack. If a code outside the range of those currently established is specified, a fatal error (F034) will result.

3.8.5.1 .RADPK - Pack three ASCII characters into one Radix-50 word.

Macro Call: .RADPK #ADDR

where ADDR is the address of the first byte in the 3-byte string of ASCII characters to be converted.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
CLR -(SP)          ;MOVE CALL CODE ONTO STACK
EMT 42
```

Global Name: CVT

Description: The string of 7- or 8-bit ASCII characters in three consecutive bytes starting at ADDR is converted to Radix-50 packed ASCII using the algorithm shown below. The packed value is returned on the top of the stack, followed by the address of the byte following the last character converted. The user must clear the stack.

Radix-50 is used by the Monitor to store in one word three characters for half a filename or an extension or other three-character sets of data.

Because the characters allowed within names (e.g., filenames or extensions, assembler symbols, etc.) are restricted to letters, digits, and a few special characters, it is possible to store three characters within a single word by using the formula:

$$((C_1 \times 50_8) + C_2) \times 50_8 + C_3$$

where C_1, C_2, and C_3 are the three characters converted from their original ASCII value to the value shown in the following table.

	ASCII Value	Radix-50 Value
Space	40	0
A-Z	101-132	1-32
$	44	33
.	56	34
unused		35
0-9	60-71	36-47

The maximum value for three characters is thus:

$$47 \times 50^2 + 47 \times 50 + 47 = 174777$$

The Radix-50 representation for various peripheral devices is shown below:

Mnemonic	Device	Radix-50 Equivalence
CR	Card Reader (CR11)	012620
DC	RC11 Disk	014570
DF	RF11 Disk	014760
DK(A,B)	RK11 Disk	015270(+1,2)
DT(A)	DECtape (TC11)	016040(+1)
KB	ASR-33 Keyboard/Printer	042420
LP	Line Printer (LP11)	046600
MT	Magtape (TM11)	052140
PP	High-Speed Paper Tape Punch	063200
PR	High-Speed Paper Tape Reader	063320
PT	ASR-33 Paper Tape Device	063440

NOTES: a. Device mnemonics may be three letters on some systems. The third letter is assigned if there is more than one controller. For example:

DTA for DECtape controller A
DTB for DECtape controller B

b. The device name may be followed by an octal number to identify a particular unit when the controller has several device units associated with it. For example:

DT1 for unit 1 under a single DECtape control

DTA1 for unit 1 under controller A in a multi-controller situation.

Errors: The conversion will be stopped if an error condition is encountered, and the user will be informed of the type of error via the condition codes in the Processor Status register:

C-bit set means that an ASCII byte outside the valid Radix-50 set was encountered.

The value returned will be left-justified and correct up to the last valid byte, e.g., DT: = DT :. The address returned will be that of the first invalid byte.

If no errors were encountered during the conversion, the condition codes will be cleared.

Example: Pack a string of 30_{10} ASCII characters, starting at UNPBUF, into a buffer starting at PAKBUF.

```
        MOV #PAKBUF,R3      ;SET UP POINTER TO PACK BUFFER
        MOV #UNPBUF,-(SP)   ;.RADPK UNBUF
NEXT:   CLR -(SP)
        EMT 42
        BCS ERRC            ;INVALID ASCII CODE ENCOUNTERED
        MOV (SP)+,(R3)+     ;MOV PACKED VALUE TO BUFFER
        CMP R3,#PAKBUF+12   ;END OF STRING?
        BNE NEXT            ;NO
        TST (SP)+           ;YES - REMOVE POINTER FROM STACK
```

Note that this example takes advantage of the fact that the Monitor returns on the stack the address of the byte which follows the last character converted.

.RADUP

3.8.5.2 .RADUP - Unpack one Radix-50 word into three ASCII characters.

Macro Call: .RADUP #ADDR,WORD

where ADDR is the address of the first of three bytes into which the unpacked characters are to be placed, and WORD is the Radix-50 word to be converted.

Assembly Language Expansion:

```
MOV WORD,-(SP)
MOV #ADDR,-(SP)
MOV #1,-(SP)        ;MOVE CALL CODE ONTO STACK
EMT 42
```

Global Name: CVT

Description: WORD is converted into a string of 7-bit ASCII charactors which are placed left-justified with trailing spaces in three consecutive bytes starting at location ADDR. The stack is cleared. See section 3.8.5.1 for a definition of Radix-50.

Errors: If an error is encountered, the user will be informed via the condition codes in the Processor Status register.

C-bit set means:

a. a value of WORD was outside the valid Radix-50 set, i.e., >I74777 (see Section 3.8.5.1).

b. a Radix-50 byte value was found to be 35, which is currently not used.

Nevertheless, three bytes will be returned with a : as the first of the three for error type (a), and a / for any of the three bytes for error type (b).

If the conversion is satisfactory, the condition codes are cleared.

3.8.5.3 .D2BIN - Convert five decimal ASCII characters into one binary word.

Macro Call: .D2BIN #ADDR

where ADDR is the address of the first byte in the 5-byte string of decimal characters to be converted.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
MOV #2,-(SP)        ;MOVE CALL CODE ONTO STACK
EMT 42
```

Global Name: CVT

Description: The 5-byte string of 7- or 8-bit decimal ASCII characters which start at ADDR are converted into their binary equivalent. The converted value is returned to the top of the stack, right-justified, followed by the address of the byte which follows the last character converted. The largest decimal number that can be converted is 65,535 (2^{16}-1). The user must clear the stack.

Errors: The conversion will be stopped if an error condition is encountered. The user will be informed of the type of error via the condition codes in the Processor Status register.

C-bit set means that a byte was not a decimal digit.
V-bit set means that the decimal number was too large, i.e., greater than 65535.

The value returned will be correct up to the last valid byte. The address returned will be that of the invalid byte. If the conversion is satisfactory, the condition codes will be cleared.

.BIN2D

3.8.5.4 .BIN2D - Convert one binary word into five decimal ASCII characters.

Macro Call: .BIN2D #ADDR,WORD
where ADDR is the address of the first byte of the buffer where the characters are to be placed, and WORD is the number to be converted.

Assembly Language Expansion:

```
MOV WORD,-(SP)
MOV #ADDR,-(SP)
MOV #3,-(SP)          ;MOVE CALL CODE ONTO STACK
EMT 42
```

Global Name: CVT

Description: WORD is converted into a string of five decimal 7-bit ASCII characters which are placed into consecutive bytes starting at location ADDR. They are right-justified with leading zeros. The stack is cleared.

Errors: No errors are possible.

3.8.5.5 .O2BIN - Convert six octal ASCII characters into one binary word.

Macro Call: .O2BIN #ADDR

where ADDR is the address of the first byte in the 6-byte string of octal characters to be converted.

Assembly Language Expansion:

```
MOV #ADDR,-(SP)
MOV #4,-(SP)        ;MOVE CALL CODE ONTO STACK
EMT 42
```

Global Name: CVT

Description: The 6-byte string of 7- or 8-bit octal ASCII characters which starts at ADDR is converted into the binary number equivalent. The converted value is returned to the top of the stack, right-justified, followed by the address of the byte which follows the last character converted. The largest octal number which can be converted is 177777. The stack must be cleared by the user.

Errors: The conversion will be stopped if an error condition is encountered, and the user will be informed of the type of error via the condition codes in the Processor Status register:

C-bit set means that a byte was not an octal digit.
V-bit set means that the octal number was too large, i.e., the first byte was greater than 1.

If the conversion has been satisfactory, the condition codes are cleared. Following C- or V-bit errors, the value returned will be correct up to the last valid byte. The address returned will be that of the first invalid byte.

3.8.5.6 .BIN2O - Convert one binary word into six octal ASCII characters.

Macro Call: .BIN2O #ADDR,WORD
where ADDR is the address of the first byte of the buffer into which the six octal ASCII characters are to be placed, and WORD is the binary number to be converted.

Assembly Language Expansion:

```
MOV WORD,-(SP)
MOV #ADDR,-(SP)
MOV #5,-(SP)
EMT 42
```

Global Name: CVT

Description: The WORD is converted into a 6-byte string of 7-bit octal ASCII characters, right-justified with leading zeros, which is placed into the buffer addressed by ADDR. The stack is cleared.

Errors: No errors are possible.

3.8.6 Requests for Interfacing with the Command String Interpreter

A user program may obtain dataset specifications via keyboard input at run time by calling the Command String Interpreter (CSI) routine. This routine is used by many system programs; it accepts keyboard input at program run time in the format presented in Appendix H.

The CSI is called in two parts, by two different requests:

- .CSI1 condenses the command string and checks for syntactical errors.
- .CSI2 sets the appropriate Link Block and Filename Block parameters for each dataset specification in the command string.

Each command string requires one .CSI1 request for the entire command string, and one CSI2 request for each dataset specifier in the command string.

The user must first set up a line buffer in his program and read in the command string. Then he does a .CSI1, which condenses the string by eliminating spaces, horizontal TABs, nulls, and RUBOUTs, sets pointers in a table to be referenced by .CSI2, and checks the command string for syntactical errors. If there are no errors, the .CSI2 request may be given once for each dataset specification that the user expects to find in the command string. .CSI2 fills in the appropriate Link Block and Filename Block parameters according to the device name, filename, extension, UIC, and switch entries in the command string.

.CSI1

3.8.6.1 .CSI1 - Condense command string and check syntax.

Macro Call: .CSI1 #CMDBUF
where CMDBUF is the address of the command buffer header described under "Rules" below.

Assembly Language Expansion:

```
MOV #CMDBUF,-(SP)
EMT 56
```

Global Name: CSX

Description: Condenses the command string by removing spaces, horizontal TABs, nulls, and RUBOUTs, and checks the entire command string for syntactical errors. Control is returned to the user with a 0 at the top of the stack if the syntax is acceptable, or with the address (in the command string line buffer) of the data byte at which the scan terminated because the first error was encountered.

Rules: The .CSI2 request must be preceded by a .CSI1 request, because .CSI2 assumes it will get a syntactically correct command; more than one .CSI2 request can follow a single .CSI1 request.

The user must set up a line buffer and read in the command string before doing .CSI1. Command Strings must not be read in dump mode.

It is the user's responsibility to print a # on the teleprinter to inform the operator that a CSI format is expected (Section 2.1). If VERTICAL TAB is used as the terminator, the # will be typed immediately without a carriage return or line feed.

The user must set up a seven-word command buffer header in his program immediately preceding the header of the line buffer into which the command is to be read. The user is not required at this time to set up anything in the command buffer header prior to calling .CSI1; it will be used as a work-and-communication area by the Monitor routines which process the .CSI1 and .CSI2 requests.

The user must clear the stack upon return from the Monitor. If the top of the stack ≠ 0 (i.e., if there was a syntax error), .CSI2 must not be called.

Example: See .CSI2, Section 3.8.6.2.

3.8.6.2 .CSI2 - Interpret one dataset specification of a command string.

Macro Call: .CSI2 #CSIBLK

where CSIBLK is the CSI control block, described under "Rules" below.

Assembly Language Expansion:

```
MOV #CSIBLK,-(SP)
EMT 57
```

Global Name: CSM

Description: Gets the next input or output dataset specification from the command string, and sets the PHYSICAL DEVICE NAME entry in the Link Block, the FILENAME, EXTENSION, and UIC entries in the Filename Block, and any switch entries in an extension of the Link Block.

Rules: Before calling .CSI2, the user must:

- Call .CSI1 to condense the command string and check it for syntax errors. There must have been no syntax errors.
- Set up a CSI control block as follows:

CSIBLK:

POINTER TO CMDBUF
POINTER TO LNKBLK
POINTER TO FILBLK

  where POINTER TO CMDBUF is the address of the 7-word work area preceding the command string line buffer header;

  POINTER TO LNKBLK is the address of the Link Block of the dataset whose specification is being requested; and

  POINTER TO FILBLK is the address of the Filename Block of the dataset whose specification is being requested (currently, CSI allows only one file per dataset specification).

- Set the first word (Code Word) of CMDBUF to either 0 or 2. 0 means "get next input dataset specification", and 2 means "get the next output dataset specification". .CSI2 does not check the validity of the code word.
- Initialize the NUMBER OF WORDS TO FOLLOW entry in the Link Block to contain the number of words to follow. This must be at least one, because .CSI2 will alter the following word, i.e., the PHYSICAL DEVICE NAME word. .CSI2 does not check the validity of this byte.

  The user may specify any number from 1 to 255_{10} in this location. All words in excess of 1 are used for switch space (see the interface with respect to switches, described below).

Upon return from the .CSI2 request, the Monitor will have provided the following information:

- The top of the stack contains two items of information. Bits 1-0 have the following meaning:

  a. 0, which means the dataset specification requested has been obtained, and there are still more dataset specifications of the type requested (i.e., input or output); or

  b. 1, which means the dataset specification requested has been obtained, and there are no further dataset specifications of the type requested; or

  c. 2, which means (a), but this particular dataset specification included more switches than would fit in the space provided; or

  c. 3, which means (b), but this particular dataset specification included more switches than would fit in the space provided.

  If there are no more dataset specifications and the user requests one anyway, a null specification will be returned.

  Bit 2, when set to one, indicates that the device name in the Link Block is a default supplied by the system (see Section 3.4.1).

- With respect to values returned in the Link Block (Figure 3-6):

  If the PHYSICAL DEVICE NAME word is zero, the user does not wish this particular output (input) dataset to be generated (read); i.e., this entry was omitted when the command string was typed. If not zero, the PHYSICAL DEVICE NAME and UNIT NUMBER are appropriately set to the device and unit specified in the command string.

- Immediately following the PHYSICAL DEVICE NAME word in the Link Block are the switches specified in the command string. The interface for each switch is shown in the switch block below. These switch blocks are written in the area provided by the programmer in the Link Block. Note that the number of words to follow in the switch block is not the same quantity as is specified in the LINK Block.

NUMBER OF WORDS TO FOLLOW		
POINTER TO FIRST CHARACTER OF Vn		
POINTER TO FIRST CHARACTER OF Vn-1		
. . .		
POINTER TO FIRST CHARACTER OF V1		
W(ASCII)	S(ASCII)	;for /SW

If NUMBER OF WORDS TO FOLLOW is zero, there are no more switches. Note that the pointers are in reverse order. After the value pointers are the ASCII bytes which contain the first two characters of the switch. The first character is in the low byte, and the second is in the high byte. If the name of the switch contains only one character, the ASCII representation of that character will be in the low byte, and the high byte will contain a zero. Note that if the NUMBER OF WORDS TO FOLLOW is not zero, it is the number of values +1. For example, if the switch /SWITCH:$12:AB is stored in memory beginning at location 1000 as:

1000	1001	1002	1003	1004	1005	1006
/	S	W	I	T	C	H
1007	**1010**	**1011**	**1012**	**1013**	**1014**	**1015**
:	$	1	2	:	A	B

then the completed interface appears as:

3	
1014	
1010	
127=W	123=S

- With respect to the values returned in the Filename Block (Figure 3-7):

  a. The FILENAME occupies the two words at FILBLK and FILBLK+2. If the Monitor returns zero at FILBLK, no filename was specified in the dataset specification; if it returns 52_8 at FILBLK, * was specified as the filename. Otherwise, the Monitor returns at FILBLK and FILBLK+2 the first six characters of the filename specified, in Radix-50 packed ASCII.

  b. The EXTENSION occupies the word at FILBLK+4. If the Monitor returns zero at FILBLK+4, no extension was specified; if it returns 52_8, * was specified. Otherwise, the Monitor returns the first three characters of the extension specified, in Radix-50 packed ASCII.

  c. The USER IDENTIFICATION CODE occupies the word at FILBLK+6. If the Monitor returns zero at FILBLK+6, no UIC was specified in the dataset specification (the I/O processors will assume the UIC of this user). If a UIC was typed in, the Monitor will set this word appropriately. The Monitor returns 377_8 in the high- or low-order byte of this word if * was specified in either of those positions.

  The user may restart at the beginning of the input dataset or output dataset side of the command string simply by recalling .CSI1 and issuing a 0 or 2 code, respectively. Note that he may not restart one without restarting the other.

Remark: There is no error checking with respect to magnitude when the UNIT or UIC values are converted from octal ASCII to binary.

LINK Block

3.9 USER PROGRAM TABLES AND CONTROL BLOCKS

3.9.1 The Link Block (used for all input/output and directory requests)

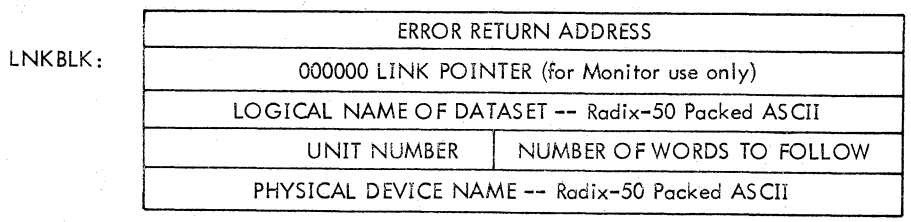


Figure 3-6 The Link Block

Each dataset in a user's program must have a Link Block associated with it. Entries in the Link Block which must be specified by the user can be written into his program or set by the program itself before the dataset is INITed. Each entry is explained below.

Address	Name	Function
LNKBLK-2	ERROR RETURN ADDRESS	This entry must be set by the user to contain the address where he wants to transfer control in the event that any request associated with this dataset fails to obtain required buffer space from the the Monitor. If no address is specified here, such an error will be treated as fatal. This address may be changed by the user's program at any time.
LNKBLK	LINK POINTER	This location must be set to zero by the user and must not be modified by him. The Monitor places a linking address here when the dataset is INITed. Before INITing a dataset, the Monitor tests this pointer for zero. If it is not zero, the Monitor assumes that the dataset was already INITed.
LNKBLK+2	LOGICAL NAME OF DATASET	The user can specify a name for the dataset in this entry. This name, which must be unique, is used to associate the dataset with a device which is specified by an ASSIGN from the keyboard. The name is stored in Radix-50 packed ASCII by the .RAD50 assembler directive. This specification is optional, but if it is omitted, the ASSIGN command cannot be used.
LNKBLK+4	NUMBER OF WORDS TO FOLLOW	This byte contains the count of the number of words to follow in the Link Block. The user should set it to a 0 if he does not specify any PHYSICAL DEVICE NAME in the

Address	Name	Function
		next word, or to a 1 if he does. Values greater than 1 may be used if the Command String Interpreter is to be called.
LNKBLK+5	UNIT NUMBER	This code specifies the unit number of the device linked to the dataset. For example, the TC11 Controller (DECtape) can drive up to eight tape drives (units), numbered 0-7.
LNKBLK+6	PHYSICAL DEVICE NAME	If the user specified 1 or greater in byte LNKBLK+4, he may specify here the standard name (Appendix A) for the device associated with the dataset in Radix-50 format. If no name is specified here, the user must specify LOGICAL NAME OF DATASET and perform an ASsign command before he runs his program. If physical device name is specified both here and in an ASSIGN command, the device specified in the ASSIGN command overrides the value given here.
LNKBLK+8 through LNKBLK+n	OPTIONAL DATA	Present only if LNKBLK+4 is greater than 1. It is used to pass additional information such as switch information when using the Command String Interpreter or Resident EMT information when using .RUN, via the Link Block.

FILENAME Block

3.9.2 The Filename Block - Each file associated with a dataset must be described by the user in a Filename Block. If a dataset is not a file, the Filename Block must still be used (if .OPEN is used) but FILENAME, EXTENSION, AND PROTECT need not be specified. The filename Block is used by OPEN and all directory management requests.

FILBLK:

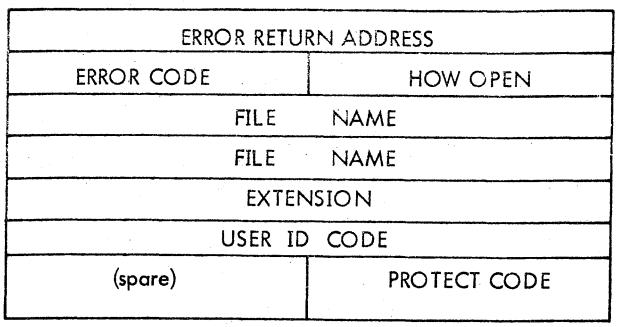


Figure 3-7 The Filename Block

Address	Name	Function
FILBLK-4	ERROR RETURN ADDRESS	The user must specify here the address to which he wants the Monitor to return control if one of the errors in Table 3-4 occurs during an operation involving the file. If no address is specified here, any such error will be treated as a fatal error.

3.9.2.1 Error Condition Codes (FILBLK-1)

Table 3-4
Filename Block Error Conditions

Error Code In Filename Block	Faulting Request	Cause	Remedy
00	.OPENC .OPENE .OPENI .OPENO .OPENU	An attempt was made to open a dataset that was previously opened.	
01		unused	

(continued on next page)

Table 3-4 (Cont)

Filename Block Error Conditions

Error Code In Filename Block	Faulting Request	Cause	Remedy
02	.OPENO	An attempt was made to open a file which already exists.	If name of file was correct, delete the file (with PIP) or change file name.
	.OPENC .OPENE .OPENI .OPENU	An attempt was made to open a file for input, extension, or update which is currently opened for output, or which does not exist.	
	.RUN	The file specified was already OPENed for output, or the file does not exist.	
03	.OPENC .OPENE .OPENI .OPENU	An attempt was made to open a file which has already been opened the maximum number of times (76_8).	Close file.
04	.OPENC .OPENE .OPENU	An .OPENC, .OPENE, or .OPENU attempt was made to open a file which has already been opened for either .OPENC, .OPENE, or .OPENU.	.CLOSE the previous open.
05	.OPENE	Illegal request to a contiguous file.	
06	.OPENC .OPENE .OPENI .OPENO .OPENU .RUN	An attempt was made to access a file which the protection code prohibits.	Resolve access problem with owner of the file.
07	.OPENC	Illegal OPEN request to a contiguous file.	
11	.OPENC .OPENE .OPENO .OPENU	File opened for output or extension is already on current DECtape unit.	Close offending file.
12	.ALLOC .OPENO	Directory full (DT).	Mount another DECtape.

(Continued on next page)

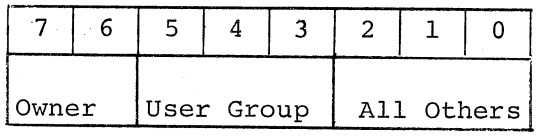
Table 3-4 (Cont)

Filename Block Error Conditions

Error Code In Filename Block	Faulting Request	Cause	Remedy
13	.ALLOC	The UIC was not entered into the device MFD.	Enter UIC via PIP.
14	.APPND .DELET .RENAM	An attempt was made to perform an illegal operation on an opened file.	Wait until file is closed.
15	.ALLOC .OPENO	An attempt was made to create a file with an illegal file name.	Change file name.
16	.RUN	All datasets were not released prior to issuing the request.	Release all datasets which were INITed.
17	.RUN	Load module format error.	File must be linked into a load module.
20	.RUN	Specified CIL entry not found.	Add proper entry to CIL or use correct name.
21	.RUN	No transfer address or illegal transfer address.	Check for END statement in source program, or use correct /TR when linking.
22	.RUN	Stack base entry in the System Vector Table (SVT) is below the Stack Pointer. Stack cannot be moved as requested in the call.	Probably a program error.
23	.RUN	Module is outside the boundaries of the allowable load area.	Relink to within boundaries. Ensure that resident portion of program is not being overlayed.

Address	Name	Function
FILBLK-2	HOW OPEN	This is set when the .OPENx macro's assembly language expansion is executed. It tells the Monitor which kind of open is being requested: .OPENU=1, .OPENO=2, .OPENE=3, .OPENI=4, .OPENC=13.
FILBLK-1	ERROR CODE	This entry should not be set by the user. It will be set by the Monitor to indicate the type of error (Table 3-4) which occurred. It will be cleared of any previous condition at each .OPEN call.
FILBLK+0 FILBLK+2	FILE NAME	This two-word entry must be specified by the user if this dataset, or a portion thereof, is a file. It is the name of the file, in packed Radix-50 format.
FILBLK+4	EXTENSION	This entry must be specified if the file named in the previous entry has an extension. It is in packed Radix-50 format.
FILBLK+6	USER I.D. CODE	The user may enter his USER ID CODE here in octal: GROUP NUMBER USER'S NUMBER High-Order Byte | Low-Order Byte If no entry is specified here, the current user's UIC is assumed.
FILBLK+10	PROTECT CODE	The user may specify here the protection to be given to the file at its creation or renaming (see following paragraph). If 0, a default protection 233 will be allotted.

3.9.2.2 The File Protection Codes



Owner: Bit 6 = 1 = Owner cannot write on or delete the file. This is a safeguard to prevent inadvertent deletion or over-writing.

Bit 7 = 1 = Protect the file from automatic deletion on FInish.

Figure 3-8 File Protection Codes

User Group and All Others

Code	Function: Delete	Write	Read	Run
0	yes	yes	yes	yes
1		yes	yes	yes
2 or 3			yes	yes
4 or 5				yes
6 or 7				

Note: yes indicates that the operation is allowed. For example, if a file belongs to user [23,10], a protection code of 3 will allow user [12,4] to read or run but not delete or write on it.

Figure 3-8 File Protection Codes

3.9.3 The Line Buffer Header - (used by READ and WRITE requests)

BUFHDR:

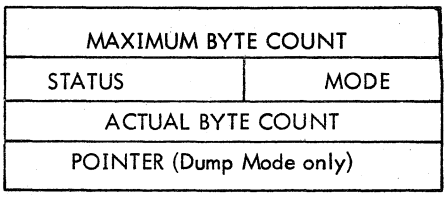


Figure 3-9 Line Buffer Header

Each element of the line buffer header table is as follows:

Address	Name	Function
BUFHDR	MAXIMUM BYTE COUNT	The count shows the size of the buffer, in bytes. It must be specified here by the user on all INPUT operations.
BUFHDR+2	MODE	The user specifies here the mode of the transfer. All modes are listed and explained in Figure 3-10.
BUFHDR+3	STATUS	The Monitor will place in this byte the status of the transfer when control is returned to the user. Figure 3-11 lists each bit and its meaning. Errors encountered executing an I/O transfer will be flagged in this byte. The user should always check its content after each transfer completes.
BUFHDR+4	ACTUAL BYTE COUNT	This count controls the number of bytes to be transferred on OUTPUT. It must be initialized by the user before any output transfer from the line buffer. After any transfer in or out, it will show how many bytes have been transmitted (or in some modes, see Section 3.6, would have been transferred had some error not been detected).
BUFHDR+6	POINTER (dump mode)	If bit 2 of MODE is 1, the user specifies here the starting address of the line buffer. If bit 2 of MODE is 0, the line buffer header is only three words in length, and must immediately precede the line buffer itself. (Section 3.9.6 Note 9.)

NOTE

The Monitor will return control to the program if a device transfer is needed to satisfy a READ or WRITE request. During this time, the header words will be used to store data relevant to the operation underway. The user should not, therefore, attempt to change this content until it is evident that the transfer has been completely effected, e.g., after a .WAIT return.

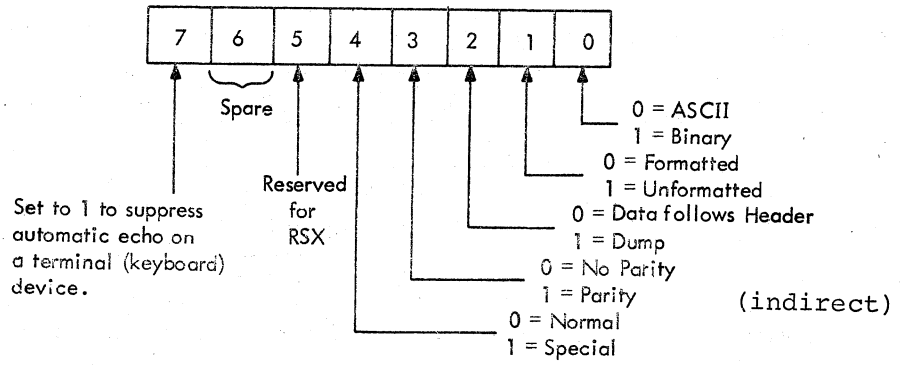


Figure 3-10 The Mode Byte

3.9.3.1 The Transfer Modes - The user can specify ASCII or binary data in nine different modes of transfer:

ASCII Modes: Formatted ASCII Parity - Special
Formatted ASCII Parity - Normal

Formatted ASCII Nonparity - Special
Formatted ASCII Nonparity - Normal

Unformatted ASCII Parity - Special
Unformatted ASCII Nonparity - Normal

Binary Modes: Formatted Binary - Special
Formatted Binary - Normal

Unformatted Binary - Normal

1. Formatted ASCII Normal - Data in this mode is assumed by the Monitor to be in strings of 7-bit ASCII characters terminated by LINE FEED, FORM FEED, or VERTICAL TAB.

