

**HP 24307B**  
**DOS-III**  
**Disc Operating System**  
**reference manual**



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# **Preface**

This manual is a programming guide to DOS-III, a Hewlett-Packard Disc Operating System for 2000-series computer systems. Programmers using this manual should be familiar with the functions of batch-processing operating systems and one of the programming languages supported by the DOS-III Operating System.

The Hewlett-Packard programming languages and program libraries that can operate under control of DOS-III are described in the following reference manuals:

- *HP ALGOL (02116-9072)*
- *HP ASSEMBLER (24307-90014)*
- *HP FORTRAN (02116-9015)*
- *HP FORTRAN IV (5951-1321)*
- *RELOCATABLE SUBROUTINES (02116-91780)*

Other information, which may be useful to the programmer, is included in the SMALL PROGRAMS MANUAL, the MANUAL OF DIAGNOSTICS and the SOFTWARE OPERATING PROCEDURES. These manuals contain custom-assembled modules pertaining to each customer's software and hardware configurations, and are supplied with each Hewlett-Packard computer system.

This manual is divided into six functional parts:

- Part 1. DOS-III OPERATING SYSTEM

Part 1 defines the standard capabilities of DOS-III. It includes a summary of DOS-III organization, hardware and software; definitions of DOS-III directives, EXEC calls and I/O routines; a description of the interaction of DOS-III and its subsystems; and a set of sample job decks.

- Part 2. DOS-III EXTENDED FILE MANAGEMENT PACKAGE (EFMP)

Part 2 describes the capabilities of the DOS-III Extended File Management Package (EFMP), which allows the programmer to extend the file-handling capabilities of the DOS-III Operating System. Part 2 contains sections on EFMP organization, EXEC calls and use of UTIL, the EFMP Utility Program.

- **Part 3. GENERATING AND LOADING DOS-III**

Part 3 gives complete instructions for generating and loading a DOS-III System.

- **Part 4. DOS-III SYSTEMS PROGRAMMING**

Part 4 contains information which will help the advanced programmer to write his own EXEC modules, plan I/O drivers and use the DOS-III privileged mode capabilities.

- **Part 5. ERROR CODES AND MESSAGES**

Part 5 is a complete set of all DOS-III Operating System error codes and messages.

- **Part 6. APPENDIX AND INDEXES**

Part 6 contains an appendix of DOS-III system tables and three indexes: the first two are convenient summaries of DOS-III directives and EXEC calls; the third refers to terms discussed in the manual.

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**PART 1**

***DOS-III Operating System***



# ***SECTION I***

## ***DOS-III Organization***

The DOS-III supervisory software consists of a Disc Monitor (DISCM) that resides in main memory; EXEC modules which may reside either in main memory or on disc; and a Job Processor (JOBPR) that is disc-resident. Together these modules manage I/O processing, interrupt processing, executive processing, job processing, and file handling.