   READ: The line buffer is filled until either a terminator is seen or the number of bytes transferred becomes equal to the MAXIMUM BYTE COUNT. If the MAXIMUM BYTE COUNT is reached before the terminator is seen, the invalid line error bit in the Status Register of the buffer header is set, and each remaining character through to the terminator is read into the last byte of the line buffer, i.e., the surplus bytes are overlayed. After the transfer, the actual byte count is set to the number of bytes read (including the excess). RUBOUTs and NULLs are discarded. The terminator is transferred. LINE FEED is supplied after RETURN.

   WRITE: The line buffer is output until the number of bytes transferred equals the ACTUAL BYTE COUNT. If the last character is not a terminator, the invalid line error bit is set in the STATUS BYTE of the buffer header. Previous terminators are output as normal characters.

For non file-structured devices, TABs are automatically followed by RUBOUTs; FORM FEEDs are automatically followed by NULLs.

The READ/WRITE processor passes data to the device driver specified, and each driver will convert the information to meet its specific needs. Appendix G summarizes the characteristics of the device drivers. Normally, output is deferred until the current buffer is full or until a .CLOSE or .RLSE occurs. However, for terminal devices, the buffer is written when a line terminator is seen. VERTICAL TAB plays a special role here, since it is a terminator but does not cause a carriage return or paper motion.

2. Formatted ASCII Special -

READ: The same as formatted ASCII normal with this exception: if the MAXIMUM BYTE COUNT is reached before the terminator, the transfer is stopped. The remaining characters are not overlaid, but are retained for transfer at the next .READ. An invalid line error will be returned in the STATUS BYTE, and ACTUAL BYTE COUNT will equal MAXIMUM.

WRITE: The same as formatted ASCII normal with this exception: the line buffer is output until the first terminator; the ACTUAL BYTE COUNT will stop the transfer if it is reached before the terminator is seen. In this case, the invalid line error bit is set in the STATUS BYTE. Note that in this mode only one line of data can be output at once, but its byte count need not be exactly specified, provided it is not greater than the ACTUAL BYTE COUNT.

3. Formatted Binary Normal -

READ: This is an 8-bit transfer. Words 2 and 3, STATUS/MODE, and ACTUAL BYTE COUNT always accompany the data during formatted binary transfers. The counts are adjusted by the Monitor to include the extra words. On input, the line buffer is filled until the number of characters transferred equals the ACTUAL BYTE COUNT read, or the MAXIMUM BYTE COUNT. If the MAXIMUM is reached before the ACTUAL, an invalid line error occurs and the remaining bytes are overlaid into the last byte until the checksum is verified. After the transfer, the ACTUAL BYTE COUNT contains the actual number of data bytes read (including the excess).

WRITE: This is an 8-bit transfer. Words 2 and 3 of the line buffer header are output, and data is transferred until the number of characters transferred is equal to the ACTUAL BYTE COUNT; then a checksum is calculated. The checksum is output at the end. The byte count is adjusted to reflect the presence of words 2 and 3 from the line buffer header.

READ: The line buffer is filled until the number of characters transferred equals the ACTUAL BYTE COUNT read. If the MAXIMUM COUNT is reached before the ACTUAL, the remainder of the line is retained by the Monitor. The MAXIMUM BYTE COUNT is transferred to the line

buffer and the ACTUAL BYTE COUNT is set to the full input count, rather than to the number of bytes actually transferred. The invalid line error will be set in the STATUS BYTE. The user can compare the MAXIMUM COUNT with the ACTUAL, determine how much data remains, and recover it by an unformatted binary read (allowing 1 extra byte for the checksum).

WRITE: Identical to formatted binary normal

5. Unformatted ASCII Normal or Special - This mode is available to the user who wants to do his own formatting. Seven bits are transferred; the eighth is always set to zero. NULLs are discarded.

   READ: Transfer stops when the number of bytes transferred reaches the MAXIMUM BYTE COUNT. Nulls are discarded but all other characters are treated as valid.

   WRITE: All characters are transferred. The transfer stops when the ACTUAL BYTE COUNT is reached.

6. Unformatted Binary Normal or Special - This mode is identical to unformatted ASCII except that eight bits are transferred on both input and output and nulls are not discarded. No checksum is calculated.

7. Formatted ASCII Parity - Identical to formatted ASCII (Special or Normal) except that even parity is generated in the eighth bit on OUTPUT; during INPUT it will be checked. Valid characters will be passed to the user as 7 bits; invalid characters will be marked by bit 8 = 1, and will cause the setting of the parity error bit in the STATUS BYTE.

8. Unformatted ASCII Parity - Identical to unformatted ASCII (Special or Normal) except that eight bits are transferred instead of seven. No parity generating or checking is performed.

9. Indirect Modes - All modes can be specified as indirect, which means that the word after the ACTUAL BYTE COUNT is considered to be a pointer to the beginning of the data rather than the beginning of the data proper. (Section 3.9.4.) This is referred to as DUMP mode.

3.9.3.2 The Status Byte

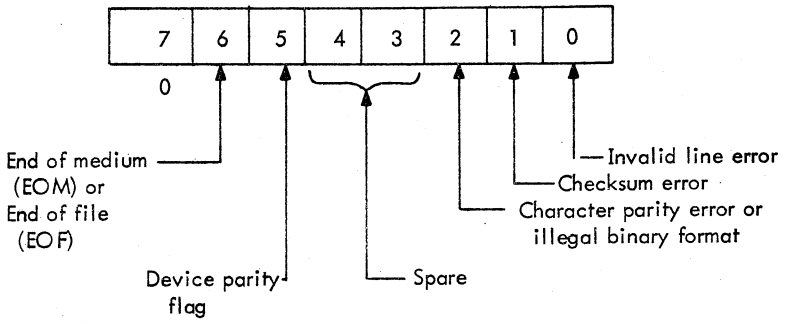


Figure 3-11 Status Byte Format

The function of each status format bit is explained below.

Bit	Mode	Request	Condition
	ALL	.READ/WRITE	Appropriate BYTE COUNT = 0 at call.
0 (INVALID LINE)	FORMATTED ASCII NORMAL (parity or non-parity)	.READ	The MAXIMUM BYTE COUNT ran out before a line terminator was seen. (Last byte has been overlaid until the terminator has been reached.)
		.WRITE	The last byte was not a terminator.
	FORMATTED ASCII SPECIAL (parity or non-parity)	.READ	The MAXIMUM BYTE COUNT was reached before a line terminator was seen (excess data has not yet been read).
		.WRITE	The ACTUAL BYTE COUNT was reached before any terminator was seen.
	FORMATTED BINARY NORMAL	.READ	The MAXIMUM BYTE ran out before the count stored with the data. (The last byte has been overlaid in order to verify the checksum.)
	FORMATTED BINARY SPECIAL	.READ	The MAXIMUM BYTE COUNT was reached before the count stored with the data. (The excess data still remains to be read and checksum has not been verified.)
	ALL UNFORMATTED MODES	.READ	BYTE COUNT = the actual number of bytes transferred. The reason BYTE COUNT < MAXIMUM BYTE COUNT is that an EOF or EOM has been encountered before the buffer was full. Bit 6 will also be set.
1 (CHECKSUM ERROR)	FORMATTED BINARY	.READ	There was a discrepancy between the checksum accumulated during the .READ, and that stored with the incoming data.

2 (PARITY FORMAT)	FORMATTED ASCII PARITY NORMAL OR SPECIAL	.READ	A character was read which had odd parity. The eighth bit of the illegal character delivered is set to a 1. The transfer continues. If this bit is set the user need only check each character returned during processing of the buffer for bit 8 set to locate the character returned with wrong parity.
2 (ILLEGAL BINARY FORMAT)	FORMATTED BINARY	.READ	This bit is set if a line processed in a binary mode does not have a 001 in the first word. The first word is ignored, i.e., no data is returned to the buffer. Subsequent reads access successive lines and return error bits or data as appropriate.
6 (EOM/EOF)	ALL MODES	.READ or .WRITE	An input device cannot supply any more data or an output device cannot accommodate more, i.e., the disk has no more storage space, or the paper tape reader has run out of paper tape. No data is returned on .READs unless bit Ø is also set (see bit Ø). On .WRITEs an unspecified portion of the buffer may have been written (enough data to fill a partially filled monitor buffer may have been transferred to the buffer and written before the EOM or EOF was detected). Subsequent requests return to user with this bit set.
5 (DEVICE PARITY)	ALL MODES	.READ or .WRITE	A hardware error has been detected on a bulk storage device. This could be either a parity error or a timing error. The driver will already have tried to READ or WRITE 8 or 9 times before setting this bit. (This flag is a warning that the data in this line or some subsequent line still using data from the same device block may be invalid. It will be returned for each transfer call using the same block.)

3.9.4 The RECORD Block

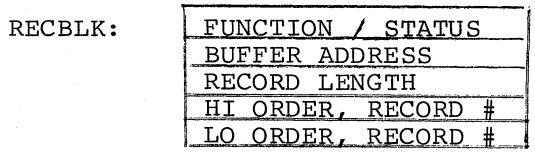


Figure 3-12 The Record Block

ADDRESS FUNCTION

RECBLK FUNCTION / STATUS WORD

BIT

Ø - Not used
1 - Record Output - Set by user
2 - Record Input - Set by user
3-8 - Not used

(Following bits set by Monitor)

9 - Illegal Function
1Ø - File is linked or device is not File structured.
11 - Record requested lies outside the file.
12 - File not OPEN
13 - Protect code violation, Incorrect Open
14 - Not used
15 - Device parity error

The user may set only bits 1 or 2; error bits are set by the Monitor, and should be tested for by the user upon return from the request. The error bits are cleared by the Monitor when a .RECRD request is issued and are set as appropriate upon return from the Monitor.

RECBLK+2 BUFFER ADDRESS

The address of the user's buffer. The buffer must be large enough to contain a record of the length indicated in the next word, as the Monitor assumes that sufficient space is available and will overlay data stored below a buffer of insufficient length.

RECBLK+4 RECORD LENGTH

The number of bytes of a Record. This value, which must remain the same for all records in the file, is supplied by the user.

RECBLK+6 High Order - Record Number
RECBLK+1Ø Low Order - Record Number

This entry identifies the record to be read or written. Two words are provided in anticipation of files with more than 65,536 records.

First Record of File is number Ø.

BLOCK Block

3.9.5 The BLOCK Block - (used by BLOCK request only)

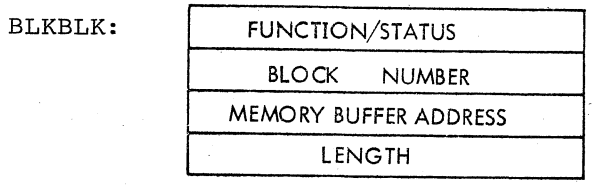


Figure 3-13 The BLOCK Block

Address	Name	Function
BLKBLK	FUNCTION/STATUS	User specifies here the function to be performed, and the Monitor returns to the user with the appropriate status bits set.

Bit		Bit = 1 means:
function	0	function is GET
	1	function is OUTPUT
	2	function is INPUT
	3-8	reserved
error	9	illegal function
	10	file is linked, or device is not file structured
	11	block number does not exist in file, i.e., it is greater than the file length
status	12	file not open
	13	protect code violation
	14	end of data error
	15	device parity error

BLKBLK+2	BLOCK NUMBER	Requested block number to be transferred relative to the beginning of the file. First block of file is 0.
BLKBLK+4	MEMORY BUFFER ADDRESS	The address of the buffer (supplied by the Monitor on INPUT or GET functions).
BLKBLK+6	LENGTH	The length of the buffer in words. BLKBLK+6 is set by the Monitor on INPUT or GET functions.

3.9.6 The TRAN Block (used by TRAN request only)

TRNBLK:

DEVICE BLOCK NUMBER
MEMORY START ADDRESS
POSITIVE WORD COUNT
FUNCTION/STATUS
NUMBER OF WORDS NOT TRANSFERRED

Figure 3-14 The TRAN Block

The user must set up a TRAN block for each .TRAN in his program.

Address	Name	Function
TRNBLK	DEVICE BLOCK NUMBER	User specifies here the absolute block number of the device, at which the transfer is to begin. Block Ø is the first block on bulk storage devices. If it is not a bulk storage device, specify block Ø.
TRNBLK+2	BUFFER ADDRESS	User specifies here the core memory address at which the data transfer is to begin.
TRNBLK+4	WORD COUNT	User specifies here the total number of 16-bit words to be transferred. Word count may be more or less than block size.
TRNBLK+6	FUNCTION/STATUS	

Bit	Bit Meaning
0	Binary = 1, as opposed to ASCII = 0
1	Write = 1*
2	Read = 1*
3	
4	
5	
6	
7	Reserved for Monitor's use
8	
9	
10	
11	DECtape direction* 0 = forward 1 = reverse
12	Reserved for RSX-11
13	Invalid call (improper function/no word count)**
14	End of medium**

*Must be specified by user.
**This bit is cleared by the Monitor upon .TRAN request issue and is set as appropriate upon return.

Address	Name	Function	
		Bit	Bit = 1 means:
		15	Recoverable device error (such as parity, timing, or record length)**
TRNBLK+10	NUMBER OF WORDS NOT TRANSFERRED	User leaves this entry blank. If an EOM occurs during the transfer, the Monitor will place in this entry the number of words not transferred.	

**This bit is cleared by the Monitor upon .TRAN request issue and is set as appropriate upon return.

3.9.7 The Special Functions Block (used for SPEC request only)

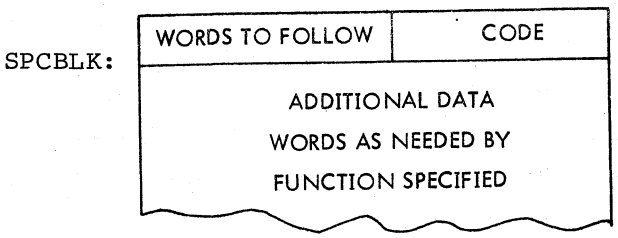


Figure 3-15

Where a special function requires supporting data the user must set up a Special Functions Block in his program.

Address	Name	Function
SPCBLK	CODE	The user identifies the function here by inserting the appropriate code in the range $0\text{-}255_{10}$.
SPCBLK+1	WORDS TO FOLLOW	The size of each Special Functions Block is dependent upon the Function. The user shows here how many more words belong to the particular block.
SPCBLK+2 ⋮	---	The user places in these words data to be passed to the function processor or the function processor will return here such items as status information, etc. The format in each case is determined by the function.

See Appendix J for a description of the special functions which may be performed for each device.

3.9.8 The RUN Block

The RUN Block is used exclusively with the .RUN request. It is a variable length control block containing a function word and several parameter words. The function word is always present; any of the parameter words may be omitted, depending upon the settings of the function word.

NOTE

Omitting a parameter word does not mean setting it to zero, but rather leaving it out. Hence, no parameter word occupies a set position in the RUN Block and the block itself is of variable length. For reference, all words but the function word are referred to by a letter, not by a number.

Word*	Parameter	Present If:
1	FUNCTION WORD	always
A	FILE BLOCK POINTER	Bit 15=0
B	LINK BLOCK POINTER	Bit 15=0
C	NAME	Bit 15=1 or Bit 13=1
D	NAME	Bit 15=1 or Bit 13=1
E	LOAD ADDRESS	Bit 3=1
F	TRANSFER ADDRESS OFFSET	Bit 4=1
G	RETURN ADDRESS	Bit 5=1

* Words A through G are so designated because any of them might be omitted under certain conditions.

Figure 3-16 The RUN Block

Address	Name	Function
RUNBLK	FUNCTION	User specifies here the function to be performed (see below).
RUNBLK+A	FILE BLOCK	Address of the File Block describing the file which contains the load module or core image to be loaded.
RUNBLK+B	LINK BLOCK	Address of the Link Block which describes the device from which the entity is to be loaded. Sufficient room must be provided in the Link Block to contain the EMT numbers of all Monitor modules which are to be loaded (these are contained in the load module, if there are any).

Address	Name	Function
RUNBLK+C and RUNBLK+D	NAME	Two Radix-50 words containing either the name of the specific core image to be loaded from a CIL (bit 13=1) or the name of the file to be loaded if no File Block was given (bit 15=1).
RUNBLK+E	LOAD ADDRESS	Specifies an address at which the entity is to be loaded, without regard to the load address in the load module or CIL. The entity should be position independent.
RUNBLK+F	TRANSFER ADDRESS OFFSET	Specifies a value to be added to the transfer address obtained from the load module or CIL. Provides for alternate entry points to the module.
RUNBLK+G	TRANSFER ADDRESS	Specifies an address to which control must be passed when loading is completed. This address may or may not be in the loaded entity.

3.9.8.1 The Function Word

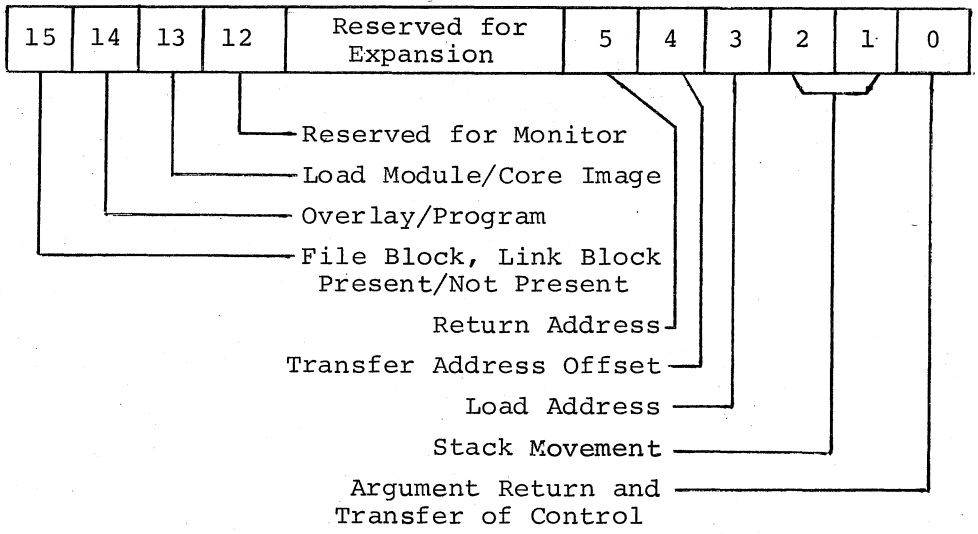


Figure 3-17 The Function Word

Bit Ø Argument Return and Transfer of Control

=Ø Indicates control is to be returned to the instruction following the .RUN request after completing the requested actions, unless bit 5=1. Regardless of the setting of bit 5, the load module's transfer address, size in bytes, and low address will be on top of the stack when bit Ø=Ø (see Section 3.8.1.1).

=1 Indicates control is to be switched to the transfer address of the loaded module after completion of the load, unless bit 5=1. Regardless of the setting of bit 5, no information is returned on the stack when bit Ø=1, but information may be passed by the call to the loaded module either on the stack or in the general registers.

Bit 1 Stack Movement

=Ø Indicates that the stack is not to be moved from its present position under any condition.

=1 Indicates that stack relocation may be necessary and that bit 2 of this word must be tested to determine under what conditions relocation will be necessary.

Bit 2 Movement Condition

=Ø Indicates that the stack is to be unconditionally moved to the area directly below the module to be loaded. In this position the stack base entry in the System Vector Table (SVT) will be the same as the low address of the loaded module.

=1 Indicates that the stack is to be conditionally moved, based on the relative positions of the stack base and low address of the module to be loaded. If the stack base entry in the SVT is higher than the low address of the module to be loaded, then the stack should be relocated as described above. If the stack base entry in the SVT is lower in core or equal to the low address of the module to be loaded, then the stack will not be relocated.

Bit 3 Load Address

=Ø Indicates that no optional load address is specified in the RUN Block. The load address information in the load module will be used.

=1 Indicates that the address specified in the RUN Block is to be used as the load address for the requested module. This entry overrides the load module information.

Bit 4 Transfer Address Offset

=Ø Indicates that no offset from the module's transfer address is included in the RUN Block.

=1 Indicates that the user desires an offset, specified in the RUN Block, to be added to the loaded module's transfer address. This offset is added to the transfer address regardless of the setting of bit 0 of the action word.

Bit 5 Return Address

=Ø Indicates that no alternate return address is included in the RUN Block. Return of control will thus be determined by the setting of bit 0.

=1 Indicates that an alternate return address has been specified in the RUN Block and that this address will receive control instead of the address following the .RUN request or the transfer address of the load module. The setting of bit 0 will still determine whether information will be returned on the stack.

Bit 12 Reserved for Monitor

This bit should always be zero.

Bit 13 Load Module/Core Image

=Ø Indicates that the entity being loaded is a load module. If the file identified by the File Block is a CIL, the first member of the CIL will be loaded.

Bit 13 (continued)

=1 Indicates that the entity to be loaded is a member of Core Image Library. The File Block identifies the CIL, while words 4 and 5 of the RUN Block contain the name of the CIL member.

Bit 14 Overlay/Program

=Ø Indicates that an overlay is being loaded. Since this is a continuation of the current program, datasets may be left open across this call. The overlay may not extend above the low address of the resident module, nor may it extend below the top of the Monitor area. System control tables are not refreshed as a consequence of this call. No additional Monitor modules may be made resident.

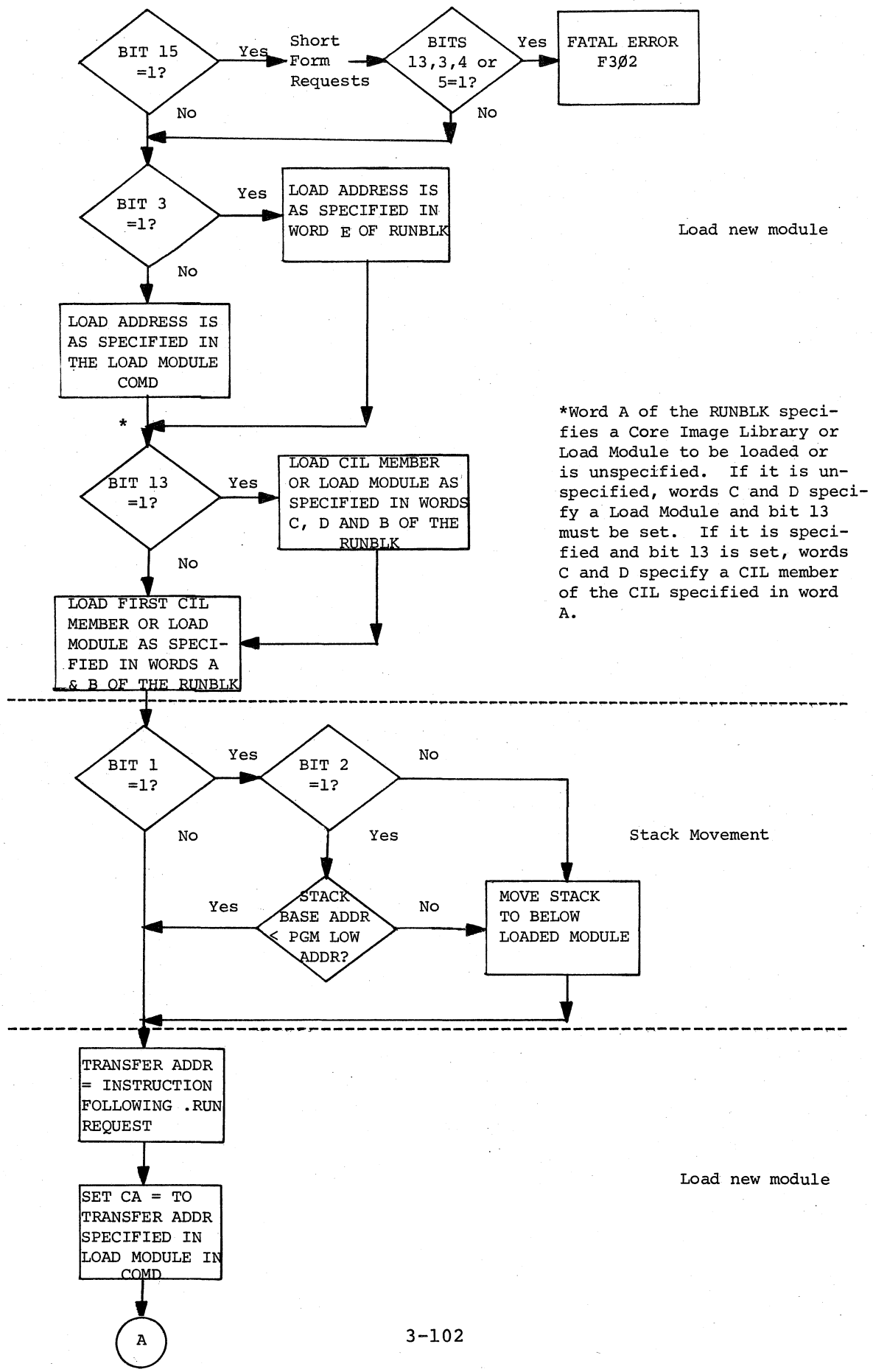
=1 Indicates that a new program is being loaded. This is as if a new program were being RUN from the keyboard. Although all datasets must be released by the program which called RUN, RUN itself will do several things to refresh the environment. This includes releasing Monitor modules made resident by the previous program, undoing dataset assignments made specifically for the previous program, loading any Monitor modules which should be resident for this program, and changing any program-related values in the SVT.

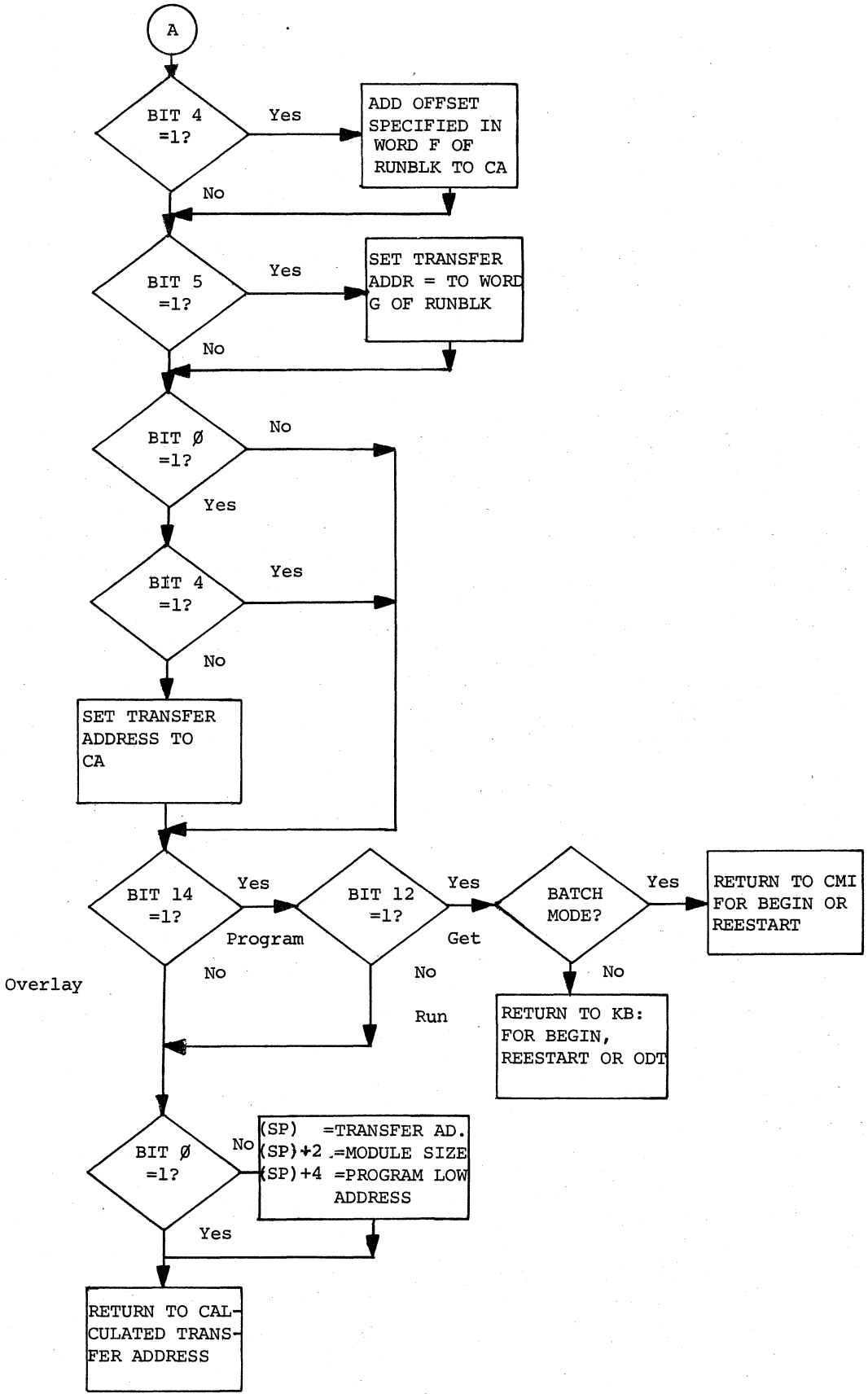
Bit 15 File Block, Link Block

=Ø Indicates that a Link Block and a File Block pointer are in the RUN Block.

=1 Indicates that the caller has provided a short form of the RUN Block; the short form contains only a function word and a six-character filename. The Link Block and File Block are created by the .RUN request itself. The entity to be loaded must be either in the current user's area or in the [1,1] UIC area and must have an extension of LDA or null. All other function bits are ignored. The load module or core image (first member of CIL) is loaded at its normal load address, as if it were an overlay, and receives control at its normal transfer address. The stack is not moved.

The following flowchart illustrates the effects of the various function word bits and their interrelationships.


BIT 15 =1?
Yes
Short Form Requests
BITS 13,3,4 or 5=1?
Yes
FATAL ERROR F3Ø2
No
No
BIT 3 =1?
Yes
LOAD ADDRESS IS AS SPECIFIED IN WORD E OF RUNBLK
No
LOAD ADDRESS IS AS SPECIFIED IN THE LOAD MODULE COMD
*
BIT 13 =1?
Yes
LOAD CIL MEMBER OR LOAD MODULE AS SPECIFIED IN WORDS C, D AND B OF THE RUNBLK
No
LOAD FIRST CIL MEMBER OR LOAD MODULE AS SPECIFIED IN WORDS A & B OF THE RUNBLK
Load new module
*Word A of the RUNBLK specifies a Core Image Library or Load Module to be loaded or is unspecified. If it is unspecified, words C and D specify a Load Module and bit 13 must be set. If it is specified and bit 13 is set, words C and D specify a CIL member of the CIL specified in word A.
BIT 1 =1?
Yes
BIT 2 =1?
No
No
Yes
Stack Movement
Yes
STACK BASE ADDR < PGM LOW ADDR?
No
MOVE STACK TO BELOW LOADED MODULE
TRANSFER ADDR = INSTRUCTION FOLLOWING .RUN REQUEST
SET CA = TO TRANSFER ADDR SPECIFIED IN LOAD MODULE IN COMD
Load new module
A


A
BIT 4 =1?
Yes
ADD OFFSET SPECIFIED IN WORD F OF RUNBLK TO CA
No
BIT 5 =1?
Yes
SET TRANSFER ADDR = TO WORD G OF RUNBLK
No
BIT Ø =1?
No
Yes
BIT 4 =1?
Yes
No
SET TRANSFER ADDRESS TO CA
BIT 14 =1?
Yes
Program
Overlay
No
BIT 12 =1?
Yes
Get
No
Run
BATCH MODE?
Yes
RETURN TO CMI FOR BEGIN OR REESTART
No
RETURN TO KB: FOR BEGIN, REESTART OR ODT
BIT Ø =1?
No
(SP) =TRANSFER AD.
(SP)+2 =MODULE SIZE
(SP)+4 =PROGRAM LOW ADDRESS
Yes
RETURN TO CAL-CULATED TRANS-FER ADDRESS

APPENDICES

APPENDIX A
PHYSICAL DEVICE NAMES

Mnemonic	Device	
DC	RC11 Disk	014570
DF	RF11 Disk	014760
DK	RK11 Disk	015270
DT	DECtape (TC11)	016040
KB	ASR-33 Keyboard/Teletype	042420
LP	Line Printer (LP11)	046600
MT	Magtape (TM11)	052140
PP	High-Speed Paper Tape Punch	063200
PR	High-Speed Paper Tape Reader	063320
PT	ASR-33 Paper Tape Device	063440
CR	Card Reader (CR11)	012620
SY	System Residence Device (DC, DF, or DK)	075250

a. Device mnemonics may be three letters on a particular system. The third letter is assigned if there is more than one controller, e.g.:

DTA for DECtape controller "A"
DTB for DECtape controller "B"

b. The device name may be followed by an octal number to identify a particular unit when the controller has several device units associated with it, e.g.:

DT1 indicates unit 1 under a single DECtape control.

DTA1 indicates unit 1 under controller A in a multicontrol situation.

The Radix-50 equivalence is derived in accordance with the following formula:

$$C_1 \times 50_8^{\,2} + C_2 \times 50_8 + C_3$$

where C_n is a character (legal characters are space A-Z, $, period, and 1-9. These characters are assigned values from Ø (for space) through 47_8 (for 9).

The following program may be used to print the octal representation of any 3-character set Radix-5Ø equivalence. To exit type an illegal character.

APPENDIX B
EMT CODES

EMT Code	Programmed Request	Described on Page
0	.WAITR	3-36
1	.WAIT	3-35
2	.WRITE	3-29
3	[2]	
4	.READ	3-28
5	[2]	
6	.INIT	3-20
7	.RLSE	3-21
10	.TRAN	3-33
11	.BLOCK	3-31
12	.SPEC	3-37
13	.STAT	3-38
14	.LOOK	3-44
15	.ALLOC	3-39
16	.OPENx	3-22
17	.CLOSE	3-22
20	.RENAM	3-26
21	.DELET	3-41
22	.APPND	3-43
24	.KEEP	3-46
25	.RECRD	3-30
26-27	[2]	
30-31	[1]	
32	Diagnostic Print	
33-35	[1]	
36-37	[2]	
40	[1]	
41	General Utilities	3-50,-66
42	General Conversions	3-67,-74
43-55	[1]	
56,57	Command String Interpreter	3-76,77
60	.EXIT	3-49
61-63	[1]	
64	[1]	
65	.RUN	3-47
66	.CVTDT	3-57
67	[2]	
68-76	[2] (70, reserved for Multi-User Operation)	
77	[1]	
100-117	(reserved for Communications Executive, COMTEX-11)	
120-137	(reserved for Real-Time Monitor, RSX-11)	
140-167	(reserved for user-implemented routines)	

[1] Reserved for Monitor internal communication.

[2] Reserved for future Monitor expansion.

APPENDIX C
SUBSIDIARY ROUTINES AND OVERLAYS

With the exception of .READ/.WRITE and .WAIT, all Monitor code for performing programmed requests is potentially non-resident. Since non-resident modules are limited to a size of 256 words (the size of the swap buffer) and since many common functions are required, many of the programmed request modules must make use of subsidiary routines. The table given below can be used in two ways:

- when assessing the number of disk accesses required to satisfy a request, the table shows how many modules (in addition to the primary module) may be loaded;
- when making certain functions resident, one must not only make the primary module resident, but must also make resident each of the subsidiary modules which may be called. For example, if one wants all .OPENI processing routines (except for magtape) resident, he would put the following assembler directive in his program:

```
.GLOBL OPN,FOP,LUK,CKX
```

The following summary explains the codes used in the table.

(blank) = subsidiary routine is never called

X = subsidiary routine is called only when a file-structured device is referenced

L = subsidiary routine is called only when a linked file is referenced

C = subsidiary routine is called only when a contiguous file is referenced

D = subsidiary routine is called only when DECtape is referenced

M = subsidiary routine is called only if magtape is referenced

		Name of Subsidiary Routine														
Global Name of Primary Module	Request	Open Existing File FOP	Creating New Linked File FCR	Close File FCL	Directory Search LUK	Allocate Block, Linked File LBA	Get Bit Map Segment GMA	Allocate Contiguous Blocks CBA	Check Access CKX	Delete Linked File DLN	Delete Contiguous File DCN	Append DECtape AP2	Get Next Bit Map Segment GNM[2]	Magtape Open MTO	LDR[4] Loader	LD2[4] Loader
RWN	.READ/WRITE[1]												X			
OPN	.OPENU	X			X				X					M		
OPN	.OPENO[3]		X		X	X	X		X					M		
OPN	.OPENE	X			X	X	X		X					M		
OPN	.OPENI[4]	X				X			X					M		
OPN	.OPENC	X				X			X							
CLS	.CLOSE[4]			X												
ALO	.ALLOC				X			X	X							
DEL	.DELET				X				X	L	C					
REN	.RENAM				X				X							
APP	.APPND				X				X			D				
DIR	.LOOK				X				X							
PRO	.KEEP				X				X							
RUN	.RUN[4]	X		X	X				X					M	X	X
INR	.INIT[5]															
RLS	.RLSE[4]															

[1]Always resident.

[2]Should never be made resident.

[3]The .OPENO module requires a second section if a dataset other than CMO is being opened on the device assigned to CMO.

[4]The .RUN EMT calls the following routines:

```
.INIT
.OPENI    (once for each combination of filename and UIC)
.LDR      (three sections if LDA file; two if CIL file)
.LD2
.CLOSE    (once for each .OPENI)
.RLSE
```

[5]The .INIT module has two sections, but the second has no name. It is resident automatically if .INIT is resident.

APPENDIX D

SUMMARY OF MONITOR COMMANDS

Command	Usage
Commands to Allocate System Resources	
ASSIGN	Assign a physical device to a logical device name
Commands to Manipulate Core Images	
RUN	Load and begin a program
GET	Load a program
DUMP	Write a specified core area onto a device as a core image
SAVE	Write a program onto a device in loader format
Commands to Start a Program	
BEGIN	Start execution of a program
CONTINUE	Resume execution of a halted program
RESTART	Restart execution of a previously operating program
Commands to Stop a Program	
STOP	Halt the current program, including any I/O in progress
WAIT	Halt current program after finishing any I/O in progress
KILL	Halt the current program, finish any I/O in progress, close all open files, and pass control back to the Monitor
Commands to Exchange Information with the System	
DATE	Fetch/Specify date
TIME	Fetch/Specify time

(continued on next page)

Optional characters are underlined. If any optional character appears, all must appear.

Command	Usage
Commands to Exchange Information with the System (Cont)	
LOGIN	Enter User Identification Code
MODIFY	Modify contents of memory location
FINISH	Log off system
Miscellaneous Commands	
ECHO	Disable/enable keyboard echo to user program
PRINT	Disable/enable teleprinter output from user program
END	End input from a device
ODT	Begin operation of Octal Debugger (ODT)

Optional characters are underlined. If any optional character appears, all must appear.

Global Mnemonic	Function	Macro Call (see notes)	Assembly Language Expansion (see notes)	Refer to Page

.ALLOC	Allocate a Contiguous File	.ALLOC #LNKBLK,#FILBLK,#N	MOV #N,-(SP)
			MOV #FILBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 15
				3-39

.APPND	Append to a Linked File	.APPND #LNKBLK,#FIRST,#SECOND	MOV #SECOND,-(SP)
			MOV #FIRST,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 22
				3-43

.BIN2D	Convert Binary to Decimal ASCII	.BIN2D #ADDR,WORD	MOV WORD,-(SP)
			MOV #ADDR,-(SP)
			MOV #3,-(SP)
			EMT 42
				3-72

.BIN2O	Convert Binary to Octal ASCII	.BIN2O #ADDR,WORD	MOV WORD,-(SP)
			MOV #ADDR,-(SP)
			MOV #5,-(SP)
			EMT 42
				3-74

.BLOCK	Transfer a Block	.BLOCK #LNKBLK, #BLKBLK	MOV #BLKBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 11
				3-31

.CLOSE	Close a Dataset	.CLOSE #LNKBLK	MOV #LNKBLK,-(SP) EMT 17	3-26
.CORE	Obtain Core Size	.CORE	MOV #100,-(SP) EMT 41	3-52
.CSI1	CSI Interface - part 1	.CSI1 #CMDBUF	MOV #CMDBUF,-(SP) EMT 56	3-76
.CSI2	CSI Interface - part 2	.CSI2 #CSIBLK	MOV #CSIBLK,-(SP) EMT 57	3-77

Global Mnemonic	Function	Macro Call (see notes)	Assembly Language Expansion (see notes)	Refer to Page

.CVTDT	Convert Binary Date or Time to ASCII character string	.CVTDT #CODE,#ADDR[,VALUE]
		VALUE is an optional argument specified with Codes 2 and 3 only.
			If Code = 3
			MOV VALUE+2,-(SP)
			If Code = 2 or 3
			MOV VALUE,-(SP)
			All codes
			MOV #ADDR,-(SP)
			MOV #CODE,-(SP)
			EMT 66
				3-57

.DATE	Obtain Date	.DATE	MOV #103,-(SP) EMT 41	3-55

.DELET	Delete a File	.DELET #LNKBLK,#FILBLK	MOV #FILBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 21
				3-41

.D2BIN	Convert Decimal ASCII to Binary	.D2BIN #ADDR	MOV #ADDR,-(SP)
			MOV #2,-(SP)
			EMT 42
				3-71

.EXIT	Exit to Monitor	.EXIT	EMT 60	3-49
.GTCIL	Get disk address of Core Image library	.GTCIL	MOV #111,-(SP) EMT 41	3-63
.GTUIC	Get Current UIC	.GTUIC	MOV #105,-(SP) EMT 41	3-59
.GTPLA	Get Program Low Address	.GTPLA	CLR -(SP) MOV #5,-(SP) EMT 41	3-61
.GTSTK	Get the Stack Base Address	.GTSTK	CLR -(SP) MOV #4,-(SP) EMT 41	3-64

Global Mnemonic	Function	Macro Call (see notes)	Assembly Language Expansion (see notes)	Refer to Page
.INIT	Initialize a Dataset	.INIT #LNKBLK	MOV #LNKBLK,-(SP) EMT 6	3-20

.KEEP	Protect a File	.KEEP #LNKBLK,#FILBLK	MOV #FILBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 24
				3-46

.LOOK	Directory Search	.LOOK #LNKBLK,#FILBLK[,1]
		
		,1 is an optional argument
			MOV #FILBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 14
			or when optional argument is specified:
			
			MOV #FILBLK,-(SP)
			CLR -(SP)
			MOV #LNKBLK,-(SP)
			EMT 14
				3-44

.MONF	Obtain Full Monitor Size	.MONF	MOV #102,-(SP) EMT 41	3-54
.MONR	Obtain Size of Resident Monitor	.MONR	MOV #101,-(SP) EMT 41	3-53

.OPEN	Open a Dataset	.OPEN #LNKBLK,#FILBLK	MOV #FILBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 16
				3-22

.OPENx	Open a Dataset	.OPENx #LNKBLK,R	MOV #CODE,-2(R)
			MOV R,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 16
			
			CODE=1 for .OPENU
			2 for .OPENO
			3 for .OPENE
			4 for .OPENI
			13 for .OPENC
				3-22

Global Mnemonic	Function	Macro Call (see notes)	Assembly Language Expansion (see notes)	Refer to Page

.O2BIN	Convert Octal ASCII to Binary	.O2BIN #ADDR	MOV #ADDR,-(SP)
			MOV #4,-(SP)
			EMT 42
				3-73

.RADPK	Radix-50 ASCII Pack	.RADPK #ADDR	MOV #ADDR,-(SP) CLR -(SP) EMT 42	3-67

.RADUP	Radix-50 ASCII Unpack	.RADUP #ADDR,WORD	MOV WORD,-(SP)
			MOV #ADDR,-(SP)
			MOV #1,-(SP)
			EMT 42
				3-70

.READ	Read from Device	.READ #LNKBLK,#BUFHDR	MOV #BUFHDR,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 4
				3-28

.RECRD	Read or Write a Specified Record in a File	.RECRD #LNKBLK,#RECBLK	MOV #RECBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 25
				3-30

.RENAM	Rename a File	.RENAM #LNKBLK,#OLDNAM,#NEWNAM	MOV #NEWNAM,-(SP)
			MOV #OLDNAM,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 20
				3-42

.RLSE	Release a Dataset	.RLSE #LNKBLK	MOV #LNKBLK,-(SP) EMT 7	3-21

.RSTRT	Set REstart address	.RSTRT #ADDR	MOV #ADDR,-(SP)
			MOV #2,-(SP)
			EMT 41
				3-51

.RUN	Load a program or Overlay	.RUN #RUNBLK	MOV #RUNBLK,-(SP) EMT 65	3-47

.SPEC	Special Function	.SPEC #LNKBLK,#SPCARG	MOV #SPCARG,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 12
				3-37

Global Mnemonic	Function	Macro Call (see notes)	Assembly Language Expansion (see notes)	Refer to Page
.STAT	Obtain Device Status	.STAT #LNKBLK	MOV #LNKBLK,-(SP) EMT 13	3-38

.STPLA	Set Program Low Address	.STPLA #ADDR	MOV #ADDR,-(SP)
			MOV #5,-(SP)
			EMT 41
				3-62

.STFPU	Initialize the Floating Point exception vector (11/45)	.STFPU #PSW,#ADDR	MOV #ADDR,-(SP)
			MOV #PSW,-(SP)
			MOV #3,-(SP)
			EMT 41
				3-66

.STSTK	Set the Stack Base Address	.STSTK #ADDR	MOV #ADDR,-(SP)
			MOV #4,-(SP)
			EMT 41
				3-65

.SYSDV	Obtain System Device Name	.SYSDV	MOV #106,-(SP) EMT 41	3-60
.TIME	Obtain Time of Day	.TIME	MOV #104,-(SP) EMT 41	3-56

.TRAN	Transfer Absolute Block	.TRAN #LNKBLK,#TRNBLK	MOV #TRNBLK,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 10
				3-33

.TRAP	Set TRAP Vector	.TRAP #STATUS,#ADDR	MOV #ADDR,-(SP)
			MOV #STATUS,-(SP)
			MOV #1,-(SP)
			EMT 41
				3-50

.WAIT	Wait for Completion	.WAIT #LNKBLK	MOV #LNKBLK,-(SP) EMT 1	3-35

.WAITR	Wait for Completion; Return to ADDR	.WAITR #LNKBLK,#ADDR	MOV #ADDR,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 0
				3-36

.WRITE	Write on a Device	.WRITE #LNKBLK,#BUFHDR	MOV #BUFHDR,-(SP)
			MOV #LNKBLK,-(SP)
			EMT 2
				3-29

NOTES:

ADDR	a memory address
BLKBLK	address of BLOCK Block
BUFHDR	address of Line Buffer Header
CMDBUF	address of Command String Buffer
CSIBLK	address of Command String Interpreter Control Block
FILBLK	address of Filename Block
FIRST	address of Filename Block of file which is to be appended to
LNKBLK	address of Link Block
N	number of 64-word segments requested
NEWNAM	address of Filename Block containing the file's new name
OLDNAM	address of Filename Block containing the file's old name
PSW	program status word for an exception routine
R	register from RØ through R5 containing address of Filename Block
RECBLK	address of RECORD Block
SECOND	address of Filename Block of file which is appended
SP	Stack Pointer (register R6)
SPCARG	code for Special Function or Address of Special Function Block as determined by Function called.
TRNBLK	address of TRAN Block

APPENDIX F
SUMMARY OF DOS ERROR MESSAGES

Following is a complete summary of all error messages which can appear when using the DOS Monitor and system programs.

F.1 Keyboard Command Messages

If a command cannot be executed satisfactorily, an appropriate message will be printed at the teleprinter and the command will be ignored. The message will be one of the following.

Message	Meaning
ILL CMD!	Command requested does not exist
INV CMD!	Command cannot be accepted at this time (e.g., KILL with no program to kill)
SYN ERR!	Syntax of command is faulty
ILL DEV!	The device specified is illegal
NO FILE!	File specified does not exist or cannot be loaded by the RUN processor.
ILL ADR!	Address is illegal (not on word-bound or in core)
NO CORE!	Insufficient core capacity to execute command (SAVE)

F.2 Error Messages

Error messages are printed on the teleprinter in the following format.

CNNN XXXXXX

where C is one of five letters identifying the type of message:

I Information
A Action required by the operator
W Warning to the operator
F Fatal error
S System program error

NNN is the message number; and XXXXXX gives appropriate additional information. Information, Warning, and System program messages are printed and the program continues.

Action messages are printed and the program is suspended. The Monitor expects the operator to take some action such as "continue the program" (type CONTINUE), or "kill the program" (type KILL).

Fatal error messages are printed if possible, and the program is suspended. The Monitor will not allow the operator to CONTINUE the program, but expects to see either a BEGIN, RESTART or KILL command. If a fatal error is a system disk failure and the error message cannot be printed, the central processor halts. This is the only time that a halt occurs in the Monitor.

F.2.1 Action Message

Action messages are printed and the program is suspended. The Monitor expects the operator to take some action such as "continue the program" (type CONTINUE), or "kill the program" (type KILL).

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
AØØ1	User Call Address
DOS	Disk address error.
AØØ2	Device (RAD5Ø)
DOS	Device not ready. For example, the desired device/unit may be off-line or it may not be write-enabled. For DECtape or magtape, the proper unit may not have been selected. Make the device ready and type CO.
AØØ3	Link Block Address
DOS	The Link Block contains either an illegal device code or no device code at all. Use the MODIFY command to display the contents of Link Block+2, which is the dataset name (RAD5Ø), and then use the ASSIGN command to assign a device and/or file; type CO when ready.
AØØ4	User Call Address
DOS	DECtape error. Try adjusting the tape; type CO to retry the operation.
AØØ5	Pause Number
OTS	A PAUSE was encountered in a FORTRAN program. Type CO to continue.
AØØ6	Correct Module Name
LINK	Paper tape loaded out of order on Pass 2 of Linker. Load correct module and type CO to continue.
AØØ7	Call Address
DOS	The name of the output file being created on magtape is the same as that of an existing file. Type CO to write over the old file or mount another tape and then type CO.
AØ1Ø	Ø
DOS	A parity error occurred when trying to open a file on magtape. Type CO to continue searching. If the file being sought has a parity error in its label, it cannot be found.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
AØ11 DOS	Ø = Date is Bad, 1 = Time is Bad System date or time is not valid. Re-enter date or time via the console keyboard and type CO to continue.
AØ12 DOS	Status Register Magtape error. After having made 15 entries on a WRITE or WRITE EOF, the operation is still unsuccessful. Type CO to ignore the error and proceed, or type KI to stop the program and start over with a good tape.
AØ43 PIP	Disk Pack Block Number This is the block that is bad; issued by the RP11 pack initializer to provide a list of bad blocks and to permit job termination if too many are bad. Type CO if number of bad blocks thus far is tolerable.
AØ5Ø BATCH	Ø Batch Stream Wait. Type CO to continue.
A35Ø DOS	Ø Power has come up following a power failure. Any I/O in progress has been lost, but information in core and in the registers has been retained. If you wish to continue, type CO. Note, however, that if I/O was in progress, the driver(s) may have been left in a state which will not permit your program to be continued.

F.2.2 Information Messages

Information messages are printed and the program generally continues.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
I350 OTS	STOP Number A STOP statement was executed in a FORTRAN program.
I351 FORTRN	Ø More errors of a specified type occurred than were allowed. The program is terminated.
I352 FORTRN	Address of DEVTB Entry The logical device specified is not available, (See FORTRAN device table, DEVTB, for a layout.)
I353 OTS	Error Class Number No logging device. The command input device was in use when a run-time diagnostic message was to be issued. Because of a device conflict the normal message could not be issued.
I354 PIP	Ø Illegal response to CONFIRM; when attempting to zero an RK11 disk cartridge. The disk was not zeroed. Legal responses are: H for high-density disks (RKØ3/Ø5) L for low-density disk (RKØ2).