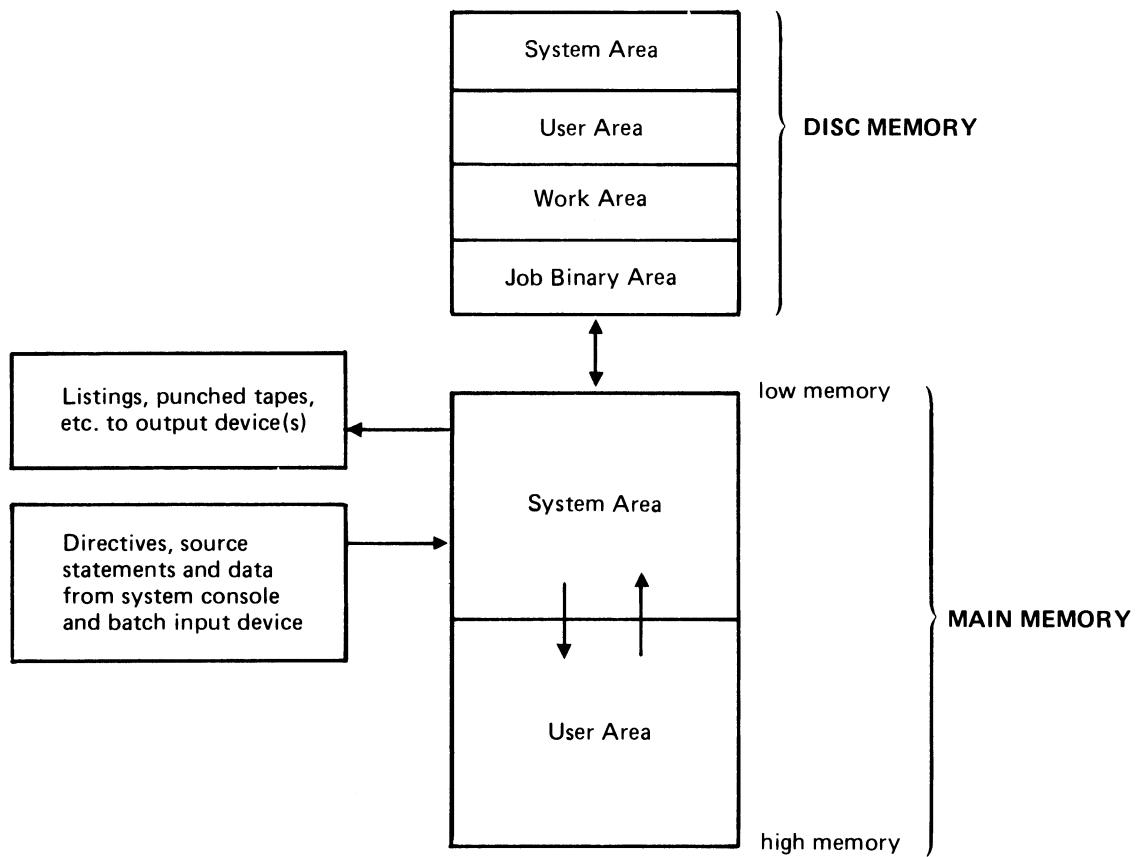
Other DOS-III software consists of a series of relocatable binary software modules. Since each module is an independent, general-purpose program, the hardware and software configuration of the system is flexible. Modules can either reside in main memory or on the disc, at the user's option (specified during system generation). In a system with a small main memory, the modules can reside on the disc to save main memory space; in a large main memory system, modules can reside in main memory for greater efficiency.

### **MAIN MEMORY LAYOUT**

When DOS-III is active, the main memory is divided into a User Area and a System Area (as shown in Figure 1-1). The Disc Monitor program handles all EXEC calls and, if they are legal, transfers them to the proper module for processing. The I/O drivers handle all actual I/O transfers of information. If some I/O drivers are disc-resident, they are read into main memory by the supervisor when needed. The User Area provides space for execution of user programs.

In addition, large DOS-III software modules, such as the FORTRAN Compilers, Assembler, Relocating Loader, and Job Processor, reside on the disc and execute in the User Area. (See Appendix A for figures on disc and main memory layout.)

If the memory protect option is present, a memory protect boundary is set between the System Area and the User Area. This boundary interrupts whenever a user program attempts to execute an I/O instruction (including a HALT) or to modify the System Area. (Instructions can reference the switch register and overflow register.) Programs to be run in the User Area must use EXEC calls for input/output, termination, suspension, and other external processes.



**Figure 1-1. Functional Diagram of DOS-III**

## DOS-III OPERATION

DOS-III operates in either keyboard or batch mode. In keyboard mode, the user enters statements and commands to the system (called directives) to control his programming job through a keyboard device (system console). Each line entered must terminate with a *return* and a *linefeed*. In batch mode, the user enters directives through a batch input device, sometimes integrated with a source program on punched cards, paper tape or magnetic tape, thus forming a job deck. Jobs can be stacked one upon another in a queue.