F.2.3 Warning Messages

Warning messages are printed and the program generally continues.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
WØØ2	Device Name (RAD5Ø) Device time out.
WØ43	Block Number Transfer error while using .TRAN to zero the disk.
W1Ø1 RSX	Number of Task Called Task called by number not present or call number illegal. Request ignored.
W1Ø2 RSX	Addr. in Call Sequence Delay units not correct in call start. Request ignored.
W1Ø3 RSX	Addr. in Call Sequence Delay time too large in call start. Request ignored.
W1Ø4 RSX	Addr. in Call Sequence No time slot available. Request ignored.
W1Ø5 RSX	Current Run-Time A level 1 task has exceeded its maximum run time. Task continued.
W1Ø6 RSX	Illegal or unrecognized console command. Command ignored.
W1Ø7 RSX	Report Number Illegal system report number in system command. Command ignored.
W11Ø RSX	Addr. in Call Sequence Attempted to start a background task while the background is busy. Request ignored.
W111 RSX	Addr. in Call Sequence Attempted to clock a background task. Request ignored.
W112 RSX	Symbolic task name not found. Request ignored.
W113 RSX	Command syntax error. Command ignored.
W114 RSX	Addr. in Call Sequence Illegal clock (call TRNON) time. Request ignored.
W3ØØ LINK	Ø, Module Name Non-unique object module detected in first pass. Second and subsequent occurrences of the module are ignored.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
W3Ø1 LINK	Addr. of Byte Error Byte relocation error. Linker automatically continues.
W3Ø2 LINK	Ø, Symbol and Module Names Multiple definitions of global symbol. Second definition is ignored and linking continues.
W3Ø3 EDIT	Buffer overflow. Overflow of one of the following Editor buffers: Command Input Buffer Save Buffer Page Buffer
W3Ø4 EDIT	Macro overflow. The command string as stored in the Save Buffer was too long to execute, when requested to do so by an EM (Execute Macro) command.
W3Ø5 EDIT	Recursive macro. The command string as stored in the Save Buffer contains an EM command.
W3Ø6 EDIT	Empty Save Buffer. An EM or U (Unsave) command was issued with nothing in the Save Buffer.
W3Ø7 EDIT	Search failure. The n^{th} occurrence of the search object was not found in the available test.
W31Ø EDIT	Unsave failure. Insufficient room to copy the contents of the Save Buffer into the Page Buffer at dot.
W311 EDIT	End-of-data detected. The end of the input file or the end of the input medium was reached during the last read of text into the Page Buffer, last page read was last in the file.
W312 EDIT	Illegal line feed. A line feed character was encountered in the command string.
W313 EDIT	Illegal negative argument. A negative argument was used with a command that does not accept negative arguments.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
W314 EDIT	Arguments not permitted. The command specified does not permit any argument with it.
W315 EDIT	Illegal argument. The given argument was not acceptable to the specified command.
W316 EDIT	Illegal text string.
W317 EDIT	Illegal command. The Editor was unable to execute the specified command. The command may be an illegal character, one that is not an EDIT-11 command character.
W32Ø EDIT	Page Buffer almost full. The Page Buffer was within 128 characters of being full. Write out part or all of the Page Buffer and then delete from the Buffer the part that was written.
W321 EDIT	File closed. An attempt to Read from or Write to a primary file after an EF (End-of-File) command was issued.
W322 Ø LINK	Undefined global symbols in load module. Linking continues.
W323 RSX	Illegal size of named .CSECT or illegal entry in named .CSECT or task's named .CSECT size too large.
W324 RSX	Too many entries in tasks named .CSECT.
W325 RSX	Illegal priority specification in real-time header.
W35Ø RSX	Number of Failures Powerfail interrupt occurred.
W352 RSX	Disk Error Code Disk error detected by RSX. Codes are: 3 transmission error 5 illegal error 6 undefined file 7 illegal file, i.e., linked 8 block of file out of range

F.2.4 Fatal Messages

Fatal error messages are printed, if possible, and the program is suspended. The Monitor will not allow the operator to continue the program, but eventually expects to see a BEGIN, RESTART or KILL command. If a fatal error is a system disk failure and the error message cannot be printed, the central processor halts. This is the only time that a halt occurs in the Monitor.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
FØØØ DOS	Request Address Dataset not INITed. Program must issue .INIT before any other requests to a dataset.
FØØ1 DOS	Request Address Stack overflow. Once loaded, a program requires additional space for its stack, buffers and control blocks. These are allocated as they are needed. Reduce the size of the program. If the error has been caused by a stack overflow, the stack pointer is reset by bytes before the message is printed. This allows the monitor to proceed (since it needs the stack) and leaves the top of the stack intact (though not pointed to by SP). (See F.2.)
FØØ2 DOS	Request Address Invalid EMT call. The EMT code issued by the program has not been assigned.
FØØ3 DOS	Request Address Invalid .TRAN function or .TRAN to an open file.
FØØ4 DOS	Error Code Incorrect OPEN on industry compatible magnetic tape. Caused by program error or improperly assigning devices via datasets. Defined error code values: Ø - another file currently opened on tape, 1 - attempt to READ or WRITE to unopened file.
FØØ5 DOS	Request Address .RLSE error. If a file has been OPENed, it must be CLOSEd before a .RLSE can be issued.
FØØ6 DOS	Request Address Device full. No more space exists on the device being referenced by the request. For a file-structured device, use PIP to look at the number of free blocks and delete any files which are not needed.
FØØ7 DOS	Request Address No buffer space available. Insufficient space for completion of required operation. Reduce program size or close open files.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
FØ1Ø DOS	Request Address Illegal .READ/.WRITE. Incorrect mode for device or file not opened correctly.
FØ11 DOS	Request Address Illegal OPEN. OPEN code is not used or is unsuitable for device.
FØ12	Request Address File access violation. You are trying to OPEN a file that cannot be opened for the requested purpose. See Table 1 below for details. Assure that the name of the file requested was correct.
FØ14 DOS	Request Address Device error on trying to read bit map. The system cannot proceed if it cannot read the bit map. New files cannot be created on the device nor can old files be extended. Existing files may be copied to a backup medium for recovery.
FØ15 DOS	Request Address DECtape error. Nonexistent memory addressed or end-zone reached during transfer.
FØ16 DOS	Block Number DECtape search failure. Block requested cannot be found.
FØ17 DOS	Device (RAD5Ø) Parity error on file-structured device.
FØ2Ø DOS	Irrelevant Too many datasets using low-speed paper tape. A maximum of one each for input or output is allowed. Restart your job and use the ASSIGN command to reassign the excess datasets.
FØ21 DOS	Irrelevant Checksum error or device parity error while typing to load a program. Type KILL then try again. If that doesn't work, try relinking the program. Try recreating the file. If the error persists, hardware may be faulty. Call field service.
FØ22 DOS	Irrelevant An attempt was made to load for execution a dataset which is not formated binary or which has no start address. Typically this means that the dataset being loaded is not a load module.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
FØ23 DOS	Program Size Program too large for core available. Try to overlay the program or make it smaller.
FØ24 DOS	Request Address File access violation. You are trying to perform an operation that violates the monitor's user and file protection scheme. See Table 1 below for details. Resolve access problems with owner.
FØ25 PIP	Device (RAD5Ø) Master directory full when attempting to add UIC. No more UIC's can be added.
FØ26 DOS	Disk Control Status Register Disk (RF11 or RC11) transfer failure. Hardware error or persistent parity failure.
FØ27 DOS	Error Register Disk (RK11) transfer failure.
FØ3Ø OTS	Error Class, Number FORTRAN system error. An illegal call to the FORTRAN Error Processor was made.
FØ31 OTS	Addr. of Log Device No more room on FORTRAN logging deivce, or illegal end-of-file was encountered while a FORTRAN READ was in progress.
FØ32 DOS	Status Register Magtape hardware error.
FØ33 DOS	Special Function Block Address Invalid special function block.
FØ34 DOS	Call Address The call code passed to a conversion request was invalid, e.g., 5 means binary-to-octal, but 63 is not defined.
FØ35 DOS	Block Number Illegal block number (RK11).
FØ36 RSX	Lowest Slot Used by Tasks No slot available.
FØ37	Lowest Slot used by Tasks Illegal slot specified.
FØ4Ø RSX	Low Address of Task Code Attempted to overlay the executive for another task.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
FØ41 RSX	Load address of Binary Block Attempted to load outside limits defined in the command.
FØ42 DOS	Error Register Disk (RP11) transfer failure.
FØ43 DOS	Block Number Illegal block number (RP11).
FØ44 LINK	Ø Error in command string passed by a Compiler via the .RUN request.
FØ45 DOS	Reguest Address The RUN EMT cannot find the requested entry in the specified core image library. Add proper entry to CIL or use correct name.
FØ5Ø BATCH	Request Address Illegal I/O to batch stream. Either an illegal mode (e.g., unformatted binary when not in "OWN" mode) or a byte count less than 83, on formatted read.
FØ51 BATCH	Request Address Too many successive read errors or EOF's while reading the batch stream.
FØ52 BATCH	PC Illegal Open to one of the Batch Datasets. OPENO and OPENI are the only legal OPEN's and OPENO (OPENI) to an input (output) dataset is also illegal.
FØ53 BATCH	PC Illegal request to the BATCH stream flush EMT. Request code must be Ø, 1, or 2.
FØ54 DOS	Address of DDB An attempt was made to load a new program via the RUN request (EMT) before releasing all of the datasets INITed by the current program. Correct the program by releasing all INITed datasets before the RUN request is issued.
FØ55 BATCH	PC The time limit for the current job has expired. The current job has been aborted.
F1ØØ RSX	Address in Call Sequence Insufficient arguments in call sequence or in console command.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
F24Ø DOS	Irrelevant An attempt was made to allocate a contiguous file, but not enough contiguous blocks are free.
F274 DOS	Irrelevant The stack base address has not properly set. Thus the stack could not be moved by the RUN EMT as requested. This is probably a program error. The .STSTK request may be used to set the stack base prior to issuing the .RUN request.
F275 OTS	Ø Incorrect argument to link subroutine.
F276 DOS	Request Address The transfer address of the program or overlay to be loaded (by the RUN or GET commands or by the .RUN request) was not specified or is not legal. Specify a transfer address in your source program (END statement) or correct the /TR specification in your linking procedure.
F277 DOS	Request Address The program or overlay could not be loaded because it was outside the legal load area (on top of the Monitor or the main program or outside actual memory). Relink the program to conform to allowable boundries. Assure that the section being improperly loaded does not overlay the resident portion of your program.
F3ØØ FORTRN	Ø FORTRAN Compiler overlays cannot be executed. FORTRN.OVR may be nonexistent or improperly constructed.
F3Ø1 FORTRN	Ø No output file specified for the "/GO" options.
F3Ø2 DOS	Action Word. Illegal options requested in short form of RUNΔEMT.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
F34Ø DOS	PC at Time of IOT The DOS error routine was called with an invalid error code. This might happen if the program branched into a data area since the integer 4 would be executed as an IOT instruction (the error routine is called via an IOT).
F342 DOS	Contents of PC Error trap. Probably caused by a reference to a byte boundary or to nonexistent memory or to a nonexistent device. Could also be caused as a consequence of the stack pointer being below 4ØØ or by executing JMP or JSR with register mode destination.
F344 DOS	Contents of PC Reserved instruction trap. The instruction just executed is not a valid PDP-11 instruction. Perhaps you jumped to a point outside your program or perhaps you have stored information over an instruction.
F346 DOS	Contents of PC Trace trap. Bit 4 of the Processor Status Register is on. Look for traps in the PDP-11 Processor Handbook.
F352 DOS	Contents of PC Trap Instruction trap. A trap instruction was issued by your program and you did not previously specify a trap address with the .TRAP request.
F356 DOS	Contents of PC Unexpected device interrupt. Either a new device has been added to your system without initializing the interrupt vector or a hardware failure has occurred.

Table F-1

Recovery from FØ12 or FØ24 File Access Violations

CONDITION	ACTION
Are you logged in?	LOgin
Is your UIC entered?	Enter it with PIP.
Are you attempting to create a file which already exists?	Run PIP and DELETE
Does the Input file you are accessing exist?	Use PIP with /BR or /DI switch to check
Are you attempting to delete a non-existent file?	Use PIP with /BR or /DI switch to check
Are you attempting to delete a locked file? (The command to delete is correct, and the file exists.)	Run PIP and UNlock
Are you attempting to access another user's file illegally?	Ask PIP to list the user's directory and see if an access error results

F.2.5 System Program Messages

System program messages are printed and the program continues. This class of error may be issued by a variety of system programs. If an ISSUER is specified, the error is unique to the indicated program. See the appropriate program manual for greater detail.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
SØØ1 FORTRN	Ø FORTRAN Compiler has exhausted symbol table space during the assembly phase of compilation.
S2ØØ	Ø Too many .CSECT directives.
S2Ø1	Ø Conditionals nested too deeply.
S2Ø2	Error Status Byte. Dev: file, ext. EOD or device error on .WRITE or .READ; the disk may have filled up.
S2Ø3	Relative address of error call Illegal switch, or too many switches, or illegal switch value, or switch value not given, or switch in output field.
S2Ø4	Relative address of error call Too many or too few output files.
S2Ø5	Ø Too many or too few input files.
S2Ø6	Relative address of error call No input files specified.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
S2Ø7	Error Status Byte EOD or device error on .TRAN.
S21Ø	Ø , dev:file.ext Unrecognized symbol table entry in indicated file.
S211	Ø , dev:file.ext An RLD of the given file references a global name which cannot be found in the symbol table.
S212	Ø , dev:file.ext An RLD of the given file contains a location counter modification command which is not last.
S213	Ø , dev:file.ext Object module does not start with a GSD in the indicated file.
S214	Ø , dev:file.ext The first entry in the module is not the module name of the indicated file.
S215	Ø , dev:file.ext An RLD of the given file references a section name which cannot be found.
S216	Ø The TRA specification references a nonexistent module name.
S217	Relative address at error call. Insufficient core.
S22Ø	Ø An internal jump table index is out of range.
S223	Ø No more room for CSI input buffer or Monitor's file manager routine, or Monitor's library search buffer.
S225	Ø Program too large or top too low (program has been linked below zero in memory).
S226	Ø An open angle bracket, <, is present in a line other than the first.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
S227	Error Code Illegal file combinations due to name conflicts. Defined error codes are: 1 No Primary File (PRI) output, 2 Secondary File (SEC) input = SEC output, 3 SEC input = PRI output, 4 PRI input = SEC output, 5 PRI input = SEC input, 6 PRI output = SEC output.
S23Ø	Error Status Byte Error on.BLOCK I/O.
S231	Illegal command, file-structured device required.
S232	No more than one action switch permitted.
S233	Specified UIC not found in MFD.
S234	Null filename of "*" given where filename required.
S235	No files found in UFD.
S236	Operation applicable to DECtape only.
S237	File not found during file recovery operation.
S24Ø	No space for file allocate.
S241	MFD is full.
S242	Meaningless command, no action taken.
S243 Ø	An open angle bracket, < , is not present in the first line.
S244 Ø	Already past requested position.
S245 Ø	Object module not found, could be out of order.
S246 Ø	Illegal library format.
S247 Ø	Listing requested, but unable to read output library from specified output device.

CODE/ISSUER	ADDITIONAL INFORMATION/MEANING
S25Ø	Ø Core library symbol table not specified first or consecutively.
S251	Ø No files found for "*" request.
S252	Ø Filename given when none allowed.
S253	Ø Linker error.
S254	Ø It is illegal to zero the system resident disk.
S255	Ø Match found in third of later binary block in a paper tape library.
S256	Ø Illegal input device.
S257	File Block Error Code, dev:file.ext Illegal file operation. For example, protect code does not allow transfer of file; UIC different from Login UIC, thus making certain "wildcard" operations illegal. The operation in question is not performed.
S26Ø	Ø Same device needed for input and output in fast copy operation
S262	Ø Record size too big for buffer.
S263	File Number File record sizes do not agree on verify, "/V".
S264	Ø Conflict in standard file name extension which determines mode of transfer. Use explicits to resolve.
S265	Ø Operation attempted on device which is not legal for non-privileged user, for example, /PK PIP switch attempted by a user not logged in under [1,1].

APPENDIX G

LISTING OF SYSMAC.SML (SYSTEM MACRO FILE)

```
;       PDP-11 DOS SYSTEM MACROS   V005A


        .MACRO  .PARAM
R0=%A00
R1=%A01
R2=%A02
R3=%A03
R4=%A04
R5=%A05
R6=%A06
R7=%A07
SP=%A06
PC=%A07
PSW=A0177776
SWR=A0177570
        .ENDM
        .MACRO  .INIT   .LBLCK
        .MCALL  .AMODE
        .AMODE  .LBLCK
        EMT <A06>
        .ENDM

        .MACRO  .RLSE   .LBLCK
        .MCALL  .AMODE
        .AMODE  .LBLCK
        EMT <A07>
        .ENDM

        .MACRO  .CLOSE  .LBLCK
        .MCALL  .AMODE
        .AMODE  .LBLCK
        EMT <A017>
        .ENDM

        .MACRO  .READ   .LBLCK,.LBUFF
        .MCALL  .AMODE
        .AMODE  .LBUFF
        .AMODE  .LBLCK
        EMT <A04>
        .ENDM
```

```
.MACRO   .WRITE   .LBLCK,.LBUFF
.MCALL   .AMODE
.AMODE   .LBUFF
.AMODE   .LBLCK
EMT <^O02>
.ENDM

.MACRO   .OPENO   .LBLCK,.FBLCK
.MCALL   .CODE,.OPEN
.CODE    .FBLCK,<^O02>
.OPEN    .LBLCK,.FBLCK
.ENDM

.MACRO   .OPENT   .LBLCK,.FBLCK
.MCALL   .CODE,.OPEN
.CODE    .FBLCK,<^O04>
.OPEN    .LBLCK,.FBLCK
.ENDM

.MACRO   .OPENU   .LBLCK,.FBLCK
.MCALL   .CODE,.OPEN
.CODE    .FBLCK,<^O01>
.OPEN    .LBLCK,.FBLCK
.ENDM

.MACRO   .OPENC   .LBLCK,.FBLCK
.MCALL   .CODE,.OPEN
.CODE    .FBLCK,<^O13>
.OPEN    .LBLCK,.FBLCK
.ENDM

.MACRO   .OPENF   .LBLCK,.FBLCK
.MCALL   .CODE,.OPEN
.CODE    .FBLCK,<^O03>
.OPEN    .LBLCK,.FBLCK
.ENDM

.MACRO   .OPEN    .LBLCK,.FBLCK
.MCALL   .AMODE
.AMODE   .FBLCK
.AMODE   .LBLCK
EMT <^O16>
.ENDM

.MACRO   .WAIT    .LBLCK
.MCALL   .AMODE
.AMODE   .LBLCK
EMT <^O1>
.ENDM

.MACRO   .WAITR   .LBLCK,.ADDR
.MCALL   .AMODE
.AMODE   .ADDR
.AMODE   .LBLCK
EMT <^O00>
.ENDM

.MACRO   .BLOCK   .LBLCK,.BBLCK
.MCALL   .AMODE
.AMODE   .BBLCK
.AMODE   .LBLCK
EMT <^O11>
.ENDM
```

```
.MACRO  .TRAN   .LBLCK,.TBLCK
.MCALL  .AMODE
.AMODE  .TBLCK
.AMODE  .LBLCK
EMT <^C10>
.ENDM

.MACRO  .SPEC   .LBLCK,.SARG
.MCALL  .AMODE
.AMODE  .SARG
.AMODE  .LBLCK
EMT <^C12>
.ENDM

.MACRO  .STAT   .LBLCK
.MCALL  .AMODE
.AMODE  .LBLCK
EMT <^C13>
.ENDM

.MACRO  .ALLOC  .LBLCK,.FBLCK,.N
.MCALL  .AMODE
.AMODE  .N
.AMODE  .FBLCK
.AMODE  .LBLCK
EMT <^C15>
.ENDM

.MACRO  .DELET  .LBLCK,.FBLCK
.MCALL  .AMODE
.AMODE  .FBLCK
.AMODE  .LBLCK
EMT <^C21>
.ENDM

.MACRO  .RENAM  .LBLCK,.OFB,.NFB
.MCALL  .AMODE
.AMODE  .NFB
.AMODE  .OFB
.AMODE  .LBLCK
EMT <^C20>
.ENDM

.MACRO  .APPND  .LBLCK,.1FB,.2FB
.MCALL  .AMODE
.AMODE  .2FB
.AMODE  .1FB
.AMODE  .LBLCK
EMT <^C22>
.ENDM

.MACRO  .LOCK   .LBLCK,.FBLCK,.OP
.MCALL  .AMODE
.AMODE  .FBLCK
.IIF NB,.OP,CLR =(SP)
.AMODE  .LBLCK
EMT <^C14>
.ENDM

.MACRO  .KEEP   .LBLCK,.FBLCK
.MCALL  .AMODE
.AMODE  .FBLCK
.AMODE  .LBLCK
EMT <^C24>
.ENDM
```

```
.MACRO  .EXIT
EMT <^C60>
.ENDM

.MACRO  .TRAP   .STUS,.ADDR
.MCALL  .AMODE
.AMODE  .ADDR
.AMODE  .STUS
MOV     #^C1,-(SP)
EMT <^C41>
.ENDM

.MACRO  .STEPU  .STLS,.ADDR
.MCALL  .AMODE
.AMODE  .ADDR
.AMODE  .STUS
MOV     #^C3,-(SP)
EMT <^C41>
.ENDM

.MACRO  .RECRD  .LBLCK,.RBLCK
.MCALL  .AMODE
.AMODE  .RBLCK
.AMODE  .LBLCK
EMT <^C25>
.ENDM

.MACRO  .DUMP   .LOW,.HIGH,.CDE
.MCALL  .AMODE
.AMODE  .LOW
.AMODE  .HIGH
.AMODE  .CDE
EMT <^C64>
.ENDM

.MACRO  .RSTRT  .ADDR
.MCALL  .AMODE
.AMODE  .ADDR
MOV     #^C2,-(SP)
EMT <^C41>
.ENDM

.MACRO  .CORE
MOV     #^C100,-(SP)
EMT <^C41>
.ENDM

.MACRO  .MONR
MOV     #^C101,-(SP)
EMT <^C41>
.ENDM

.MACRO  .MONF
MOV     #^C102,-(SP)
EMT <^C41>
.ENDM

.MACRO  .DATE
MOV     #^C103,-(SP)
EMT <^C41>
.ENDM
```

```
.MACRO  .TIME
MOV     #^O104,-(SP)
EMT <^C41>
.ENDM

.MACRO  .GTUIC
MOV     #^O105,-(SP)
EMT <^C41>
.ENDM

.MACRO  .SYSDV
MOV     #^O106,-(SP)
EMT <^C41>
.ENDM

.MACRO  .RADPK  .ADDR
.MCALL  .AMODE
.AMODE  .ADDR
CLR     -(SP)
EMT <^C42>
.ENDM

.MACRO  .RADUP  .ADDR,.WRD
.MCALL  .AMODE
.AMODE  .WRD
.AMODE  .ADDR
MOV     #^O1,-(SP)
EMT <^C42>
.ENDM

.MACRO  .R2BIN  .ADDR
.MCALL  .AMODE
.AMODE  .ADDR
MOV     #^O2,-(SP)
EMT <^C42>
.ENDM

.MACRO  .BIN2D  .ADDR,.WRD
.MCALL  .AMODE
.AMODE  .WRD
.AMODE  .ADDR
MOV     #^O3,-(SP)
EMT <^C42>
.ENDM

.MACRO  .C2BIN  .ADDR
.MCALL  .AMODE
.AMODE  .ADDR
MOV     #^O4,-(SP)
EMT <^C42>
.ENDM

.MACRO  .BIN2O  .ADDR,.WRD
.MCALL  .AMODE
.AMODE  .WRD
.AMODE  .ADDR
MOV     #^O5,-(SP)
EMT <^C42>
.ENDM
```

```
.MACRO   .CST1    .CMDBF
.MCALL   .AMODE
.AMODE   .CMDBF
EMT <^C56>
.ENDM

.MACRO   .CST2    .CSBLK
.MCALL   .AMODE
.AMODE   .CSBLK
EMT <^C57>
.ENDM

.MACRO   .DTCVT   .ADDR
.MCALL   .CVTDT
.CVTDT   #^D0,.ADDR
.ENDM

.MACRO   .TMCVT   .ADDR
.MCALL   .CVTDT
.CVTDT   #^D1,.ADDR
.ENDM

.MACRO   .CVTDT   .CDE,.ADDR,.VAL1,.VAL2
.MCALL   .AMODE
.IF      NB,.VAL2
.AMODE   .VAL2
.ENDC
.IF      NB,.VAL1
.AMODE   .VAL1
.ENDC
.AMODE   .ADDR
.AMODE   .CDE
EMT <^C66>
.ENDM

.MACRO   .GTPLA
CLR      -(SP)
MOV      #^O5,-(SP)
EMT <^C41>
.ENDM

.MACRO   .STPLA   .ADDR
.MCALL   .AMODE
.AMODE   .ADDR
MOV      #^O5,-(SP)
EMT <^C41>
.ENDM

.MACRO   .GTCIL
MOV      #^O111,-(SP)
EMT <^C41>
.ENDM

.MACRO   .GTSTK
CLR      -(SP)
MOV      #^O4,-(SP)
EMT <^C41>
.ENDM

.MACRO   .STSTK   .ADDR
.MCALL   .AMODE
.AMODE   .ADDR
```

```
        MOV     #^O04,-(SP)
        EMT <^O41>
        .ENDM

        .MACRO  .RUN    .RNBLK
        .MCALL  .AMODE
        .AMODE  .RNBLK
        EMT <^O65>
        .ENDM

        .MACRO  .FLUSH  .CDE
        .MCALL  .AMODE
        .AMODE  .CDE
        EMT <^O67>
        .ENDM

; THE MACRO .AMODE ACCEPTS ONE ARGUMENT AND
; AS A FUNCTION OF THE ADDRESSING MODE OF
; THE ARGUMENT GENERATES THE APPROPRIATE
; MOV TO -(SP).
; ADDRESS MODES THAT ARE TROUBLESOME (E.G.
; X(SP)) OR UNLIKELY (E.G. SP) WILL RESULT
; IN A .ERROR TO CMD INCLUDING THE
; VALUE OF THE ADDRESS MODE (E.G. X(SP)
; IS REPRESENTED AS 000066), THE ARGUMENT ITSELF
; AND THE TEXT "ADDRESSING MODE ILLEGAL AS SYSTEM
; MACRO ARGUMENT".
;
        .MACRO  .AMODE  .ARG
SP=%^O06
        .NTYPE  .SYM,.ARG       ;.SYM=ADDRESS MODE.

        .IF LE,.SYM-^O5
        MOV     .ARG,-(SP)      ;R0 TO R5
        .MEXIT
        .ENDC

        .IF EQ,.SYM&^O70-^O10
        .IF LE,.SYM&^O7-^O6
        MOV     .ARG,-(SP)      ;@R0 TO @R6
        .MEXIT
        .ENDC
        .ENDC

        .IF EQ,.SYM&^O60-^O20
        MOV     .ARG,-(SP)      ;(R0)+ TO (R7)+
        .MEXIT                  ; #N,@#ADDR
        .ENDC

        .IF EQ,.SYM&^O40-^O40
        .IF LE,.SYM&^O7-^O5
        MOV     .ARG,-(SP)      ;-(R0) TO -(R5)
        .MEXIT                  ;X(R0) TO X(R5)
        .ENDC
        .ENDC

        .IF EQ,.SYM&^O67-^O67
        MOV     .ARG,-(SP)      ;ADDR AND @ADDR
        .MEXIT
        .ENDC
```

```
        .ERROR .SYM                 ;'.ARG ADDRESSING MODE ILLEGAL
        .PRINT                      ;AS SYSTEM MACRO ARGUMENT'.
        .ENDM

; THE MACRO .CODE SETS UP THE FILEBLOCK
; WITH THE FCW OPEN CODE'.
; THE ADDRESS OF THE FILEBLOCK MUST
; BE IN A REGISTER (R0 TO R5)

        .MACRO  .CODE   .FBLK,.N
        .NTYPE  .SYM,.FBLK

        .IF LE,.SYM-^O5
        MOVB    #.N,-^O2(.FBLK) ;R0 TO R5
        .MEXIT
        .ENDC

        .ERROR .SYM                 ;.FBLK ADDRESSING MODE ILLEGAL
        .PRINT                      ;FOR .OPEN FILE BLOCK
        .ENDM
```

APPENDIX H
PERIPHERAL DEVICES

H.1 OPERATING THE TELETYPE

The ASR-33 Teletype is the basic input/output device for PDP-11 computers. It consists of a printer, keyboard, paper tape reader, and paper tape punch, all of which can be used either on-line under program control or off-line. The Teletype controls (Figure H-1) are described as they apply to the operation of the computer.

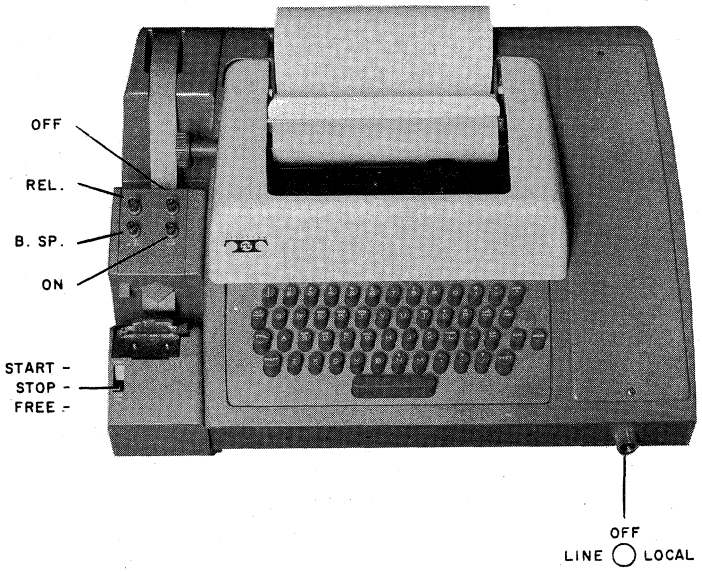


Figure H-1 ASR-33 Teletype Console

H.1.1 Power Controls

LINE - The Teletype is energized and connected to the computer as an input/output device, under computer control.

OFF - The Teletype is de-energized.

LOCAL - The Teletype is energized for off-line operation.

H.1.2 Printer

The printer provides a typed copy of input and output at 10 characters per second, maximum.

H.1.3 Keyboard

The Teletype keyboard is similar to a typewriter keyboard. However, certain operational functions are shown on the upper part of some of the keytops. These functions are activated by holding down the CTRL key while depressing the desired key. For example, when using the Text Editor, CTRL/U causes the current line of text to be ignored.

Although the left and right square brackets are not visible on the keyboard keytops, they are shown in Figure H-2 and are generated by typing SHIFT/K and SHIFT/M, respectively. The ALT MODE key is identified as ESC (ESCape) on some keyboards.

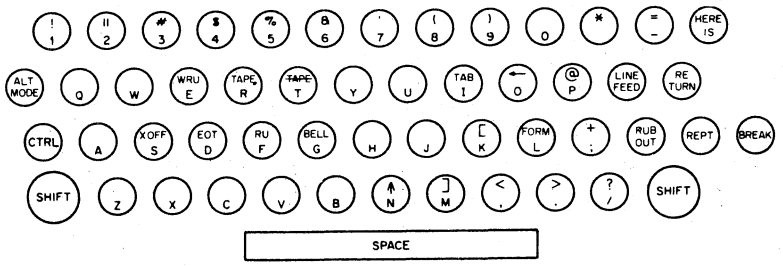


Figure H-2 ASR-33 Teletype Keyboard

H.1.4. Paper Tape Reader

The paper tape reader is used to read data punched on eight-channel perforated paper tape at a rate of 10 characters per second, maximum. The reader controls are shown in Figure H-1 and described below.

START	Activates the reader; reader sprocket wheel is engaged and operative.
STOP	Deactivates the reader; reader sprocket wheel is engaged but not operative.
FREE	Deactivates the reader; reader sprocket wheel is disengaged.

The following procedure describes how to properly position paper tape in the low-speed reader.

a. Raise the tape retainer cover.
b. Set reader control to FREE.
c. Position the leader portion of the tape over the read pens with the sprocket (feed) holes over the sprocket (feed) wheel and with the arrow on the tape (printed or cut) pointing outward.
d. Close the tape retainer cover.
e. Make sure that the tape moves freely.
f. Set reader control to START, and the tape will be read.

H.1.5 Paper Tape Punch

The paper tape punch is used to perforate eight-channel rolled oiled paper tape at a maximum rate of 10 characters per second. The punch controls are shown in Figure H-1 and described below.

RELease	Disengages the tape to allow tape removal or loading.
B.SP	Backspaces the tape one space for each firm depression of the B.SP button.
ON (LOCK ON)	Activates the punch.
OFF (UNLOCK)	Deactivates the punch.

Blank leader/trailer tape is generated by:

1. Turning the TTY switch to LOCAL
2. Turning the low speed punch on (depress ON button)
3. Typing the HERE IS key
4. Turning the low speed punch off (depress OFF button)
5. Turning the TTY switch to LINE.

H.2 OPERATING THE HIGH-SPEED PAPER TAPE READER AND PUNCH UNITS

A high-speed paper tape reader and punch unit is pictured in Figure H-3 and descriptions of the reader and punch units follow.

H.2.1 Reader Unit

The high-speed paper tape reader is used to read data from eight-channel fan-folded (non-oiled) perforated paper tape photoelectrically at a maximum rate of 300 characters per second. Primary power is applied to the reader when the computer POWER switch is turned on. The reader is under program control. However, tape can be advanced past the photoelectric sensors without causing input by pressing the reader FEED button.

H.2.2 Punch Unit

The high-speed paper tape punch is used to record computer output on eight-channel fan-folded paper tape at a maximum rate of 50 characters per second. All characters are punched under program control from the computer. Blank tape (feed holes only, no data) may be produced by pressing the FEED button. Primary power is available to the punch when the computer POWER switch is turned on.

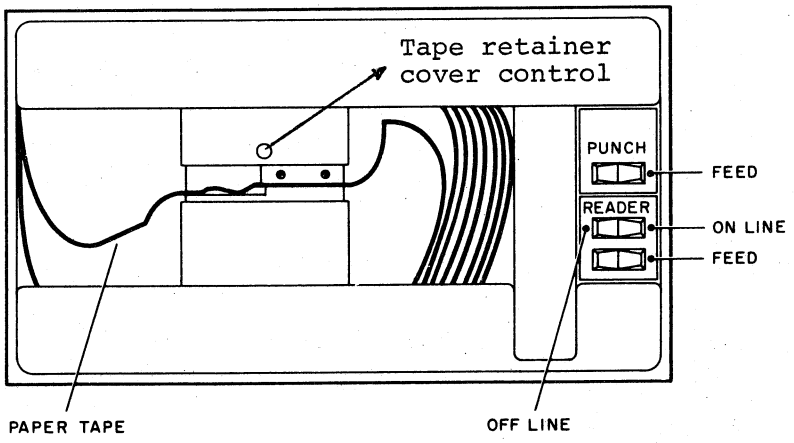


Figure H-3 High-Speed Paper Tape Reader/Punch

Paper tape is loaded into the reader as explained below.

1. Raise tape retainer cover.
2. Put tape into right-hand bin with channel one of the tape toward the rear of the bin.
3. Place several folds of blank tape through the reader and into the left-hand bin.

4. Place the tape over the reader head with feed holes engaged in the teeth of the sprocket wheel.
5. Close the tape retainer cover.
6. Depress the tape feed button until the leader tape is over the reader head.

CAUTION

Oiled paper tape should not be used in the high-speed reader or punch - oil collects dust and dirt which can cause reader or punch errors.

H.3 THE LP11 LINE PRINTER

The LP11 is a line printer with 80 column capacity, capable of printing more than 300 lines per minute at a full 80 columns, and more than 1100 lines per minute at 20 columns. The print rate is dependent upon the data and the number of columns to be printed.

Characters are loaded into the printer memory via the Line Printer Buffer (LPB) serially. When the memory becomes full (20 characters) the characters are automatically printed. This continues until the 80 columns have been printed or a carriage return, line feed, or form feed character is recognized.

H.3.1 Printer Control Panel

Figure H-4 illustrates the printer control panel on which are mounted three indicator lights and three toggle switches.

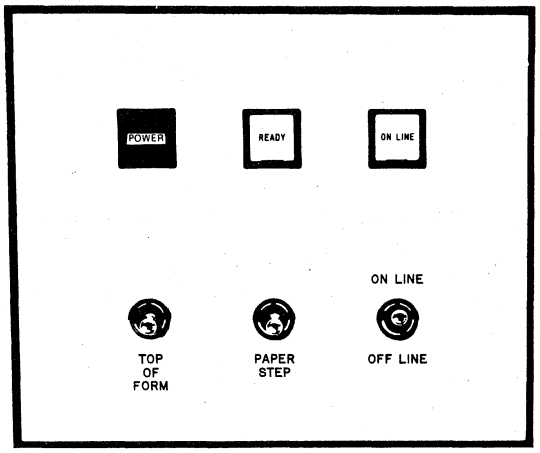


Figure H-4 Line Printer Control Panel

Operation of the lights and switches is as follows:

POWER light	Glows red to indicate main power switch (located inside cabinet) is at ON position and power is available to the printer.
READY light	Glows white, shortly after the POWER light goes on to indicate that internal components have reached synchronous state and the printer is ready to operate.
ON LINE light	Glows white to indicate that ON LINE/ OFF LINE toggle switch is in ON LINE position.
TOP OF FORM switch	This switch is tipped toward the front of the cabinet to roll up the form to the top of the succeeding page. It is spring-returned to center position, and produces a single top-of-form operation each time it is actuated. The switch is effective only when the printer is off line.
PAPER STEP switch	Operates similarly to TOP OF FORM but produces a single line step each time it is actuated. It is only effective with printer off line.
ON LINE/OFF LINE switch	This two-position toggle switch is spring-returned to center. When momentarily positioned at ON LINE it logically connects the printer to the computer and causes the ON LINE light to glow. Positioned momentarily at OFF LINE, the logical connection to the computer is broken, the ON LINE light goes off, and the TOP OF FORM and PAPER STEP switches are enabled.

H.3.2 Maintenance Panel

The maintenance panel contains controls used for the line printer's initial set-up and maintenance. It is accessible only by opening the front cabinet door, located beneath the control panel.

This panel contains three switches, and three indicators.

1. Main AC power switch;
2. PRINT INHIBIT switch - must be off (down) to enable printing;

3. DRUM GATE indicator - if lit, drum gate not properly locked;
4. PAPER FAULT - if lit, check for no paper, or torn paper;
5. PRINT INHIBIT indicator - if lit, turn PRINT INHIBIT switch off;
6. MASTER CLEAR switch - spring-loaded to off (down); if toggled to on (up), resets printer logic, turns off READY and ONLINE indicators.

H.3.3 Adjustment Controls

Controls are provided as listed in Table H-1.

Table H-1 Adjustment Controls

Control	Location	Function
Drum gate latch	Gearshift type knob near right-hand side of maintenance panel.	Unlocks drum gate which can then be swung open for access to components on back.
Tractor paper width adjustment	Setscrew at far right of tractor pressure plate behind drum gate.	Adjusts right tractor for various paper widths; left tractor is factory adjusted.
Tractor horizontal tension adjustment	Next to left side of tractor paper width adjustment.	Adjusts horizontal tension of paper.
COPIES CONTROL lever	Extreme upper right-hand corner of cabinet just above drum gate hinge.	Adjusts the distance between hammer bank and character drum for different numbers of printed copies. Settings are: 1-2, 3-4 and 5-6.
Paper vertical adjustment control	Knob at upper left of cabinet, directly above right-hand side of maintenance panel	Adjusts vertical alignment of printing so that it prints on lined paper. Can be adjusted to plus or minus one line and may be adjusted while the printer is in operation.
Top-of-form indicators	Red arrows visible when drum gate is swung open one on each side of paper directly below tractor pressure plates	Aligns paper during loading.

H.3.4 Loading Paper

Follow the steps listed below to load paper into the printer.

Step	Procedure
1.	Open front door of cabinet to gain access to maintenance panel and turn main AC power switch on. Verify that control panel POWER indicator lights.
2.	Lift control panel TOP OF FORM switch and release to move tractors to correct loading position.
3.	Open the drum gate by moving the drum gate latch knob to the left and up. Swing drum gate open.
4.	Adjust right-hand tractor paper width adjustment for proper paper width. This is accomplished by loosening the set screw on the 8Ø-column model or by using the easy release mechanism on the 12Ø column model. Make certain that the right-hand tractor is tightened in place after it is adjusted.
5.	Open spring-loaded pressure plates on both tractors.
6.	Load paper so that a perforation is pointed to by the two red arrows (top-of-form indicators). Paper should lie smoothly between tractors without wrinkling or tearing the feed holes.
7.	Close spring-loaded pressure plates on both tractors.
8.	Adjust the COPIES CONTROL lever to the proper number for the number of copies to be made. For example, set to 1-2 for single forms, set to 5-6 for six-part forms.
9.	Close drum gate and lock into position with drum gate latch. After approximately 1Ø seconds the control panel READY indicator should light. If it does not, check to see if any error is indicated. An error is indicated if one of the following lights is on: DRUM GATE, PAPER FAULT, or PRINT INHIBIT.
10.	Lift TOP OF FORM switch several times to ensure paper is feeding properly.
11.	Set system to on-line mode by lifting ON LINE/OFF LINE switch and verifying that ON LINE indicator lights. At this point, printed matter can be aligned with the paper lines by rotating the paper vertical adjustment knob.

For further details on the LP11, refer to the LP11 Line Printer Manual, DEC-11-ODLPA-A-D.

H.4 THE TU10 MAGTAPE DRIVE

The TU10 is a magnetic tape drive which may be a 7- or 9-track unit and which will record data in densities of 200, 556 or 800 bits per inch.

Figure H-5 shows the magnetic tape drive control panel and its schematic representation. Table H-2 shows the meaning assigned to each indicator light and Table H-3 explains the function of each switch.

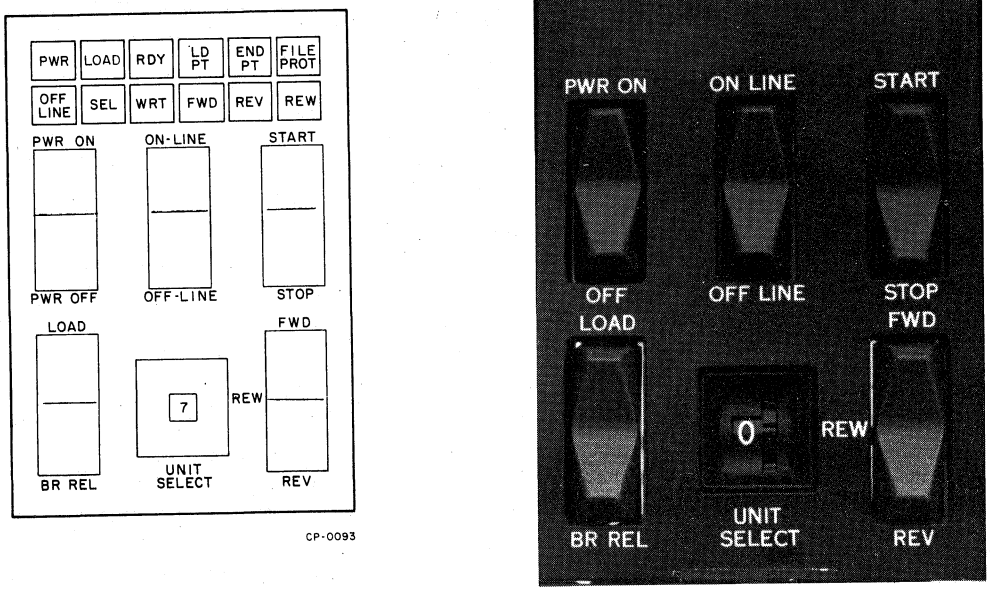


Figure H-5 Magnetic Tape Drive Control Panel

Table H-2
Status Indicators

Indicator	Procedure
PWR	Indicates that power is being supplied to the drive unit.
OFF-LINE	Indicates local operation by the control box.
LOAD	Indicates that the vacuum system has been enabled and the unit is prepared to accept on-line or off-line commands.
SEL	Indicates the tape transport has been selected by the controller (program).
RDY	Indicates that the drive is ready to accept requests for operation (provided the SEL light is also lit).
WRT	Indicates that the program has initiated a write operation in the tape transport.
LD PT	Indicates that the tape mounted on this unit is at its Load point (BOT marker is being sensed). REW command is disabled.
FWD	Indicates that a forward command has been issued.
END PT	Indicates that the tape mounted on this unit is at its end point (EOT marker is being sensed). FWD command is disabled.
REV	Indicates that a reverse command has been issued.
FILE PROT	Indicates that the tape may not be written on (No Write ring in tape reel).
REW	Indicates that a rewind command has been issued.

Table H-3
Switch Functions

Switch	Function
PWR ON/OFF	Controls power to the drive.
ONLINE/OFFLINE	Transfers drive control to processor (ON LINE) or enables local control box control by operator (OFF LINE).
START/STOP	Initiates or terminates tape movement.
LOAD/BR REL	LOAD position causes tape to be drawn into vacuum columns. Center position applies reel motion brakes. BR REL position releases reel motion brakes.
UNIT SELECT	Assigns a logical unit number (zero through seven) to this drive.
FWD/REW/REV	Selects tape motion direction to be controlled by START/STOP switch. FWD position indicates transfer to take-up reel until EOT (end of tape) marker is sensed, REV position indicates transfer to file reel until BOT (beginning of tape) marker is sensed, REW position indicates transfer as in REV at a higher tape speed; when the tape stops at BOT, depressing the start switch again causes tape to unload.

H.4.1 Operating Procedures

H.4.1.1 Loading and Threading Tape - Use the following procedure to mount and thread the tape:

Step	Procedure
1	Apply power to the transport by depressing PWR ON switch.
2	Ensure the LOAD/BR REL switch is in the center position (this applies the brakes).
3	Place a write enable ring in the groove on the file reel if data is to be written on the tape. Ensure there is no ring in the groove if data on the tape is not to be erased or written over.
4	Mount the file reel onto the lower hub with the groove facing towards the back. Ensure that the reel is firmly seated against the flange of the hub.
5	Install the take-up reel (top) as described in Step 4.
6	Place LOAD/BR REL switch to the BR REL position.
7	Unwind tape from the file reel and thread the tape over the tape guides and head assembly as shown in Figure H-6.
8	Wind about five turns of tape onto the take-up reel.
9	Set the LOAD/BR REL switch to the LOAD position to draw tape into the vacuum columns.
10	Select FWD and press START to advance the tape to Load Point. When the BOT marker is sensed, tape motion stops, the FWD indicator goes out, and the LOAD PT indicator comes on.

NOTE

If tape motion continues for more than 10 seconds, press STOP, select REV (reverse) and press START. The tape should move to the BOT marker (Load Point) before stopping.

H.4.1.2 Unloading Tape - To unload the tape proceed as follows:

Step	Procedure
1	Press OFF-LINE switch if the transport has been operating in the on-line mode.
2	Press STOP switch and select REW.
3	Press START switch. The tape should rewind until the BOT marker is reached.
4	Press the LOAD/BR REL switch to release the brakes.
5	Gently hand wind the file reel in a counterclockwise direction until all of the tape is wound onto the reel.

CAUTION

When handwinding the tape, do not jerk the reel. This can stretch or compress the tape which could cause irreparable damage.

6	Remove the file reel from the hub assembly.

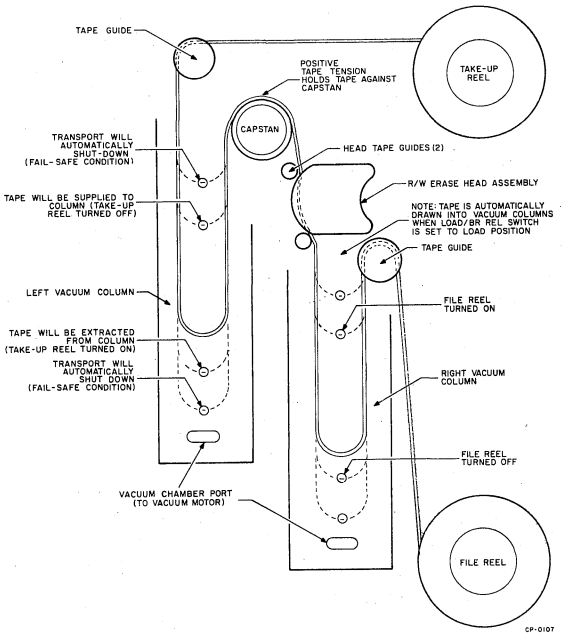


Figure H-6 Tape Transport Mechanism

H.4.1.3 Restart After Power Failure - In the event of a power failure, the DECmagtape automatically shuts down and tape motion stops without damage to the tape. Return of power is indicated when the PWR indicator lights. To restart the transport proceed as follows:

Step	Procedure
1	Press the LOAD/BR REL switch to release the brakes.
2	Manually wind the reels to take up any slack in the tape.
3	Set the LOAD/BR REL switch to the LOAD position to draw tape into the vacuum columns.
4	Set ON-LINE/OFF-LINE switch to the desired position and continue operation.

H.4.1.4 Restart After Fail-Safe - If the tape loop in either buffer column exceeds the limits shown in Figure H-6, the vacuum system automatically shuts down and tape motion stops without damage to the tape. When this fail-safe condition occurs, the DECmagtape does not respond to on-line or off-line commands. To restart the transport, perform Steps 1 through 4 in Paragraph H.4.1.3.

H.4.1.5 - Tape Handling - Observe the following precautions when handling magnetic tape:

a. Always handle a tape reel by the hub hole; squeezing the reel flanges can cause damage to the tape edges when winding or unwinding tape.

b. Never touch the portion of tape between the BOT and EOT markers. Oils from fingers attract dust and dirt. Do not allow the end of the tape to drag on the floor.

c. Never use a contaminated reel of tape. This spreads dirt to clean tape reels and can affect tape transport operation.

d. Always store tape reels inside their containers. Keep empty containers closed so dust and dirt cannot get inside.

e. Inspect tapes, reels, and containers for dust and dirt. Replace take-up reels that are old or damaged.

f. Do not smoke near the transport or tape storage area. Tobacco smoke and ash are especially damaging to tape.

g. Do not place the DECmagtape near a line printer or other device that produces paper dust.

h. Clean the tape path frequently as described in Paragraph 5.2.1.

H.5 THE TC11 DECTAPE DRIVE

Figure H-7 pictures the TC11 DECtape drive unit. Table H-4 shows the meaning of each indicator lamp and Table H-5 shows the function of each switch.

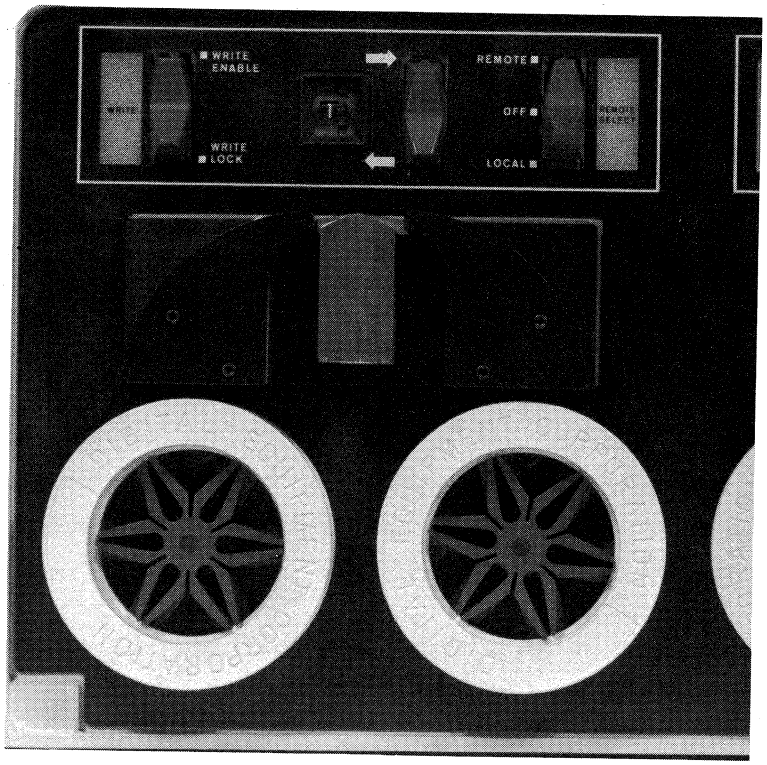


Figure H-7 TC11 DECtape Drive

To mount a DECtape on the TC11:

1. Move the LOCAL/REMOTE/OFF switch to the OFF position.
2. Mount a DECtape by centering it over the left band hub and pushing it firmly onto the spring loaded hub.
3. Wind sufficient tape to wrap around the recording head guides and the empty DECtape reel which should be mounted on the right hand hub.
4. Take up a few inches to tape on the right hand hub by hand.
5. Move the LOCAL/REMOTE/OFF switch to LOCAL position.
6. Depress the DECtape motion switch to the LOAD position until about 6 feet of tape are on the right hand hub.

7. Depress the WRITE PROTECT switch or write enable as appropriate.

8. Assure that the unit number showing for this drive does not show on any other drive.

9. Move the LOCAL/OFF/REMOTE switch to the remote position.

To dismount a DECtape from the TC11:

1. Move the LOCAL/OFF/REMOTE switch to the LOCAL position.

2. Depress the tape motion switch in the rewind direction (←) until all the tape is on the left hand reel.

3. Move LOCAL/OFF/REMOTE switch to OFF position.

4. Pull the DECtape reel from the left hand hub.

APPENDIX I
COMMAND STRING INTERPRETER

I.1 SYSTEM PROGRAM/USER PROGRAM COMMAND STRINGS

There is a single, general format for all system program command strings. All system programs use it, and any user program may also do so. These command strings are all processed by a Monitor routine, the Command String Interpreter (CSI) which is in Section 3.8.6. Any program expecting such a command first types # on the console to indicate the fact to the operator. The general format is

ds-spec [,[ds-spec] ...]] ... [<ds-spec] [,[ds-spec]] ...

where "ds-spec" represents a dataset specifier (described in the next section), brackets indicate optional items, and elipsis (...) indicates that the preceding item may appear zero or more times. Items preceding the < (if any) describe output datasets; those which follow describe input datasets.

I.2 CSI COMMAND FORMAT

Whenever a system program requests input through the CSI, a # will be printed on the teleprinter (exception, ODT-11R prints an *) and the program will wait for the operator's reply. A CSI command may consist of one or more output dataset specifications, followed by <, followed by one or more input dataset specifications. Spaces, horizontal TABs, and nulls may appear anywhere in the string and are ignored. A command is terminated by typing the RETURN key, which causes both carriage return and line feed characters to be passed to the program. The line-feed character terminates the input. < need not occur. If it does, at least one input file specification must appear. Only one < per command is allowed. Commands can not be continued from line to line.

A dataset specification must be delimited by a comma. If no items appear before the comma, it is interpreted as "this particular positional field will not be used". For example, suppose a program requires three (output) data specifications. Then the syntax:

indicates that the second (output) dataset specified will not be generated.

Each dataset specification is a field which describes a dataset. It generally contains information as to where to find the dataset, the file name and extension if the dataset is a file, the user identification code associated with the file, and one or more switches which request various actions to be performed. A dataset specification containing all of the above elements would appear as:

$$dev:filnam.ext[uic]/sw_1:v_1:...:v_n/sw_2:v_1:...:v_n,$$

where: dev = The device specification consisting of two or three letters (and often an octal digit) terminated by a colon. The letters identify the device and the digit identifies the unit. Units must be given in octal. The colon delimits this field with one exception; only physical names as listed in Appendix A may be specified. For example, DTA1: is the correct specification for DECtape, controller A, unit 1. The exception is SY: which is a generic name for the system residence device (e.g., on an RK system SY: is equivalent to DK:). If no digit appears, unit 0 is assumed. If the device specification itself does not appear, the device is assumed to be the device last specified, on the current side of the <, if there is one; otherwise, the system disk (SY:) unit 0 is assumed.

Assumptions (defaults) do not carry across the <, i.e., from output to input.

filnam = The file name specification consists of one or more letters or digits, or exactly one asterisk. The first six letters or digits specify the name. The first character must be a letter. All letters and digits in excess of six are ignored.

The file name need not appear if the device is not file-structured or if the program can supply a name.

.ext = The extension specification consists of a period, followed by one or more letters or digits, or followed by exactly one asterisk. The first three letters or digits specify the extension. All letters or digits in excess of three are ignored.

The extension need not appear.

The asterisk is used to specify "all". For example:

*.EXT specifies all files with extension .EXT,

FIL.* specifies all files with name FIL, and
. specifies all files and all extensions.

[uic] = The User Identification Code (UIC) specification consists of a left square bracket, followed by one or more octal digits or exactly one asterisk, followed by a comma, followed by one or more octal digits or exactly one asterisk, followed by a right square bracket. The field to the left of the comma specifies the user's group and the field to the right of the comma specifies the user within the group. Both fields must be given in octal, and the largest valid octal number is 376 in both cases (0 is invalid). For example, [12,136] is the correct specification for user number 136 of user group 12.

NOTE

The left and right square brackets are not visible on some keyboard keys; however, they may be typed using SHIFT/K and SHIFT/M, respectively.

As in filnam and .ext, the asterisk specifies "all". For example:

[*,136] specifies all users whose number is 136
[12,*] specifies all members of user group 12, and
[*,*] specifies all users.

The user identification code need not appear, in which case the default is the identification entered with the LOGIN command.

/sw:v_1:...:v_n = A switch specification consists of a slash (/), followed by one or more letters or digits, and optionally followed by one or more value specifications. A value specification is initially delimited by a colon. The value itself can be null, or consist of one or more letters, digits, periods, or dollar signs. Other characters are illegal. The digits 8 and 9 are legal.

For examples: /DATE:12.20.69 might be a switch to enter December 20, 1969 in a date field.

/DATE:12::69 might enter December, 1969 in a date field.

Switches need not appear. If a switch does appear, it need not contain more than one letter or digit after the slash. For example:

/S and /SWITCH2 are both legal.

The first two characters after the slash uniquely identify the switch. For example:

/S is treated as if it were /S null.
/SWITCH1 and /SWITCH2 are both treated as /SW.

Table I-1 summarizes the legal command syntax.

Table I-1

.CSI Command String Syntax Rules

Item Which Last Appeared	Item Immediately Following								
	,	DEV:	FILNAM	.EXT	UIC	/SWITCH	<	Terminator	*
blank[1]	*	*	*	E	*	*	*	*	*
,	*	*	*	E	*	*	*	*	*
DEV:	*	E	*	E	*	*	*	*	*
FILNAM	*	E	E	*	*	*	*	*	E[2]
.EXT	*	E	E	E	*	*	*	*	E
UIC	*	E	E	E	E	*	*	*	E
/SWITCH	*	E	E	E	E	*	*	*	E
<	*	*	*	E	*	*	E	E	*

Legend: E indicates error. * indicates legal.

[1]The next item encountered is the first item in the command string.

[2] .* is legal following FILNAM.

For example, a device specification immediately followed by an extension specification is an error, whereas a file name specification immediately followed by a comma is legal. Note that a /SWITCH specification is always legal even alone. In such a case, the system device SY: and a null filename are assumed.

I.3 CSI COMMAND EXAMPLE

An example of a complete command is:

```
F1.E1,,DTA1:F2.E2/S:1<F3.E3[11,123],DTB:F4.E4/ABC,F5.E5
```

which is interpreted as explained below.

a. The first positional output dataset is to be a file named F1 and will have extension E1. It is to be put on disk unit 0, and catalogued under the ID of the user who entered the command. No switches are associated with this dataset.

b. The second positional output dataset will not be generated.

c. The third positional output dataset is to be in a file named F2 and will have extension E2. It is to be put on the DECtape which is mounted on unit 1 of controller A. This file is to be catalogued under the ID of the user who entered the command. The action indicated by switch S with value 1 is to be performed on this dataset.

d. The fourth and subsequent positional output dataset will not be generated.

e. The first positional input dataset is a file named F3, and its extension is E3. It can be found on disk unit 0, catalogued under the user number 123 of user group 11. No switches are associated with this dataset.

f. The second positional input dataset is a file named F4, and its extension is E4. It can be found on the DECtape currently mounted on controller B, unit 0. Associate the ID of the user who entered the command with this dataset. Perform the action indicated by switch AB (not ABC) on this dataset. No values are associated with the switch.

g. The third positional input dataset is a file named F5 and its extension is E5. It can be found on the DECtape currently mounted on controller B, unit 0. Associate the ID of the user who entered the command with this dataset. No switches are associated with this dataset.

h. The fourth and subsequent input datasets are not required.