### Deleting Keyboard Errors

To delete an entire line of input, strike *rubout* then *linefeed*. To delete the character just entered, strike *Control-A* (simultaneous “A” and *control* key striking). Each *Control-A* deletes one additional preceding character.

### Batch Abort

Some errors when encountered in batch mode cause a batch abort. When such an error occurs (mostly in response to a directive) DOS-III takes the following action:

1. The offending directive and an error message is printed on the list device.
2. JOB ABORTED is printed on both the system console and the list device.
3. The offending statement and subsequent statements are ignored until a JOB, EJOB, or TYPE directive is encountered. The current operation is aborted and the next input is processed.

## DOS-III DIRECTIVES

The DOS-III Supervisor operates in response to directives input by the programmer or operator. Directives are strings of up to 72 characters that specify tasks to DOS-III. They are entered in one of the two modes of DOS-III operation: keyboard or batch.

The DOS-III directives are used for the following functions:

- Create, rename, edit, list, and dump user files (relocatable, absolute, loader-generated, source statements, and ASCII or binary data)
- Search the various disc subchannels for specified file names
- Check status of user disc tracks
- Turn on user programs or system programs such as FORTRAN and Assembler
- Examine and modify the logical organization of the I/O; rewind magnetic tapes and output end-of-file commands to magnetic tapes; output top-of-form commands to list devices
- Start and stop a job; type comments; suspend operations; resume execution of suspended programs

- Assemble or compile, load and execute a user program
- Dump main or disc memory
- Set the date; abort programs; transfer to batch mode (from keyboard mode or batch mode); return to keyboard mode (from batch mode)
- Change the subchannel of the user disc
- Initialize (label) a disc subchannel
- Dump all (or part of) a disc to another disc
- Purge file name entries from the user file directory
- Repack discs to eliminate purged user files
- Reserve logical memory space for specific subsystems (Memory Management)

DOS-III directives are described in Section II.

### **DOS-III EXEC CALLS**

After being translated and loaded, an executing user program communicates with DOS-III by means of EXEC calls. An EXEC call is a JSB instruction which transfers control to the DOS-III Supervisor.

The EXEC calls perform the following functions:

- I/O read and write operations
- User file and work area read and write operations
- I/O control operations (backspace, EOF, etc.)
- Request I/O status
- Change the subchannel of the user disc
- Request limits and status of WORK area (temporary disc storage)
- Program completion
- Program suspension
- Loading of program segments or main programs
- Request the time
- Control of memory protect
- Store values into base page memory locations
- Memory Management
- Programmatic file control

DOS-III EXEC calls are described in Section III.

## DOS-III INPUT/OUTPUT

All I/O operations and interrupts are channeled through the DISCM section of the DOS-III Supervisor. DISCM is always main-memory resident and maintains ultimate control of the computer resources.

I/O programming is device-independent. Programs written in FORTRAN, ALGOL, and Assembler specify a logical unit number (with a predefined function, such as data input) in I/O statements instead of a particular device. Logical unit numbers initially are assigned to appropriate devices by the operator during system generation, depending upon what is available and can be assigned during a job. Thus, the programmer need not worry about the type of input or output device performing the actual operation.

## PRIVILEGED INTERRUPT

For DOS-III system interrupt processing, the I/O channel select codes are assigned decreasing priority. Channel  $10_8$  has the highest priority and channel  $37_8$  has the lowest. When an interrupt occurs on an I/O channel, system interrupt processing is disabled on all channels having a lower priority (higher number) until the higher priority interrupt processing is completed.

DOS-III provides an optional capability which permits privileged interrupts on specific I/O devices (channels). These devices have their own user-supplied interrupt routines and have their interrupts processed without going through the system's central interrupt processor (\$CIC). The system guarantees a response time of 100 microseconds for privileged device interrupts. (For a description of privileged interrupt driver routines, see Section 13.)

The privileged interrupt capability is obtained by including a "fence" board in the system hardware configuration and notifying the system software of the existence of the fence during system generation (see Section 10). The privileged interrupt fence physically separates privileged devices from system devices. Privileged devices are those with interface boards in I/O channels of a lower number (higher priority) than the fence. System devices are those with interface boards in I/O channels with a higher number than the fence.