APPENDIX J
SPECIAL I/O FUNCTIONS

Certain I/O functions are sufficiently device-dependent that they are beyond the scope of the File System. The .SPEC request (see Section 3.6.12) is provided as a means of accommodating such functions. A special function request requires one argument, which must be either a code in the range 0-255 or a pointer to a special function block. When a special function block is used, it must contain a code.

In general, special function codes will have similar meanings from device to device. When a code has no meaning for a device, it is treated as a no-op. Currently, special functions are defined only for magtape.

J.1 MAGTAPE FUNCTIONS

J.1.1 Special Function Block

The magtape driver requires a special function block to perform the special function requests. The following is the calling sequence for magtape special functions and the special function block format:

```
            .SPEC   #LNKBLK, #SFBLK
            .
            .
            .
SFBLK:      .BYTE   Special function code
            .BYTE   Words to follow (must be 3 or larger)
            .WORD   Tape unit status (returned by driver)
            .WORD   User specified count or control information
            .WORD   Residue count (returned by driver)
```

J.1.2 Functions

Code	Function
1	Offline (rewind and unload)
2	Write End-of-File
3	Rewind
4	Skip Record(s)
5	Backspace Record(s)
6	Set Density and Parity
7	Obtain Status

J.1.2.1 OFFLINE (Rewind and Unload) - function Code 1

This request causes the magtape to be rewound to the beginning-of-tape (BOT) marker and SELECT REMOTE status to go off. If the last command to the driver for this device was a WRITE, three EOF's are written before rewinding. Thus, this function could cause data to be lost if it is issued before a CLOSE during READ/WRITE processing.

J.1.2.2 WRITE END-OF-FILE - function Code 2

This request writes an end-of-file (EOF) record on magtape. It may cause data to be lost as described under OFFLINE.

J.1.2.3 REWIND - function Code 3

The REWIND request performs the same function as OFFLINE except that the SELECT REMOTE status does not go off.

J.1.2.4 SKIP RECORD(S) - function Code 4

Skips forward over the requested number of records (SFBLK+4) until either the SKIP count is exhausted or until an EOF record is encountered, in which case the EOF is spaced over and counted, but the operation terminates and a residue count (SFBLK+6) is returned (if any).

J.1.2.5 BACKSPACE RECORD(S) - function Code 5

This request skips backwards over the requested number of records until either the SKIP count is exhausted or an EOF or the BOT marker is encountered. If an EOF is encountered it is spaced over and counted, but the operation terminates and a residue count is returned (if any). If the BOT marker is encountered, it is not skipped or counted. Instead, the operation is terminated and a residue count is returned.

J.1.2.6 SET DENSITY AND PARITY - function Code 6

This request is ignored for 9-track tapes; it sets density and parity as follows for 7-track tapes:

DENSITY (SFBLK+5)	PARITY (SFBLK+4)
Ø = 2ØØ BPI	Ø = ODD
1 = 556 BPI	1 = EVEN
2 = 8ØØ BPI	
3 = 800 BPI Dump Mode	

The default density and parity are 8ØØ BPI Dump Mode, ODD. In this mode, one byte from core is represented as two bytes on 7-track magtape. Changing from this default causes one byte from core to be represented by one byte on tape with a loss of the two high order bits (6-7) of the byte.

J.1.2.7 TAPE UNIT STATUS - function Code 7

This request returns the current status of the tape unit in SFBLK+2 in the following form:

Bits	Content
Ø - 2	Last command was: Ø = OFFLINE 1 = READ 2 = WRITE 3 = WRITE EOF 4 = REWIND 5 = SKIP RECORD 6 = BACKSPACE RECORD
3 - 6	Unused.
7	1 = TAPE AFTER EOF (BEFORE EOF IF LAST COMMAND WAS BACKSPACE)
8	1 = TAPE AT BOT MARKER
9	1 = TAPE AFTER EOT MARKER
1Ø	1 = WRITE LOCK ON
11	PARITY: Ø = ODD 1 = EVEN (DEFAULT = ODD)
12	Ø = 9 TRACK 1 = 7 TRACK
13 - 14	DENSITY: Ø = 2ØØ BPI 1 = 556 BPI 2 = 8ØØ BPI 3 = 8ØØ BPI DUMP MODE
15	1 = LAST COMMAND CAUSED ERROR

Tape unit status is returned in SFBLK+2 for all special functions.

APPENDIX K
PROGRAMS

K.1 The two following example program listings illustrate methods for utilizing DOS monitor services. Note that the assembly language expansions of the programmed requests are used. Users with less than 12K of core should code their programs as illustrated and assemble the resultant code with the 8K assembler. Users with 12K of core or more may replace the assembly language expansion code with appropriate programmed requests and assemble with MACRO-11.

Example Program #1

```
                        ;PROGRAM WHICH TYPES A MESSAGE ON THE TELETPE WHILE
                        ;ACCEPTING A MESSAGE FROM THE KEYBOARD. PROGRAM REPEATS

        000000          R0=%0
        000001          R1=%1
        000002          R2=%2
        000003          R3=%3
        000004          R4=%4
        000005          R5=%5
        000006          SP=%6
        000007          PC=%7
        000015          CR=15
        000012          LF=12
        000011          HT=11
        000107          EROR=107

000000 012746'BEGIN:    MOV #LNK1,-(SP) ;INIT LNK1
       000312
000004 104005           EMT 5
000006 012746'          MOV #LNK2,-(SP) ;INIT LNK2
       000324
000012 104006           EMT 6
000014 012746'          MOV #FIL1,-(SP) ;OPEN FOR OUTPUT
       000340
000020 012746'          MOV #LNK1,-(SP)
       000312
000024 104015           EMT 15
000026 012746'          MOV #FIL2,-(SP) ;OPEN FOR INPUT
       000356
000032 012746'          MOV #LNK2,-(SP)
       000324
000036 104016           EMT 16
000040 012746'          MOV #MSG1,-(SP) ;WRITE THE MESSAGE
       000370
000044 012746'          MOV #LNK1,-(SP)
       000312
000050 104002           EMT 2
000052 012700'          MOV #LIB1+6,R0  ;SET THE BUFFER POINTER
       000170
000056 005020 LOOP1:    CLR (R0)+       ;CLEAR THE ADDRESS AND INCREMENT
000060 020027'          CMP R0,#LIB1+R0.        ;END OF BUFFER?
       000302
000064 103774           BLO LOOP1       ;NO, GO BACK & CONTINUE CLEARING
000066 012746'          MOV #LNK1,-(SP) ;YES,CONTINUE
       000312
000072 104001           EMT 1
000074 012746'          MOV #LIB1,-(SP) ;NO,READ LNK2,LIB1
       000162
000100 012746'          MOV #LNK2,-(SP)
       000324
000104 104004           EMT 4
000106 012746'          MOV #LNK2,-(SP) ;WAIT
       000324
```

```
000112 104001          EMT 1
000114 132767          BITB #EROR,LIB1+3       ;ANY ERRORS?
       000107
       000043
000122 001016          BNE ERR3          ;YES,GO TO THE ERROR#3 ADDRESS
000124 012746'         MOV #LNK1,-(SP)   ;NO, .CLOSE LNK1
       000312
000130 104017          EMT 17
000132 012746'         MOV #LNK2,-(SP)   ;.CLOSE LNK2
       000324
000136 104017          EMT 17
000140 012746'         MOV #LNK1,-(SP)   ;.RLSE LNK1
       000312
000144 104007          EMT 7
000146 012746'         MOV #LNK2,-(SP)   ;.RLSE LNK2
       000324
000152 104007          EMT 7
000154 000167          JMP BEGIN
       177620


               ERR1:
               ERR2:
               ERR3:
000160 104060          EMT 60            ; EXIT ON ANY ERROR


000162 000120 LIB1:    .WORD 80.         ;MAX BYTE COUNT
000164    000          .BYTE 0,0         ;FORMATTED ASCII
000165    000
000166 000000          .WORD 0           ;ACTUAL BYTE COUNT
       000310          .=.+80.  ;RESERVE THE BUFFER SPACE


000310 000160'         .WORD ERR1        ;ERROR RETURN ADDRESS
000312 000000 LNK1:    .WORD 0 ;POINTER
000314 016027          .RAD50 /DS1/      ;LOGICAL NAME
000316    001          .BYTE 1,0         ;UNIT 0
000317    000
000320 042420          .RAD50 /KB/       ;KEYBOARD


000322 000160'         .WORD ERR2        ;ERROR RETURN ADDRESS
000324 000000 LNK2:    .WORD 0
000326 016030          .RAD50 /DS2/
000330    001          .BYTE 1,0
000331    000
000332 042420          .RAD50 /KB/       ;KEYBOARD

000334 000000          .WORD 0 ;GO TO FATAL ERROR MESSAGE
000336    002          .BYTE 2,0         ;OPEN FOR OUTPUT
000337    000
000340 000000 FIL1:    .WORD 0,0,0,0,0,0 ;NO NAME, EXT, UIC, OR PROTECT
000342 000000
000344 000000
```

```
000346 000000
000350 000000

000352 000000          .WORD 0 ;GO TO FATAL ERROR
000354     004          .BYTE 4,0        ;OPEN FOR INPUT
000355     000
000356 000000 FIL2:    .WORD 0,0,0,0,0,0 ;NO NAME, EXT, UIC, OR PROTECT
000360 000000
000362 000000
000364 000000
000366 000000


000370 000210 MSG1:    .WORD 210        ;MAX BYTE COUNTS
000372     000          .BYTE 0,0        ;FORMATTED ASCII
000373     000
000374 000205          .WORD MSGEND-MSG1-6      ;ACTUAL BYTE COUNT
000375     015          .BYTE CR,LF,HT
000377     012
000400     011
000401     040          .ASCII / SPEAK ROUGHLY TO YOUR LITTLE BOY /
000402     123
000403     120
000404     105
000405     101
000406     113
000407     040
000410     122
000411     117
000412     125
000413     107
000414     110
000415     114
000416     131
000417     040
000420     124
000421     117
000422     040
000423     131
000424     117
000425     125
000426     122
000427     040
000430     114
000431     111
000432     124
000433     124
000434     114
000435     105
000436     040
000437     102
000440     117
000441     131
000442     040
000443     015          .BYTE CR,LF,HT,
000444     012
```

```
000445    011
000446    000
000447    040          .ASCII / AND BEAT HIM WHEN HE SNEEZES /
000450    101
000451    116
000452    104
000453    040
000454    102
000455    105
000456    101
000457    124
000460    040
000461    110
000462    111
000463    115
000464    040
000465    127
000466    110
000467    105
000470    116
000471    040
000472    110
000473    105
000474    040
000475    123
000476    116
000477    105
000500    105
000501    132
000502    105
000503    123
000504    040
000505    015          .BYTE CR,LF,HT
000506    012
000507    011
000510    040          .ASCII / HE ONLY DOES IT TO ANNOY /
000511    110
000512    105
000513    040
000514    117
000515    116
000516    114
000517    131
000520    040
000521    104
000522    117
000523    105
000524    123
000525    040
000526    111
000527    124
000530    040
000531    124
000532    117
000533    040
000534    101
```

```
000535     116
000536     116
000537     117
000540     131
000541     040
000542     015          .BYTE CR,LF,HT
000543     012
000544     011
000545     040          .ASCII / BECAUSE HE KNOWS IT TEASES /
000546     102
000547     105
000550     103
000551     101
000552     125
000553     123
000554     105
000555     040
000556     110
000557     105
000560     040
000561     113
000562     116
000563     117
000564     127
000565     123
000566     040
000567     111
000570     124
000571     040
000572     124
000573     105
000574     101
000575     123
000576     105
000577     123
000600     040
000601     015          .BYTE CR,LF
000602     012
        000603 MSGEND=.
        000604          .EVEN

        000001          .END
```

```
BEGIN     000000R     CR      = 000015     ERROR   = 000107
ERR1      000160R     ERR2      000160R    ERR3      000160R
FIL1      000340R     FIL2      000356R    HT      = 000011
LF      = 000012      LIB1      000162R    LNK1      000312R
LNK2      000324R     LOOP1     000056R    MSGEND  = 000603R
MSG1      000370R     PC      =%000007     R0      =%000000
R1      =%000001      R2      =%000002     R3      =%000003
R4      =%000004      R5      =%000005     SP      =%000006
.       = 000604R
```

Example Program #2

```
                ; PROGRAM TO DUPLICATE A PAPER TAPE
                ; USING TRAN-LEVEL REQUESTS
                ;
        000000          R0=%0
        000006          SP=%6
        000007          PC=%7
        000015          CR=15
        000012          LF=12
        000011          HT=11
        000004          RD=04           ;TRANBLOCK FUNCTION CODE FOR .READ
        000002          WR=02           ;TRANBLOCK FUNCTION CODE FOR .WRITE
        000107          G=107           ;ASCII G
        040000          EOD=40000       ;TRANBLOCK FUNCTION/STATUS=EOD
        000107          EROR=107
000000 012746'BEGIN:    MOV #LNK1,-(SP)      ;.INIT LNK1
        000416
000004 104006           EMT 6
000006 012746'          MOV #LNK2,-(SP)      ;.INIT LNK2
        000430
000012 104006           EMT 6
000014 012746'          MOV #LNK3,-(SP)      ;INIT LNK3
        000346
000020 104006           EMT 6
000022 012746'          MOV #LNK4,-(SP)      ;.INIT LNK4
        000372
000026 104006           EMT 6
000030 005067 START:    CLR FLAG1                ;ZERO END FLAG
        000210
000034 012767    MOV #100.,BLK1+4     ;INITIALIZE BUFFER SIZE
        000144
        000344
000042 005067           CLR BUF1+6       ;INITIALIZE INPUT BUFFER
        000316
000046 005067           CLR BUF1+10       ;INITIALIZE INPUT BUFFER
        000314
000052 012746'          MOV #MSG1,-(SP)  ;.WRITE LNK3,MSG1
        000246
000056 012746'          MOV #LNK3, -(SP)      ;
        000346
000062 104002           EMT 2
000064 012746'          MOV #LNK3,-(SP)      ;.WAIT LNK3
        000346
000070 104001           EMT 1
000072 012746'          MOV #BUF1,-(SP)      ;.READ LNK4,BUF1
        000356
000076 012746'          MOV #LNK4,-(SP)
        000372
000102 104004           EMT 4
000104 012746'          MOV #LNK4,-(SP)      ;.WAIT LNK4
        000372
000110 104001           EMT 1
000112 132767           BITB #EROR,BUF1+3
        000107
        000241
```

```
000120 001050          BNE ERR6
000122 122767          CMPB #G,BUF1+6        ;G?
       000107
       000234
000130 001337          BNE START             ;NO
000132 112767 LOOPR:   MOVB #RD,BLK1+6       ;YES,SET UP READ
       000004
       000250
000140 012746'         MOV #BLK1,-(SP)       ;.TRAN LNK1,BLK1
       000402
000144 012746'         MOV #LNK1,-(SP)
       000416
000150 104010          EMT 10
000152 012746'         MOV #LNK1,-(SP)       ;.WAIT LNK1
       000416
000156 104001          EMT 1
000160 032767          BIT #EOD,BLK1+6       ;TEST FUNCTION FOR EOD
       040000
       000222
000166 001406          BEQ LOOPW
000170 166767 ENDM:    SUB BLK1+10,BLK1+4    ;RESET WORDCOUNT TO FINAL
       000216
       000210                               ;   BUFFER'S SIZE
000176 012767          MOV #1,FLAG1          ;SET EOD=FLAG
       000001
       000040
000204 112767 LOOPW:   MOVB #WR,BLK1+6       ;SET UP WRITE
       000002
       000176
000212 012746'         MOV #BLK1,-(SP)       ;.TRAN LNK2,BLK1
       000402
000216 012746'         MOV #LNK2,-(SP)
       000430
000222 104010          EMT 10
000224 012746'         MOV #LNK2,-(SP)       ;.WAIT LNK2
       000430
000230 104001          EMT 1
000232 005767          TST FLAG1             ;END OF DATA?
       000006
000236 001274          BNE START             ;YES,START OVER
000240 000734          BR LOOPR              ;NO, GET MORE
                ERR1:
                ERR2:
                ERR3:
                ERR4:
                ERR5:
                ERR6:
                ERR7:
000242 104060          EMT 60                ;EXIT ON ANY ERROR
000244 000000 FLAG1:   .WORD 0               ;1=>EOD RECEIVED ON READ
000246 000067 MSG1:    .WORD 55.
000250     000         .BYTE 0,0
000251     000
000252 000067          .WORD 55.
000254     015         .BYTE CR,LF,HT
```

```
000255    012
000256    011
000257    114          .ASCII /LOAD TAPE INTO READER/
000260    117
000261    101
000262    104
000263    040
000264    124
000265    101
000266    120
000267    105
000270    040
000271    111
000272    116
000273    124
000274    117
000275    040
000276    122
000277    105
000300    101
000301    104
000302    105
000303    122
000304    015          .BYTE CR,LF,HT
000305    012
000306    011
000307    120          .ASCII /PUSH    G, CR   WHEN READY/
000310    125
000311    123
000312    110
000313    040
000314    040
000315    040
000316    040
000317    107
000320    054
000321    040
000322    103
000323    122
000324    040
000325    040
000326    040
000327    127
000330    110
000331    105
000332    116
000333    040
000334    122
000335    105
000336    101
000337    104
000340    131
000341    015          .BYTE CR,LF
000342    012
          000344       .EVEN
000344 000242'         .WORD ERR3
```

```
000346 000000 LNK3:   .WORD 0
000350 016027         .RAD50 /DS1/
000352    001         .BYTE 1,0
000353    000
000354 042420         .RAD50 /KB/
000356 000004 BUF1:   .WORD 4
000360    000         .BYTE 0,0
000361    000
000362 000004         .WORD 4
       000370         .=.+4
       000370         .EVEN
000370 000242'        .WORD ERR4
000372 000000 LNK4:   .WORD 0
000374 016027         .RAD50 /DS1/
000376    001         .BYTE 1,0
000377    000
000400 042420         .RAD50 /KB/
000402 000000 BLK1:   .WORD 0
000404 000440'        .WORD BUF2
000406 000144         .WORD 100.
000410 000000         .WORD 0
000412 000000         .WORD 0
000414 000242'        .WORD ERR3
000416 000000 LNK1:   .WORD 0
000420 016031         .RAD50 /DS3/
000422    001         .BYTE 1,0
000423    000
000424 063320         .RAD50 /PR/
000426 000242'        .WORD ERR2
000430 000000 LNK2:   .WORD 0
000432 016032         .RAD50 /DS4/
000434    001         .BYTE 1,0
000435    000
000436 063200         .RAD50 /PP/
       000604 BUF2:   .=.+100.
       000001         .END
```

```
BEGIN    000000R     BLK1     000402R     BUF1     000356R
BUF2     000440R     CR     = 000015      ENDM     000170R
EOD    = 040000      ERDR   = 000107      ERR1     000242R
ERR2     000242R     ERR3     000242R     ERR4     000242R
ERR5     000242R     ERR6     000242R     ERR7     000242R
FLAG1    000244R     G      = 000107      HT     = 000011
LF     = 000012      LNK1     000416R     LNK2     000430R
LNK3     000346R     LNK4     000372R     LOOPR    000132R
LOOPW    000204R     MSG1     000246R     PC     =%000007
RD     = 000004      R0     =%000000      SP     =%000006
START    000030R     WR     = 000002      .      = 000604R
```

APPENDIX L
CONVERSION TABLES

L.1 OCTAL-DECIMAL INTEGER CONVERSIONS

OCTAL	DECIMAL
0000	0000
TO	TO
0577	0383
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
0000	0000	0001	0002	0003	0004	0005	0006	0007
0010	0008	0009	0010	0011	0012	0013	0014	0015
0020	0016	0017	0018	0019	0020	0021	0022	0023
0030	0024	0025	0026	0027	0028	0029	0030	0031
0040	0032	0033	0034	0035	0036	0037	0038	0039
0050	0040	0041	0042	0043	0044	0045	0046	0047
0060	0048	0049	0050	0051	0052	0053	0054	0055
0070	0056	0057	0058	0059	0060	0061	0062	0063
0100	0064	0065	0066	0067	0068	0069	0070	0071
0110	0072	0073	0074	0075	0076	0077	0078	0079
0120	0080	0081	0082	0083	0084	0085	0086	0087
0130	0088	0089	0090	0091	0092	0093	0094	0095
0140	0096	0097	0098	0099	0100	0101	0102	0103
0150	0104	0105	0106	0107	0108	0109	0110	0111
0160	0112	0113	0114	0115	0116	0117	0118	0119
0170	0120	0121	0122	0123	0124	0125	0126	0127
0200	0128	0129	0130	0131	0132	0133	0134	0135
0210	0136	0137	0138	0139	0140	0141	0142	0143
0220	0144	0145	0146	0147	0148	0149	0150	0151
0230	0152	0153	0154	0155	0156	0157	0158	0159
0240	0160	0161	0162	0163	0164	0165	0166	0167
0250	0168	0169	0170	0171	0172	0173	0174	0175
0260	0176	0177	0178	0179	0180	0181	0182	0183
0270	0184	0185	0186	0187	0188	0189	0190	0191
0300	0192	0193	0194	0195	0196	0197	0198	0199
0310	0200	0201	0202	0203	0204	0205	0206	0207
0320	0208	0209	0210	0211	0212	0213	0214	0215
0330	0216	0217	0218	0219	0220	0221	0222	0223
0340	0224	0225	0226	0227	0228	0229	0230	0231
0350	0232	0233	0234	0235	0236	0237	0238	0239
0360	0240	0241	0242	0243	0244	0245	0246	0247
0370	0248	0249	0250	0251	0252	0253	0254	0255
0400	0256	0257	0258	0259	0260	0261	0262	0263
0410	0264	0265	0266	0267	0268	0269	0270	0271
0420	0272	0273	0274	0275	0276	0277	0278	0279
0430	0280	0281	0282	0283	0284	0285	0286	0287
0440	0288	0289	0290	0291	0292	0293	0294	0295
0450	0296	0297	0298	0299	0300	0301	0302	0303
0460	0304	0305	0306	0307	0308	0309	0310	0311
0470	0312	0313	0314	0315	0316	0317	0318	0319
0500	0320	0321	0322	0323	0324	0325	0326	0327
0510	0328	0329	0330	0331	0332	0333	0334	0335
0520	0336	0337	0338	0339	0340	0341	0342	0343
0530	0344	0345	0346	0347	0348	0349	0350	0351
0540	0352	0353	0354	0355	0356	0357	0358	0359
0550	0360	0361	0362	0363	0364	0365	0366	0367
0560	0368	0369	0370	0371	0372	0373	0374	0375
0570	0376	0377	0378	0379	0380	0381	0382	0383

	Ø	1	2	3	4	5	6	7
Ø6ØØ	Ø384	Ø385	Ø386	Ø387	Ø388	Ø389	Ø39Ø	Ø391
Ø61Ø	Ø392	Ø393	Ø394	Ø395	Ø396	Ø397	Ø398	Ø399
Ø62Ø	Ø4ØØ	Ø4Ø1	Ø4Ø2	Ø4Ø3	Ø4Ø4	Ø4Ø5	Ø4Ø6	Ø4Ø7
Ø63Ø	Ø4Ø8	Ø4Ø9	Ø41Ø	Ø411	Ø412	Ø413	Ø414	Ø415
Ø64Ø	Ø416	Ø417	Ø418	Ø419	Ø42Ø	Ø421	Ø422	Ø423
Ø65Ø	Ø424	Ø425	Ø426	Ø427	Ø428	Ø429	Ø43Ø	Ø431
Ø66Ø	Ø432	Ø433	Ø434	Ø435	Ø436	Ø437	Ø438	Ø439
Ø67Ø	Ø44Ø	Ø441	Ø442	Ø443	Ø444	Ø445	Ø446	Ø447
Ø7ØØ	Ø448	Ø449	Ø45Ø	Ø451	Ø452	Ø453	Ø454	Ø455
Ø71Ø	Ø456	Ø457	Ø458	Ø459	Ø46Ø	Ø461	Ø462	Ø463
Ø72Ø	Ø464	Ø465	Ø466	Ø467	Ø468	Ø469	Ø47Ø	Ø471
Ø73Ø	Ø472	Ø473	Ø474	Ø475	Ø476	Ø477	Ø478	Ø479
Ø74Ø	Ø48Ø	Ø481	Ø482	Ø483	Ø484	Ø485	Ø486	Ø487
Ø75Ø	Ø488	Ø489	Ø49Ø	Ø491	Ø492	Ø493	Ø494	Ø495
Ø76Ø	Ø496	Ø497	Ø498	Ø499	Ø5ØØ	Ø5Ø1	Ø5Ø2	Ø5Ø3
Ø77Ø	Ø5Ø4	Ø5Ø5	Ø5Ø6	Ø5Ø7	Ø5Ø8	Ø5Ø9	Ø51Ø	Ø511
1ØØØ	Ø512	Ø513	Ø514	Ø515	Ø516	Ø517	Ø518	Ø519
1Ø1Ø	Ø52Ø	Ø521	Ø522	Ø523	Ø524	Ø525	Ø526	Ø527
1Ø2Ø	Ø528	Ø529	Ø53Ø	Ø531	Ø532	Ø533	Ø534	Ø535
1Ø3Ø	Ø536	Ø537	Ø538	Ø539	Ø54Ø	Ø541	Ø542	Ø543
1Ø4Ø	Ø544	Ø545	Ø546	Ø547	Ø548	Ø549	Ø55Ø	Ø551
1Ø5Ø	Ø552	Ø553	Ø554	Ø555	Ø556	Ø557	Ø558	Ø559
1Ø6Ø	Ø56Ø	Ø561	Ø562	Ø563	Ø564	Ø565	Ø566	Ø567
1Ø7Ø	Ø568	Ø569	Ø57Ø	Ø571	Ø572	Ø573	Ø574	Ø575
11ØØ	Ø576	Ø577	Ø578	Ø579	Ø58Ø	Ø581	Ø582	Ø583
111Ø	Ø584	Ø585	Ø586	Ø587	Ø588	Ø589	Ø59Ø	Ø591
112Ø	Ø592	Ø593	Ø594	Ø595	Ø596	Ø597	Ø598	Ø599
113Ø	Ø6ØØ	Ø6Ø1	Ø6Ø2	Ø6Ø3	Ø6Ø4	Ø6Ø5	Ø6Ø6	Ø6Ø7
114Ø	Ø6Ø8	Ø6Ø9	Ø61Ø	Ø611	Ø612	Ø613	Ø614	Ø615
115Ø	Ø616	Ø617	Ø618	Ø619	Ø62Ø	Ø621	Ø622	Ø623
116Ø	Ø624	Ø625	Ø626	Ø627	Ø628	Ø629	Ø63Ø	Ø631
117Ø	Ø632	Ø633	Ø634	Ø635	Ø636	Ø637	Ø638	Ø639
12ØØ	Ø64Ø	Ø641	Ø642	Ø643	Ø644	Ø645	Ø646	Ø647
121Ø	Ø648	Ø649	Ø65Ø	Ø651	Ø652	Ø653	Ø654	Ø655
122Ø	Ø656	Ø657	Ø658	Ø659	Ø66Ø	Ø661	Ø662	Ø663
123Ø	Ø664	Ø665	Ø666	Ø667	Ø668	Ø669	Ø67Ø	Ø671
124Ø	Ø672	Ø673	Ø674	Ø675	Ø676	Ø677	Ø678	Ø679
125Ø	Ø68Ø	Ø681	Ø682	Ø683	Ø684	Ø685	Ø686	Ø687
126Ø	Ø688	Ø689	Ø69Ø	Ø691	Ø692	Ø693	Ø694	Ø695
127Ø	Ø696	Ø697	Ø698	Ø699	Ø7ØØ	Ø7Ø1	Ø7Ø2	Ø7Ø3
13ØØ	Ø7Ø4	Ø7Ø5	Ø7Ø6	Ø7Ø7	Ø7Ø8	Ø7Ø9	Ø71Ø	Ø711
131Ø	Ø712	Ø713	Ø714	Ø715	Ø716	Ø717	Ø718	Ø719
132Ø	Ø72Ø	Ø721	Ø722	Ø723	Ø724	Ø725	Ø726	Ø727
133Ø	Ø728	Ø729	Ø73Ø	Ø731	Ø732	Ø733	Ø734	Ø735
134Ø	Ø736	Ø737	Ø738	Ø739	Ø74Ø	Ø741	Ø742	Ø743
135Ø	Ø744	Ø745	Ø746	Ø747	Ø748	Ø749	Ø75Ø	Ø751
136Ø	Ø752	Ø753	Ø754	Ø755	Ø756	Ø757	Ø758	Ø759
137Ø	Ø76Ø	Ø761	Ø762	Ø763	Ø764	Ø765	Ø766	Ø767

Ø6ØØ	Ø384
TO	TO
1377	Ø767
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1ØØØ	4Ø96
2ØØØ	8192
3ØØØ	12288
4ØØØ	16384
5ØØØ	2Ø48Ø
6ØØØ	24576
7ØØØ	28672

1400	0768
TO	TO
2177	1151
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
1400	0768	0769	0770	0771	0772	0773	0774	0775
1410	0776	0777	0778	0779	0780	0781	0782	0783
1420	0784	0785	0786	0787	0788	0789	0790	0791
1430	0792	0793	0794	0795	0796	0797	0798	0799
1440	0800	0801	0802	0803	0804	0805	0806	0807
1450	0808	0809	0810	0811	0812	0813	0814	0815
1460	0816	0817	0818	0819	0820	0821	0822	0823
1470	0824	0825	0826	0827	0828	0829	0830	0831
1500	0832	0833	0834	0835	0836	0837	0838	0839
1510	0840	0841	0842	0843	0844	0845	0846	0847
1520	0848	0849	0850	0851	0852	0853	0854	0855
1530	0856	0857	0858	0859	0860	0861	0862	0863
1540	0864	0865	0866	0867	0868	0869	0870	0871
1550	0872	0873	0874	0875	0876	0877	0878	0879
1560	0880	0881	0882	0883	0884	0885	0886	0887
1570	0888	0889	0890	0891	0892	0893	0894	0895
1600	0896	0897	0898	0899	0900	0901	0902	0903
1610	0904	0905	0906	0907	0908	0909	0910	0911
1620	0912	0913	0914	0915	0916	0917	0918	0919
1630	0920	0921	0922	0923	0924	0925	0926	0927
1640	0928	0929	0930	0931	0932	0933	0934	0935
1650	0936	0937	0938	0939	0940	0941	0942	0943
1660	0944	0945	0946	0947	0948	0949	0950	0951
1670	0952	0953	0954	0955	0956	0957	0958	0959
1700	0960	0961	0962	0963	0964	0965	0966	0967
1710	0968	0969	0970	0971	0972	0973	0974	0975
1720	0976	0977	0978	0979	0980	0981	0982	0983
1730	0984	0985	0986	0987	0988	0989	0990	0991
1740	0992	0993	0994	0995	0996	0997	0998	0999
1750	1000	1001	1002	1003	1004	1005	1006	1007
1760	1008	1009	1010	1011	1012	1013	1014	1015
1770	1016	1017	1018	1019	1020	1021	1022	1023
2000	1024	1025	1026	1027	1028	1029	1030	1031
2010	1032	1033	1034	1035	1036	1037	1038	1039
2020	1040	1041	1042	1043	1044	1045	1046	1047
2030	1048	1049	1050	1051	1052	1053	1054	1055
2040	1056	1057	1058	1059	1060	1061	1062	1063
2050	1064	1065	1066	1067	1068	1069	1070	1071
2060	1072	1073	1074	1075	1076	1077	1078	1079
2070	1080	1081	1082	1083	1084	1085	1086	1087
2100	1088	1089	1090	1091	1092	1093	1094	1095
2110	1096	1097	1098	1099	1100	1101	1102	1103
2120	1104	1105	1106	1107	1108	1109	1110	1111
2130	1112	1113	1114	1115	1116	1117	1118	1119
2140	1120	1121	1122	1123	1124	1125	1126	1127
2150	1128	1129	1130	1131	1132	1133	1134	1135
2160	1136	1137	1138	1139	1140	1141	1142	1143
2170	1144	1145	1146	1147	1148	1149	1150	1151

2200	1152
TO	TO
2777	1535
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
2200	1152	1153	1154	1155	1156	1157	1158	1159
2210	1160	1161	1162	1163	1164	1165	1166	1167
2220	1168	1169	1170	1171	1172	1173	1174	1175
2230	1176	1177	1178	1179	1180	1181	1182	1183
2240	1184	1185	1186	1187	1188	1189	1190	1191
2250	1192	1193	1194	1195	1196	1197	1198	1199
2260	1200	1201	1202	1203	1204	1205	1206	1207
2270	1208	1209	1210	1211	1212	1213	1214	1215
2300	1216	1217	1218	1219	1220	1221	1222	1223
2310	1224	1225	1226	1227	1228	1229	1230	1231
2320	1232	1233	1234	1235	1236	1237	1238	1239
2330	1240	1241	1242	1243	1244	1245	1246	1247
2340	1248	1249	1250	1251	1252	1253	1254	1255
2350	1256	1257	1258	1259	1260	1261	1262	1263
2360	1264	1265	1266	1267	1268	1269	1270	1271
2370	1272	1273	1274	1275	1276	1277	1278	1279
2400	1280	1281	1282	1283	1284	1285	1286	1287
2410	1288	1289	1290	1291	1292	1293	1294	1295
2420	1296	1297	1298	1299	1300	1301	1302	1303
2430	1304	1305	1306	1307	1308	1309	1310	1311
2440	1312	1313	1314	1315	1316	1317	1318	1319
2450	1320	1321	1322	1323	1324	1325	1326	1327
2460	1328	1329	1330	1331	1332	1333	1334	1335
2470	1336	1337	1338	1339	1340	1341	1342	1343
2500	1344	1345	1346	1347	1348	1349	1350	1351
2510	1352	1353	1354	1355	1356	1357	1358	1359
2520	1360	1361	1362	1363	1364	1365	1366	1367
2530	1368	1369	1370	1371	1372	1373	1374	1375
2540	1376	1377	1378	1379	1380	1381	1382	1383
2550	1384	1385	1386	1387	1388	1389	1390	1391
2560	1392	1393	1394	1395	1396	1397	1398	1399
2570	1400	1401	1402	1403	1404	1405	1406	1407
2600	1408	1409	1410	1411	1412	1413	1414	1415
2610	1416	1417	1418	1419	1420	1421	1422	1423
2620	1424	1425	1426	1427	1428	1429	1430	1431
2630	1432	1433	1434	1435	1436	1437	1438	1439
2640	1440	1441	1442	1443	1444	1445	1446	1447
2650	1448	1449	1450	1451	1452	1453	1454	1455
2660	1456	1457	1458	1459	1460	1461	1462	1463
2670	1464	1465	1466	1467	1468	1469	1470	1471
2700	1472	1473	1474	1475	1476	1477	1478	1479
2710	1480	1481	1482	1483	1484	1485	1486	1487
2720	1488	1489	1490	1491	1492	1493	1494	1495
2730	1496	1497	1498	1499	1500	1501	1502	1503
2740	1504	1505	1506	1507	1508	1509	1510	1511
2750	1512	1513	1514	1515	1516	1517	1518	1519
2760	1520	1521	1522	1523	1524	1525	1526	1527
2770	1528	1529	1530	1531	1532	1533	1534	1535

3000	1536
TO	TO
3577	1919
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
3000	1536	1537	1538	1539	1540	1541	1542	1543
3010	1544	1545	1546	1547	1548	1549	1550	1551
3020	1552	1553	1554	1555	1556	1557	1558	1559
3030	1560	1561	1562	1563	1564	1565	1566	1567
3040	1568	1569	1570	1571	1572	1573	1574	1575
3050	1576	1577	1578	1579	1580	1581	1582	1583
3060	1584	1585	1586	1587	1588	1589	1590	1591
3070	1592	1593	1594	1595	1596	1597	1598	1599
3100	1600	1601	1602	1603	1604	1605	1606	1607
3110	1608	1609	1610	1611	1612	1613	1614	1615
3120	1616	1617	1618	1619	1620	1621	1622	1623
3130	1624	1625	1626	1627	1628	1629	1630	1631
3140	1632	1633	1634	1635	1636	1637	1638	1639
3150	1640	1641	1642	1643	1644	1645	1646	1647
3160	1648	1649	1650	1651	1652	1653	1654	1655
3170	1656	1657	1658	1659	1660	1661	1662	1663
3200	1664	1665	1666	1667	1668	1669	1670	1671
3210	1672	1673	1674	1675	1676	1677	1678	1679
3220	1680	1681	1682	1683	1684	1685	1686	1687
3230	1688	1689	1690	1691	1692	1693	1694	1695
3240	1696	1697	1698	1699	1700	1701	1702	1703
3250	1704	1705	1706	1707	1708	1709	1710	1711
3260	1712	1713	1714	1715	1716	1717	1718	1719
3270	1720	1721	1722	1723	1724	1725	1726	1727
3300	1728	1729	1730	1731	1732	1733	1734	1735
3310	1736	1737	1738	1739	1740	1741	1742	1743
3320	1744	1745	1746	1747	1748	1749	1750	1751
3330	1752	1753	1754	1755	1756	1757	1758	1759
3340	1760	1761	1762	1763	1764	1765	1766	1767
3350	1768	1769	1770	1771	1772	1773	1774	1775
3360	1776	1777	1778	1779	1780	1781	1782	1783
3370	1784	1785	1786	1787	1788	1789	1790	1791
3400	1792	1793	1794	1795	1796	1797	1798	1799
3410	1800	1801	1802	1803	1804	1805	1806	1807
3420	1808	1809	1810	1811	1812	1813	1814	1815
3430	1816	1817	1818	1819	1820	1821	1822	1823
3440	1824	1825	1826	1827	1828	1829	1830	1831
3450	1832	1833	1834	1835	1836	1837	1838	1839
3460	1840	1841	1842	1843	1844	1845	1846	1847
3470	1848	1849	1850	1851	1852	1853	1854	1855
3500	1856	1857	1858	1859	1860	1861	1862	1863
3510	1864	1865	1866	1867	1868	1869	1870	1871
3520	1872	1873	1874	1875	1876	1877	1878	1879
3530	1880	1881	1882	1883	1884	1885	1886	1887
3540	1888	1889	1890	1891	1892	1893	1894	1895
3550	1896	1897	1898	1899	1900	1901	1902	1903
3560	1904	1905	1906	1907	1908	1909	1910	1911
3570	1912	1913	1914	1915	1916	1917	1918	1919

3600	1920
TO	TO
4377	2303
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
3600	1920	1921	1922	1923	1924	1925	1926	1927
3610	1928	1929	1930	1931	1932	1933	1934	1935
3620	1936	1937	1938	1939	1940	1941	1942	1943
3630	1944	1945	1946	1947	1948	1949	1950	1951
3640	1952	1953	1954	1955	1956	1957	1958	1959
3650	1960	1961	1962	1963	1964	1965	1966	1967
3660	1968	1969	1970	1971	1972	1973	1974	1975
3670	1976	1977	1978	1979	1980	1981	1982	1983
3700	1984	1985	1986	1987	1988	1989	1990	1991
3710	1992	1993	1994	1995	1996	1997	1998	1999
3720	2000	2001	2002	2003	2004	2005	2006	2007
3730	2008	2009	2010	2011	2012	2013	2014	2015
3740	2016	2017	2018	2019	2020	2021	2022	2023
3750	2024	2025	2026	2027	2028	2029	2030	2031
3760	2032	2033	2034	2035	2036	2037	2038	2039
3770	2040	2041	2042	2043	2044	2045	2046	2047
4000	2048	2049	2050	2051	2052	2053	2054	2055
4010	2056	2057	2058	2059	2060	2061	2062	2063
4020	2064	2065	2066	2067	2068	2069	2070	2071
4030	2072	2073	2074	2075	2076	2077	2078	2079
4040	2080	2081	2082	2083	2084	2085	2086	2087
4050	2088	2089	2090	2091	2092	2093	2094	2095
4060	2096	2097	2098	2099	2100	2101	2102	2103
4070	2104	2105	2106	2107	2108	2109	2110	2111
4100	2112	2113	2114	2115	2116	2117	2118	2119
4110	2120	2121	2122	2123	2124	2125	2126	2127
4120	2128	2129	2130	2131	2132	2133	2134	2135
4130	2136	2137	2138	2139	2140	2141	2142	2143
4140	2144	2145	2146	2147	2148	2149	2150	2151
4150	2152	2153	2154	2155	2156	2157	2158	2159
4160	2160	2161	2162	2163	2164	2165	2166	2167
4170	2168	2169	2170	2171	2172	2173	2174	2175
4200	2176	2177	2178	2179	2180	2181	2182	2183
4210	2184	2185	2186	2187	2188	2189	2190	2191
4220	2192	2193	2194	2195	2196	2197	2198	2199
4230	2200	2201	2202	2203	2204	2205	2206	2207
4240	2208	2209	2210	2211	2212	2213	2214	2215
4250	2216	2217	2218	2219	2220	2221	2222	2223
4260	2224	2225	2226	2227	2228	2229	2230	2231
4270	2232	2233	2234	2235	2236	2237	2238	2239
4300	2240	2241	2242	2243	2244	2245	2246	2247
4310	2248	2249	2250	2251	2252	2253	2254	2255
4320	2256	2257	2258	2259	2260	2261	2262	2263
4330	2264	2265	2266	2267	2268	2269	2270	2271
4340	2272	2273	2274	2275	2276	2277	2278	2279
4350	2280	2281	2282	2283	2284	2285	2286	2287
4360	2288	2289	2290	2291	2292	2293	2294	2295
4370	2296	2297	2298	2299	2300	2301	2302	2303

4400 TO 5177 (OCTAL)	2304 TO 2687 (DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
4400	2304	2305	2306	2307	2308	2309	2310	2311
4410	2312	2313	2314	2315	2316	2317	2318	2319
4420	2320	2321	2322	2323	2324	2325	2326	2327
4430	2328	2329	2330	2331	2332	2333	2334	2335
4440	2336	2337	2338	2339	2340	2341	2342	2343
4450	2344	2345	2346	2347	2348	2349	2350	2351
4460	2352	2353	2354	2355	2356	2357	2358	2359
4470	2360	2361	2362	2363	2364	2365	2366	2367
4500	2368	2369	2370	2371	2372	2373	2374	2375
4510	2376	2377	2378	2379	2380	2381	2382	2383
4520	2384	2385	2386	2387	2388	2389	2390	2391
4530	2392	2393	2394	2395	2396	2397	2398	2399
4540	2400	2401	2402	2403	2404	2405	2406	2407
4550	2408	2409	2410	2411	2412	2413	2414	2415
4560	2416	2417	2418	2419	2420	2421	2422	2423
4570	2424	2425	2426	2427	2428	2429	2430	2431
4600	2432	2433	2434	2435	2436	2437	2438	2439
4610	2440	2441	2442	2443	2444	2445	2446	2447
4620	2448	2449	2450	2451	2452	2453	2454	2455
4630	2456	2457	2458	2459	2460	2461	2462	2463
4640	2464	2465	2466	2467	2468	2469	2470	2471
4650	2472	2473	2474	2475	2476	2477	2478	2479
4660	2480	2481	2482	2483	2484	2485	2486	2487
4670	2488	2489	2490	2491	2492	2493	2494	2495
4700	2496	2497	2498	2499	2500	2501	2502	2503
4710	2504	2505	2506	2507	2508	2509	2510	2511
4720	2512	2513	2514	2515	2516	2517	2518	2519
4730	2520	2521	2522	2523	2524	2525	2526	2527
4740	2528	2529	2530	2531	2532	2533	2534	2535
4750	2536	2537	2538	2539	2540	2541	2542	2543
4760	2544	2545	2546	2547	2548	2549	2550	2551
4770	2552	2553	2554	2555	2556	2557	2558	2559
5000	2560	2561	2562	2563	2564	2565	2566	2567
5010	2568	2569	2570	2571	2572	2573	2574	2575
5020	2576	2577	2578	2579	2580	2581	2582	2583
5030	2584	2585	2586	2587	2588	2589	2590	2591
5040	2592	2593	2594	2595	2596	2597	2598	2599
5050	2600	2601	2602	2603	2604	2605	2606	2607
5060	2608	2609	2610	2611	2612	2613	2614	2615
5070	2616	2617	2618	2619	2620	2621	2622	2623
5100	2624	2625	2626	2627	2628	2629	2630	2631
5110	2632	2633	2634	2635	2636	2637	2638	2639
5120	2640	2641	2642	2643	2644	2645	2646	2647
5130	2648	2649	2650	2651	2652	2653	2654	2655
5140	2656	2657	2658	2659	2660	2661	2662	2663
5150	2664	2665	2666	2667	2668	2669	2670	2671
5160	2672	2673	2674	2675	2676	2677	2678	2679
5170	2680	2681	2682	2683	2684	2685	2686	2687

5200	2688
TO	TO
5777	3071
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
5200	2688	2689	2690	2691	2692	2693	2694	2695
5210	2696	2697	2698	2699	2700	2701	2702	2703
5220	2704	2705	2706	2707	2708	2709	2710	2711
5230	2712	2713	2714	2715	2716	2717	2718	2719
5240	2720	2721	2722	2723	2724	2725	2726	2727
5250	2728	2729	2730	2731	2732	2733	2734	2735
5260	2736	2737	2738	2739	2740	2741	2742	2743
5270	2744	2745	2746	2747	2748	2749	2750	2751
5300	2752	2753	2754	2755	2756	2757	2758	2759
5310	2760	2761	2762	2763	2764	2765	2766	2767
5320	2768	2769	2770	2771	2772	2773	2774	2775
5330	2776	2777	2778	2779	2780	2781	2782	2783
5340	2784	2785	2786	2787	2788	2789	2790	2791
5350	2792	2793	2794	2795	2796	2797	2798	2799
5360	2800	2801	2802	2803	2804	2805	2806	2807
5370	2808	2809	2810	2811	2812	2813	2814	2815
5400	2816	2817	2818	2819	2820	2821	2822	2823
5410	2824	2825	2826	2827	2828	2829	2830	2831
5420	2832	2833	2834	2835	2836	2837	2838	2839
5430	2840	2841	2842	2843	2844	2845	2846	2847
5440	2848	2849	2850	2851	2852	2853	2854	2855
5450	2856	2857	2858	2859	2860	2861	2862	2863
5460	2864	2865	2866	2867	2868	2869	2870	2871
5470	2872	2873	2874	2875	2876	2877	2878	2879
5500	2880	2881	2882	2883	2884	2885	2886	2887
5510	2888	2889	2890	2891	2892	2893	2894	2895
5520	2896	2897	2898	2899	2900	2901	2902	2903
5530	2904	2905	2906	2907	2908	2909	2910	2911
5540	2912	2913	2914	2915	2916	2917	2918	2919
5550	2920	2921	2922	2923	2924	2925	2926	2927
5560	2928	2929	2930	2931	2932	2933	2934	2935
5570	2936	2937	2938	2939	2940	2941	2942	2943
5600	2944	2945	2946	2947	2948	2949	2950	2951
5610	2952	2953	2954	2955	2956	2957	2958	2959
5620	2960	2961	2962	2963	2964	2965	2966	2967
5630	2968	2969	2970	2971	2972	2973	2974	2975
5640	2976	2977	2978	2979	2980	2981	2982	2983
5650	2984	2985	2986	2987	2988	2989	2990	2991
5660	2992	2993	2994	2995	2996	2997	2998	2999
5670	3000	3001	3002	3003	3004	3005	3006	3007
5700	3008	3009	3010	3011	3012	3013	3014	3015
5710	3016	3017	3018	3019	3020	3021	3022	3023
5720	3024	3025	3026	3027	3028	3029	3030	3031
5730	3032	3033	3034	3035	3036	3037	3038	3039
5740	3040	3041	3042	3043	3044	3045	3046	3047
5750	3048	3049	3050	3051	3052	3053	3054	3055
5760	3056	3057	3058	3059	3060	3061	3062	3063
5770	3064	3065	3066	3067	3068	3069	3070	3071

6000 TO 6577 (OCTAL)	3072 TO 3455 (DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
6000	3072	3073	3074	3075	3076	3077	3078	3079
6010	3080	3081	3082	3083	3084	3085	3086	3087
6020	3088	3089	3090	3091	3092	3093	3094	3095
6030	3096	3097	3098	3099	3100	3101	3102	3103
6040	3104	3105	3106	3107	3108	3109	3110	3111
6050	3112	3113	3114	3115	3116	3117	3118	3119
6060	3120	3121	3122	3123	3124	3125	3126	3127
6070	3128	3129	3130	3131	3132	3133	3134	3135
6100	3136	3137	3138	3139	3140	3141	3142	3143
6110	3144	3145	3146	3147	3148	3149	3150	3151
6120	3152	3153	3154	3155	3156	3157	3158	3159
6130	3160	3161	3162	3163	3164	3165	3166	3167
6140	3168	3169	3170	3171	3172	3173	3174	3175
6150	3176	3177	3178	3179	3180	3181	3182	3183
6160	3184	3185	3186	3187	3188	3189	3190	3191
6170	3192	3193	3194	3195	3196	3197	3198	3199
6200	3200	3201	3202	3203	3204	3205	3206	3207
6210	3208	3209	3210	3211	3212	3213	3214	3215
6220	3216	3217	3218	3219	3220	3221	3222	3223
6230	3224	3225	3226	3227	3228	3229	3230	3231
6240	3232	3233	3234	3235	3236	3237	3238	3239
6250	3240	3241	3242	3243	3244	3245	3246	3247
6260	3248	3249	3250	3251	3252	3253	3254	3255
6270	3256	3257	3258	3259	3260	3261	3262	3263
6300	3264	3265	3266	3267	3268	3269	3270	3271
6310	3272	3273	3274	3275	3276	3277	3278	3279
6320	3280	3281	3282	3283	3284	3285	3286	3287
6330	3288	3289	3290	3291	3292	3293	3294	3295
6340	3296	3297	3298	3299	3300	3301	3302	3303
6350	3304	3305	3306	3307	3308	3309	3310	3311
6360	3312	3313	3314	3315	3316	3317	3318	3319
6370	3320	3321	3322	3323	3324	3325	3326	3327
6400	3328	3329	3330	3331	3332	3333	3334	3335
6410	3336	3337	3338	3339	3340	3341	3342	3343
6420	3344	3345	3346	3347	3348	3349	3350	3351
6430	3352	3353	3354	3355	3356	3357	3358	3359
6440	3360	3361	3362	3363	3364	3365	3366	3367
6450	3368	3369	3370	3371	3372	3373	3374	3375
6460	3376	3377	3378	3379	3380	3381	3382	3383
6470	3384	3385	3386	3387	3388	3389	3390	3391
6500	3392	3393	3394	3395	3396	3397	3398	3399
6510	3400	3401	3402	3403	3404	3405	3406	3407
6520	3408	3409	3410	3411	3412	3413	3414	3415
6530	3416	3417	3418	3419	3420	3421	3422	3423
6540	3424	3425	3426	3427	3428	3429	3430	3431
6550	3432	3433	3434	3435	3436	3437	3438	3439
6560	3440	3441	3442	3443	3444	3445	3446	3447
6570	3448	3449	3450	3451	3452	3453	3454	3455

6600	3456
TO	TO
7377	3839
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
6600	3456	3457	3458	3459	3460	3461	3462	3463
6610	3464	3465	3466	3467	3468	3469	3470	3471
6620	3472	3473	3474	3475	3476	3477	3478	3479
6630	3480	3481	3482	3483	3484	3485	3486	3487
6640	3488	3489	3490	3491	3492	3493	3494	3495
6650	3496	3497	3498	3499	3500	3501	3502	3503
6660	3504	3505	3506	3507	3508	3509	3510	3511
6670	3512	3513	3514	3515	3516	3517	3518	3519
6700	3520	3521	3522	3523	3524	3525	3526	3527
6710	3528	3529	3530	3531	3532	3533	3534	3535
6720	3536	3537	3538	3539	3540	3541	3542	3543
6730	3544	3545	3546	3547	3548	3549	3550	3551
6740	3552	3553	3554	3555	3556	3557	3558	3559
6750	3560	3561	3562	3563	3564	3565	3566	3567
6760	3568	3569	3570	3571	3572	3573	3574	3575
6770	3576	3577	3578	3579	3580	3581	3582	3583
7000	3584	3585	3586	3587	3588	3589	3590	3591
7010	3592	3593	3594	3595	3596	3597	3598	3599
7020	3600	3601	3602	3603	3604	3605	3606	3607
7030	3608	3609	3610	3611	3612	3613	3614	3615
7040	3616	3617	3618	3619	3620	3621	3622	3623
7050	3624	3625	3626	3627	3628	3629	3630	3631
7060	3632	3633	3634	3635	3636	3637	3638	3639
7070	3640	3641	3642	3643	3644	3645	3646	3647
7100	3648	3649	3650	3651	3652	3653	3654	3655
7110	3656	3657	3658	3659	3660	3661	3662	3663
7120	3664	3665	3666	3667	3668	3669	3670	3671
7130	3672	3673	3674	3675	3676	3677	3678	3679
7140	3680	3681	3682	3683	3684	3685	3686	3687
7150	3688	3689	3690	3691	3692	3693	3694	3695
7160	3696	3697	3698	3699	3700	3701	3702	3703
7170	3704	3705	3706	3707	3708	3709	3710	3711
7200	3712	3713	3714	3715	3716	3717	3718	3719
7210	3720	3721	3722	3723	3724	3725	3726	3727
7220	3728	3729	3730	3731	3732	3733	3734	3735
7230	3736	3737	3738	3739	3740	3741	3742	3743
7240	3744	3745	3746	3747	3748	3749	3750	3751
7250	3752	3753	3754	3755	3756	3757	3758	3759
7260	3760	3761	3762	3763	3764	3765	3766	3767
7270	3768	3769	3770	3771	3772	3773	3774	3775
7300	3776	3777	3778	3779	3780	3781	3782	3783
7310	3784	3785	3786	3787	3788	3789	3790	3791
7320	3792	3793	3794	3795	3796	3797	3798	3799
7330	3800	3801	3802	3803	3804	3805	3806	3807
7340	3808	3809	3810	3811	3812	3813	3814	3815
7350	3816	3817	3818	3819	3820	3821	3822	3823
7360	3824	3825	3826	3827	3828	3829	3830	3831
7370	3832	3833	3834	3835	3836	3837	3838	3839

7400	3840
TO	TO
0007	4095
(OCTAL)	(DECIMAL)

OCTAL	DECIMAL
1000	4096
2000	8192
3000	12288
4000	16384
5000	20480
6000	24576
7000	28672

	0	1	2	3	4	5	6	7
7400	3840	3841	3842	3843	3844	3845	3846	3847
7410	3848	3849	3850	3851	3852	3853	3854	3855
7420	3856	3857	3858	3859	3860	3861	3862	3863
7430	3864	3865	3866	3867	3868	3869	3870	3871
7440	3872	3873	3874	3875	3876	3877	3878	3879
7450	3880	3881	3882	3883	3884	3885	3886	3887
7460	3888	3889	3890	3891	3892	3893	3894	3895
7470	3896	3897	3898	3899	3900	3901	3902	3903
7500	3904	3905	3906	3907	3908	3909	3910	3911
7510	3912	3913	3914	3915	3916	3917	3918	3919
7520	3920	3921	3922	3923	3924	3925	3926	3927
7530	3928	3929	3930	3931	3932	3933	3934	3935
7540	3936	3937	3938	3939	3940	3941	3942	3943
7550	3944	3945	3946	3947	3948	3949	3950	3951
7560	3952	3953	3954	3955	3956	3957	3958	3959
7570	3960	3961	3962	3963	3964	3965	3966	3967
7600	3968	3969	3970	3971	3972	3973	3974	3975
7610	3976	3977	3978	3979	3980	3981	3982	3983
7620	3984	3985	3986	3987	3988	3989	3990	3991
7630	3992	3993	3994	3995	3996	3997	3998	3999
7640	4000	4001	4002	4003	4004	4005	4006	4007
7650	4008	4009	4010	4011	4012	4013	4014	4015
7660	4016	4017	4018	4019	4020	4021	4022	4023
7670	4024	4025	4026	4027	4028	4029	4030	4031
7700	4032	4033	4034	4035	4036	4037	4038	4039
7710	4040	4041	4042	4043	4044	4045	4046	4047
7720	4048	4049	4050	4051	4052	4053	4054	4055
7730	4056	4057	4058	4059	4060	4061	4062	4063
7740	4064	4065	4066	4067	4068	4069	4070	4071
7750	4072	4073	4074	4075	4076	4077	4078	4079
7760	4080	4081	4082	4083	4084	4085	4086	4087
7770	4088	4089	4090	4091	4092	4093	4094	4095

L.2 POWERS OF TWO AND EIGHT

$2^N, 8^M$	N, M	$2^{-N}, 8^{-M}$
1	0 **0**	1.0
2	1	0.5
4	2	0.25
8	3 **1**	0.125
16	4	0.062 5
32	5	0.031 25
64	6 **2**	0.015 625
128	7	0.007 812 5
256	8	0.003 906 25
512	9 **3**	0.001 953 125
1 024	10	0.000 976 562 5
2 048	11	0.000 488 281 25
4 096	12 **4**	0.000 244 140 625
8 192	13	0.000 122 070 312 5
16 384	14	0.000 061 035 156 25
32 768	15 **5**	0.000 030 517 578 125
65 536	16	0.000 015 258 789 062 5
131 072	17	0.000 007 629 394 531 25
262 144	18 **6**	0.000 003 814 697 265 625
524 288	19	0.000 001 907 348 632 812 5
1 048 576	20	0.000 000 953 674 316 406 25
2 097 152	21 **7**	0.000 000 476 837 158 203 125
4 194 304	22	0.000 000 238 418 579 101 562 5
8 388 608	23	0.000 000 119 209 289 550 781 25
16 777 216	24 **8**	0.000 000 059 604 644 775 390 625
33 554 432	25	0.000 000 029 802 322 387 695 312 5
67 108 864	26	0.000 000 014 901 161 193 847 656 25
134 217 728	27 **9**	0.000 000 007 450 580 596 923 828 125
268 435 456	28	0.000 000 003 725 290 298 461 914 062 5
536 870 912	29	0.000 000 001 862 645 149 230 957 031 25
1 073 741 824	30 **10**	0.000 000 000 931 322 574 615 478 515 625
2 147 483 648	31	0.000 000 000 465 661 287 307 739 257 812 5
4 294 967 296	32	0.000 000 000 232 830 643 653 869 628 906 25
8 589 934 592	33 **11**	0.000 000 000 116 415 321 826 934 814 453 125
17 179 869 184	34	0.000 000 000 058 207 660 913 467 407 226 562 5
34 359 738 368	35	0.000 000 000 029 103 830 456 733 703 613 281 25
68 719 476 736	36 **12**	0.000 000 000 014 551 915 228 366 851 806 640 625
137 438 953 472	37	0.000 000 000 007 275 957 614 183 425 903 320 312 5
274 877 906 944	38	0.000 000 000 003 637 978 807 091 712 951 660 156 25
549 755 813 888	39 **13**	0.000 000 000 001 818 989 403 545 856 475 830 078 125
1 099 511 627 776	40	0.000 000 000 000 909 494 701 772 928 237 915 039 062 5
2 199 023 255 552	41	0.000 000 000 000 454 747 350 886 464 118 957 519 531 25
4 398 046 511 104	42 **14**	0.000 000 000 000 227 373 675 443 232 059 478 759 765 625
8 796 093 022 208	43	0.000 000 000 000 113 686 837 721 616 029 739 379 882 812 5
17 592 186 044 416	44	0.000 000 000 000 056 843 418 860 808 014 869 689 941 406 25
35 184 372 088 832	45 **15**	0.000 000 000 000 028 421 709 430 404 007 434 844 970 703 125
70 368 744 177 664	46	0.000 000 000 000 014 210 854 715 202 003 717 422 485 351 562 5
140 737 488 355 328	47	0.000 000 000 000 007 105 427 357 601 001 858 711 242 675 781 25
281 474 976 710 656	48 **16**	0.000 000 000 000 003 552 713 678 800 500 929 355 621 337 890 625
562 949 953 421 312	49	0.000 000 000 000 001 776 356 839 400 250 464 677 810 668 945 312 5
1 125 899 906 842 624	50	0.000 000 000 000 000 888 178 419 700 125 232 338 905 334 472 656 25
2 251 799 813 685 248	51 **17**	0.000 000 000 000 000 444 089 209 850 062 616 169 452 667 236 328 125
4 503 599 627 370 496	52	0.000 000 000 000 000 222 044 604 925 031 308 084 726 333 618 164 062 5
9 007 199 254 740 992	53	0.000 000 000 000 000 111 022 302 462 515 654 042 363 166 809 082 031 25
18 014 398 509 481 984	54 **18**	0.000 000 000 000 000 055 511 151 231 257 827 021 181 583 404 541 015 625
36 028 797 018 963 968	55	0.000 000 000 000 000 027 755 575 615 628 913 510 590 791 702 270 507 812 5
72 057 594 037 927 936	56	0.000 000 000 000 000 013 877 787 807 814 456 755 295 395 851 135 253 906 25
144 115 188 075 855 872	57 **19**	0.000 000 000 000 000 006 938 893 903 907 228 377 647 697 925 567 626 953 125
288 230 376 151 711 744	58	0.000 000 000 000 000 003 469 446 951 953 614 188 823 848 962 783 813 476 562 5
576 460 752 303 423 488	59	0.000 000 000 000 000 001 734 723 475 976 807 094 411 924 481 391 906 738 281 25
1 152 921 504 606 846 976	60 **20**	0.000 000 000 000 000 000 867 361 737 988 403 547 205 962 240 695 953 369 140 625
2 305 843 009 213 693 952	61	0.000 000 000 000 000 000 433 680 868 994 201 773 602 981 120 347 976 684 570 312 5
4 611 686 018 427 387 904	62	0.000 000 000 000 000 000 216 840 434 497 100 886 801 490 560 173 988 342 285 156 25
9 223 372 036 854 775 808	63 **21**	0.000 000 000 000 000 000 108 420 217 248 550 443 400 745 280 086 994 171 142 578 125
18 446 744 073 709 551 616	64	0.000 000 000 000 000 000 054 210 108 624 275 221 700 372 640 043 497 085 571 289 062 5
36 893 488 147 419 103 232	65	0.000 000 000 000 000 000 027 105 054 312 137 610 850 186 320 021 748 542 785 644 531 25
73 786 976 294 838 206 464	66 **22**	0.000 000 000 000 000 000 013 552 527 156 068 805 425 093 160 010 874 271 392 822 265 625
147 573 952 589 676 412 928	67	0.000 000 000 000 000 000 006 776 263 578 034 402 712 546 580 005 437 135 696 411 132 812 5
295 147 905 179 352 825 856	68	0.000 000 000 000 000 000 003 388 131 789 017 201 356 273 290 002 718 567 848 205 566 406 25
590 295 810 358 705 651 712	69 **23**	0.000 000 000 000 000 000 001 694 065 894 508 600 678 136 645 001 359 283 924 102 783 203 125
1 180 591 620 717 411 303 424	70	0.000 000 000 000 000 000 000 847 032 947 254 300 339 068 322 500 679 641 962 051 391 601 562 5
2 361 183 241 434 822 606 848	71	0.000 000 000 000 000 000 000 423 516 473 627 150 169 534 161 250 339 820 981 025 695 800 781 25
4 722 366 482 869 645 213 696	72 **24**	0.000 000 000 000 000 000 000 211 758 236 813 575 084 767 080 625 169 910 490 512 847 900 390 625

L.3 SCALES OF NOTATION

L.3.1 2^x In Decimal

x	2^x	x	2^x	x	2^x
0.001	1.00069 33874 62581	0.01	1.00695 55500 56719	0.1	1.07177 34625 36293
0.002	1.00138 72557 11335	0.02	1.01395 94797 90029	0.2	1.14869 83549 97035
0.003	1.00208 16050 79633	0.03	1.02101 21257 07193	0.3	1.23114 44133 44916
0.004	1.00277 64359 01078	0.04	1.02811 38266 56067	0.4	1.31950 79107 72894
0.005	1.00347 17485 09503	0.05	1.03526 49238 41377	0.5	1.41421 35623 73095
0.006	1.00416 75432 38973	0.06	1.04246 57608 41121	0.6	1.51571 65665 10398
0.007	1.00486 38204 23785	0.07	1.04971 66836 23067	0.7	1.62450 47927 12471
0.008	1.00556 05803 98468	0.08	1.05701 80405 61380	0.8	1.74110 11265 92248
0.009	1.00625 78234 97782	0.09	1.06437 01824 53360	0.9	1.86606 59830 73615

L.3.2 $10^{\pm n}$ In Octal

10^n	n	10^{-n}	10^n	n	10^{-n}
1	0	1.000 000 000 000 000 000 000 00	112 402 762 000	10	0.000 000 000 006 676 337 66
12	1	0.063 146 314 631 463 146 31	1 351 035 564 000	11	0.000 000 000 000 537 657 77
144	2	0.005 075 341 217 270 243 66	16 432 451 210 000	12	0.000 000 000 000 043 136 32
1 750	3	0.000 406 111 564 570 651 77	221 411 634 520 000	13	0.000 000 000 000 003 411 35
23 420	4	0.000 032 155 613 530 704 15	2 657 142 036 440 000	14	0.000 000 000 000 000 264 11
303 240	5	0.000 002 476 132 610 706 64	34 327 724 461 500 000	15	0.000 000 000 000 000 022 01
3 641 100	6	0.000 000 206 157 364 055 37	434 157 115 760 200 000	16	0.000 000 000 000 000 001 63
46 113 200	7	0.000 000 015 327 745 152 75	5 432 127 413 542 400 000	17	0.000 000 000 000 000 000 14
575 360 400	8	0.000 000 001 257 143 561 06	67 405 553 164 731 000 000	18	0.000 000 000 000 000 000 01
7 346 545 000	9	0.000 000 000 104 560 276 41			

L.3.3 n log 2 and 10 In Decimal

n	$n \log_{10} 2$	$n \log_2 10$	n	$n \log_{10} 2$	$n \log_2 10$
1	0.30102 99957	3.32192 80949	6	1.80617 99740	19.93156 85693
2	0.60205 99913	6.64385 61898	7	2.10720 99696	23.25349 66642
3	0.90308 99870	9.96578 42847	8	2.40823 99653	26.57542 47591
4	1.20411 99827	13.28771 23795	9	2.70926 99610	29.89735 28540
5	1.50514 99783	16.60964 04744	10	3.01029 99566	33.21928 09489

L.3.4 Addition and Multiplication, Binary and Octal

Addition

Multiplication

Binary Scale

$0 + 0 = 0$
$0 + 1 = 1 + 0 = 1$
$1 + 1 = 10$

$0 \times 0 = 0$
$0 \times 1 = 1 \times 0 = 0$
$1 \times 1 = 1$

Octal Scale

0	01	02	03	04	05	06	07
1	02	03	04	05	06	07	10
2	03	04	05	06	07	10	11
3	04	05	06	07	10	11	12
4	05	06	07	10	11	12	13
5	06	07	10	11	12	13	14
6	07	10	11	12	13	14	15
7	10	11	12	13	14	15	16

1	02	03	04	05	06	07
2	04	06	10	12	14	16
3	06	11	14	17	22	25
4	10	14	20	24	30	34
5	12	17	24	31	36	43
6	14	22	30	36	44	52
7	16	25	34	43	52	61

L.3.5 Mathematical Constants In Octal

π = 3.11037 552421$_8$	e = 2.55760 521305$_8$	γ = 0.44742 147707$_8$
π^{-1} = 0.24276 301556$_8$	e^{-1} = 0.27426 530661$_8$	$\ln \gamma = -$ 0.43127 233602$_8$
$\sqrt{\pi}$ = 1.61337 611067$_8$	$\sqrt{e}$ = 1.51411 230704$_8$	$\log_2 \gamma = -$ 0.62573 030645$_8$
$\ln \pi$ = 1.11206 404435$_8$	$\log_{10} e$ = 0.33626 754251$_8$	$\sqrt{2}$ = 1.32404 746320$_8$
$\log_2 \pi$ = 1.51544 163223$_8$	$\log_2 e$ = 1.34252 166245$_8$	$\ln 2$ = 0.54271 027760$_8$
$\sqrt{10}$ = 3.12305 407267$_8$	$\log_2 10$ = 3.24464 741136$_8$	$\ln 10$ = 2.23273 067355$_8$

APPENDIX M
CHARACTER CODES

N.1 CARD CODES

CARD CODES
(ANSI X3.26–1970)

Zone / Digit	12	11	0		12 0	12 11	11 0		12 9	11 9	0 9	9	12 0 9	12 11 9
	&	–	0	space	{	|	}							
1	A	J	/	1	a	j	~		SOH	DC1				
2	B	K	S	2	b	k	s		STX	DC2		SYN		
3	C	L	T	3	c	l	t		ETX	DC3				
4	D	M	U	4	d	m	u							
5	E	N	V	5	e	n	v		HT		LF			
6	F	O	W	6	f	o	w			BS	ETB			
7	G	P	X	7	g	p	x		DEL		ESC	EOT		
8	H	Q	Y	8	h	q	y			CAN				
9	I	R	Z	9	i	r	z							
8-1				grave						EM			NUL	DLE
8-2	[	]	\	:										
8-3	.	$	,	#					VT					
8-4	<	*	%	@					FF	FS		DC4		
8-5	(	)	_	'					CR	GS	ENQ	NAK		
8-6	+	;	>	=					SO	RS	ACK			
8-7	!	^	?	"					SI	US	BEL	SUB		

NOTES

To determine the card punch for a particular character, locate the character in the table and read the corresponding zone punch and then digit punch. For example, the card punch for a % is 0-8-4.

To obtain the character corresponding to a particular card punch, locate the junction of the zone punch and the digit punch. For example, the character corresponding to the card punch 12-11-9 is r.

Slots that do not contain characters represent card punches for which there are no ASCII equivalents.

M.2 ASCII CHARACTER SET

ASCII CHARACTER SET
ASCII–1968 (ANSI X3.4–1968)

To obtain octal or decimal ASCII representation of a character, add the row value to the column value.

Column Value / Row Value	000 / 000	008 / 010	016 / 020	024 / 030	032 / 040	040 / 050	048 / 060	056 / 070	064 / 100	072 / 110	080 / 120	088 / 130	096 / 140	104 / 150	112 / 160	120 / 170
0	NUL	BS	DLE	CAN	space	(	0	8	@	H	P	X	grave	h	p	x
1	SOH	HT	DC1	EM	!	)	1	9	A	I	Q	Y	a	i	q	y
2	STX	LF	DC2	SUB	"	*	2	:	B	J	R	Z	b	j	r	z
3	ETX	VT	DC3	ESC	#	+	3	;	C	K	S	[	c	k	s	{
4	EOT	FF	DC4	FS	$	,	4	<	D	L	T	\	d	l	t	|
5	ENQ	CR	NAK	GS	%	-	5	=	E	M	U	]	e	m	u	}
6	ACK	SO	SYN	RS	&	.	6	>	F	N	V	^ (↑)	f	n	v	~ (ESC)
7	BEL	SI	ETB	US	' apos	/	7	?	G	O	W	← (_)	g	o	w	DEL

} decimal ASCII
} octal ASCII

Differences in the ASCII Standard

Octal	(ASCII 1963)	ASCII 1968
136	↑	^ (circumflex)
137	←	_ (underline)
176	ESC	~

NUL	NULL
SOH	START OF HEADING (↑A)
STX	START OF TEXT (↑B)
ETX	END OF TEXT (↑C)
EOT	END OF TRANSMISSION (↑D)
ENQ	ENQUIRY (↑E)
ACK	ACKNOWLEDGE (↑F)
BEL	BELL (↑G)
BS	BACKSPACE (↑H)
HT	HORIZ. TABULATION (↑I)
LF	LINE FEED (↑J)
VT	VERT. TABULATION (↑K)
FF	FORM FEED (↑L)
CR	CARRIAGE RETURN (↑M)
SO	SHIFT OUT (↑N)
SI	SHIFT IN (↑O)
DLE	DATA LINK ESCAPE (↑P)
DC1	DEVICE CONTROL 1 (↑Q)
DC2	DEVICE CONTROL 2 (↑R)
DC3	DEVICE CONTROL 3 (↑S)
DC4	DEVICE CONTROL 4 (STOP) (↑T)
NAK	NEGATIVE ACKNOWLEDGE (↑U)
SYN	SYNCHRONOUS IDLE (↑V)
ETB	END OF TRANSMISSION BLOCK (↑W)
CAN	CANCEL (↑X)
EM	END OF MEDIUM (↑Y)
SUB	SUBSTITUTE (↑Z)
ESC	ESCAPE (↑[)
FS	FILE SEPARATOR (↑\)
GS	GROUP SEPARATOR (↑])
RS	RECORD SEPARATOR (↑↑)
US	UNIT SEPARATOR (↑←)
DEL	DELETE (RUBOUT)

The ↑x character is produced by depressing the CTRL key and at the same time depressing the x character key.

NOTES

1. Teleprinters manufactured by Teletype Corporation, Skokie, Illinois, have used codes 175 (ALT) and 176 for ESC. Programs may forgo the use of } (175) and ~ (176) in order to use these codes as ESC on older teleprinters.

2. ASCII is a seven bit character code with an optional odd parity bit (200) added for many devices. Programs normally use just seven bits internally; the 200 bit is either stripped or added so the program will operate with either parity or non-parity generating devices.

   ISO Recommendation R646 and CCITT Recommendation V.3 (International Alphabet No. 5) is identical to ASCII except that number sign (043) is represented as £ instead of # and certain characters are reserved for national use.

APPENDIX N

GLOSSARY AND ABBREVIATIONS

ABS	Absolute
A/D	Analog-to-digital
ADC	Add Carry
ADRS	Address
ASCII	American Standard Code for Information Interchange
ASL	Arithmetic Shift Left
ASR	Arithmetic Shift Right Automatic Send/Receive
B	Byte
BAR	Bus Address Register
BBSY	Bus Busy
BCC	Branch if carry clear
BCS	Branch if carry set
BEQ	Branch if equal
BG	Bus Grant
BGE	Branch if greater or equal
BGT	Branch if greater than
BHI	Branch if higher
BHIS	Branch if higher or same
BIC	Bit Clear
BIS	Bit Set
BIT	Bit Test
Bit Map	A table describing the availability of space. Each bit in the table indicates the state (occupied or free) of one segment of storage, for example a block on a bulk storage device.
BLE	Branch if less or equal
BLOS	Branch if lower or same
BLT	Branch if less than
BMI	Branch if minus
BNE	Branch if not equal
BPL	Branch if plus
BR	Branch

BRD	Bus Register Data
BRX	Bus Request
BSP	Back Space
BSR	Bus Shift Register Back Space Record
BSY	Busy
Buffer	A storage area.
Buffer Use Table	A bit map in the permanently resident monitor, which describes the availability of buffers in the free core area.
BVC	Branch if overflow clear
BVS	Branch if overflow set
CBR	Console Bus Request
CIL	Core Image Library
CILUS	Core Image Library Update & Save Program
CLC	Clear Carry
CLK	Clock
CLN	Clear Negative
CLR	Clear
CLV	Clear Overflow
CLZ	Clear Zero
CMP	Compare
CNPR	Console Nonprocessor Request
CNTL	Control
COM	Complement
COND	Condition
CONS	Console
CONT	Contents Continue
Contiguous File	A file consisting of physically contiguous blocks on a bulk storage device.
Core Bit Map	That portion of a Permanent Bit Map which happens to be in core. Not to be confused with the Buffer Use Table.
Core Image	A copy of what a program or other data would look like if it were in core.
CP	Central Processor
CSI	Command String Interpreter
CSR	Control and Status Register

D	Data
D/A	Digital-to-analog
DAR	Device Address Register
DAT	Device Assignment Table. Contains the specifications from ASSIGN commands.
Dataset	A logical collection of data which is treated as an entity by a program. For a more detailed description see Section 1.6.1.
DATI	Data In
DATIP	Data In, Pause
DATO	Data Out
DATOB	Data Out, Byte
DBR	Data Buffer Register
DCDR	Decoder
DDB	Dataset Data Block. Contains Monitor control information for a dataset.
DE	Destination effective address
DEC	Decrement Digital Equipment Corporation
Default Device	The device specified in the Link Block of a dataset, and which is used for I/O operations on that dataset if there is no other device assigned in a DAT entry for the dataset.
DEL	Delay
DEP	Deposit
DEPF	Deposit Flag
Device Driver	The minimal routine which controls physical hardware activities on a peripheral device. The device driver is the interface between a device and the common, device-independent I/O code in the monitor.
DIV	Divide
DMA	Direct Memory Access
DSEL	Device Select
DST	Destination
DSX	Display, X-deflection Register
EMT	Emulator Trap
ENB	Enable
EOD	End-of-data
EOF	End-of-file
EOM	End-of-medium
ERR	Error

EX	External
EXAM	Examine
EXAMF	Examine Flag
EXEC	Execute
EXR	External Reset
F	Flag (part of signal name)
Fatal Error	An error from which a user's program cannot recover.
FBM	File Bit Map - A device-resident bit map with bits flagged for the blocks used for a single file. Used on DECtape to aid in the deletion process.
FCTN	Function
FIB	File Information Block. Contains (in core) information from the UFD and other sources when a file is open.
File	A physical collection of data which resides on a directory-structured device and is referenced through its name.
FILO	First in, last out
FLG	Flag
GEN	Generator
INC	Increment Increase
INCF	Increment Flag
IND	Indicator
INDIVR	Integer Divide Routine
INH	Inhibit
INIT	Initialize
INST	Instruction
Interleave Factor	The optimal minimum distance, measured in number of physical device blocks, between logically adjacent blocks of a linked file. Presently it is four on all PDP-11 bulk storage devices. For example, if physical block N is assigned to block 1 of a linked file, then physical block N+4 would be the closest device block that could be assigned to block 2 of that file.
INTR	Interrupt
INTRF	Interrupt Flag
I/O	Input/Output
IOT	Input/Output Trap

IOX	Input/Output Executive Routine
IR	Instruction Register
IRD	Instruction Register Decoder
ISR	Instruction Shift Register
JMP	Jump
JSR	Jump to subroutine
Julian Date	A 5-digit (decimal) numerical representation of the date, in which the two high-order digits give the year (1900=00, 1999=99) and the three low-order digits give the day within the year (January 1 = 001, December 31 = 365 (366 for leap year)). For example, January 28, 1971 is represented as 71028.
KSB	Keyboard Swap Buffer. The non-resident routines which process keyboard commands are brought into the keyboard swap buffer.
LIFO	Last In, First Out
Linked File	A file consisting of a set of blocks within which an ordering is specified through the use of a link word imbedded within each block.
Linker	A systems program which creates a load module to be loaded into core memory. The linker relocates and links internal and external symbols to provide communication between independently assembled programs.
LKS	Line time clock status register
Load Module	The output of the linker. A program in absolute binary form ready for loading and executing on a PDP-11.
LOC	Location
LP	Line Printer
LSB	Least Significant Bit
LSBY	Least Significant Byte
LSD	Least Significant Digit
MA	Memory Address
MAR	Memory Address Register
MBR	Memory Buffer Register
MEM	Memory
MFD	Master File Directory. Contains the names and locations of all UFDs on a file-structured device.
ML	Memory Location
MOV	Move

MRT	Monitor Residency Table. Contains the address (on disk or in core) of all non-resident Monitor modules.
MSB	Most Significant Bit
MSB	Monitor Swap Buffer. The non-resident routines which process requests to the Monitor are brought into the main swap buffer.
MSBY	Most Significant Byte
MSD	Most Significant Digit
MSEL	Memory Select
MSYN	Master Sync
ND	Negative Driver
NEG	Negate
NOR	Normalize
NPG	Nonprocessor Grant
NPR	Nonprocessor Request
NPRF	Nonprocessor Request Flag
NS	Negative Switch
Object Module	The relocatable binary output of an assembler or compiler.
ODT	Octal Debugging Technique
OP	Operate Operation
Operator	A user communicating directly with the Monitor through the keyboard.
OPR	Operator Operand
PA	Parity Available
PAL	Program Assembly Language
Parity Bit	A binary digit appended to an array of bits to make the sum of all the bit values always odd or always even.
PB	Parity Bit
PBM	Permanent Bit Map - A bit map which describes the availability of space on a DECtape or disk. It resides on the device it describes, and can be read into core in segments, called Core Bit Maps, for reference or updating.
PC	Program Counter
PD	Positive Driver
PDP	Programmed Data Processor
PERIF	Peripheral

PGM	Program
PP	Paper Tape Punch
PPB	Paper Tape Punch Buffer Register
PPS	Paper Tape Punch Status Register
PR	Paper Tape Reader
PRB	Paper Tape Reader Buffer Register
PROC	Processor
PRS	Paper Tape Reader Status Register
PS	Processor Status Positive Switch
PTR	Priority Transfer
PTS	Paper Tape Software System
PUN	Punch
Radix-50 packed ASCII	A format in which 3 ASCII characters (from a subset of all ASCII characters) are packed into a single 16-bit word.
RD	Read
RDR	Reader
REG	Register
REL	Release
RES	Reset
ROL	Rotate Left
ROM	Read-only Memory
ROR	Rotate Right
R/S	Rotate/Shift
RTI	Return from Interrupt
RTS	Return from Subroutine
R/W	Read/Write
R/WSR	Read/Write Shift Register
S	Single
SACK	Selection Acknowledge
SAL	A friend of SAM.
SAM	Swap Area Manager
SBC	Subtract Carry
SC	Single Cycle
SE	Source Effective Address

SEC	Set Carry
SEL	Select
SEN	Set Negative
SEV	Set Overflow
SEX	Sign Extend
SEZ	Set Zero
SI	Single Instruction
SP	Stack Pointer Spare
SR	Switch Register
SRC	Source
SSYN	Slave Sync
ST	Start
STPM	Set Trap Marker
STR	Strobe
SUB	Subtract
SVC	Service
SVT	System Vector Table
SWAB	Swap Byte
Swapping	The movement of programs or program sections from secondary storage to core.
TA	Trap Address Track Address
Table	A collection of data in a form suitable for ready reference.
TEMP	Temporary
TK	Teletype Keyboard
TKB	Teletype Keyboard Buffer Register
TKS	Teletype Keyboard Status Register
TP	Teletype Printer
TPS	Teletype Printer Status Register
TRT	Trace Trap
TSC	Timing State Control
TST	Test
UFD	User File Directory. Contains the names and locations of all files created under a UIC. (See MFD.)
UIC	User Identification Code. A code which associates a user with one of the UFDs on a device.

User	The person who is using the Monitor. He may use the Monitor as an operator, or via a program.
User Program	Any program written by a user to run under the Monitor.
UTR	User Trap
VEC	Vector
WC	Word Count
WCR	Word Count Register
XDR	X-line Driver
XRCG	X-line Read Control Group
XWCG	X-line Write Control Group
YDR	Y-line Driver
YRCG	Y-line Read Control Group
YWCG	Y-line Write Control Group

APPENDIX O
FILENAME EXTENSIONS

Extension	Attribute
ALG	ALOGL source file
BAS	BASIC source file
BAK	Backup file
BLI	BLISS source file
CBL	COBOL source file
CIF	Core Image File
CIL	Core Image Library
CMD	Command file
CRF	Input to cross-referencing program
DAT	DATA file for FORTRAN job
DDT	Reserved for DDT
DGN	Diagnostic message file
FTN	FORTRAN source file
FCL	FOCAL source list
LBO	Library of object modules (other types of libraries may also be implemented)
LCL	Linked core image library
LDA	Load module, Absolute
LDR	Load module, Relocatable
LOG	Logging file
LSP	LISP source file
LST	Listing file
MAC	MACRO assembler source file
MAP	MAP file
MFD	Master file directory
OBJ	Object module
OPR	Program generation information
OVR	Overlay
PAL	PAL assembler source file
PL1	PL/1 source file
RNO	Reserved for RUNOFF program
ROL	Reserved for ROLLIN program
RPG	RPG source file
SNO	SNOBOL source file
SPC	SPEC format text
STB	Symbol Table (Link-11 output)
SYM	File of symbols
SYS	System management
TMP	Temporary scratch file
UFD	User File Directory

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