The DMA channels are always considered system devices although they reside on the privileged side of the fence. When the privileged interrupt option is included in the system, any DOS-III drivers which require DMA interrupts must explicitly inform the system of this fact. This is accomplished by issuing the following subroutine call from the driver before returning control to the system:

```
EXT $SDMA  
JSB $SDMA
```

When the last DMA interrupt has been received, the driver should inform the system that no further DMA interrupts are expected by issuing the following subroutine call:

```
EXT $CDMA  
JSB $CDMA
```

When the privileged interrupt fence is installed in the system and necessary privileged interrupt drivers are included, the user can access his privileged devices with standard I/O calls (JSB EXEC).

## TIMING CAPABILITIES

A library subroutine called \$TIME is available to both system programs and user programs. The Time Base Generator is required to use this subroutine (see "Hardware Options"). \$TIME provides the capability to set, reset, or release a timer (100 millisecond resolution).

*Note: Upon return from the \$TIME subroutine, Memory Protect is disabled until a system request (JSB EXEC) is issued.*

When setting (activating) a timer, an initial time value is placed into a user-supplied buffer and this timer buffer is added to a linked list of currently active timers. When the timer expires, the sub-system, driver, or user receives temporary control from the system. A timer is reset by placing a new time value into an active timer buffer. A timer is released (deactivated) by removing the timer buffer from the linked list of active timers. It is possible to remove all timer buffers from the list with one calling sequence.

To use \$TIME, the program must include a timer buffer, a time-out processor routine, and a calling sequence.

### Timer Buffer

A 4-word timer buffer must be available to \$TIME. The address of this buffer is passed to \$TIME to identify the desired timer. Timer buffer format is:

Word 1: 16-bit buffer identifier	
Word 2: Address of time-out processor routine	
Word 3: Current time value	System use only
Word 4: Address of next timer buffer in linked list	

Program must not modify word 3 or 4.

### Time-out Processor Routine

Control is passed to the time-out processor routine when a specified timer expires. Unless the system was generated with the privileged interrupt option, the interrupt system will be OFF and should remain OFF during execution of the time-out processor routine. If the privileged interrupt option is included in the system, the interrupt system will be ON upon entry into the time-out processor. To prevent further privileged interrupts from occurring during execution of the time-out processor, the time-out processor must disable the interrupt system.

**Caution: Interrupts should not be disabled for more than 100 microseconds.**

On entry into the time-out processor routine, the timer buffer is released from the timer list and the A- and B-registers set as follows:

A = 16-bit identifier of the timer just expired (this allows one time-out processor to service many timers).

B = 15-bit address of the timer buffer associated with the expired timer.

### Calling Sequence

To set or reset a timer:

```
EXT  $TIME
.
.
LDA  VALUE      (Time specified in -100 milliseconds)
LDB  ATMBF      (Address of timer buffer)
JSB  $TIME      (Set/reset timer)
SZA
JMP  ERROR
.
.
VALUE DEC -2      (Set timer for 200 milliseconds)
```

When this request is received, the list of timers is scanned for a matching timer buffer. If no match is found, a set request is assumed and the new entry is placed in the timer list. If a match is found, a reset request is assumed and the new value is stored into the existing timer buffer.

On return from \$TIME, the contents of the A-register indicate the termination condition:

A = 0; normal termination

A = 1; illegal timer buffer address

To release a timer:

EXT	\$TIME	
	:	
CLA		(Indicates release request)
LDB	ATMBF	(Release a specific timer)
	or	or
CLB		(Release all timers)
JSB	\$TIME	(Release timer)
	<return point>	
ATMBF	DEF TMBUF[,I]	(Address of timer buffer)
TMBUF	OCT n	(16-bit identifier)
	DEF TOP[,I]	(Address of time-out processor)
	BSS 2	(Reserved for system)
	:	
	:	
TOP	NOP	
	:	
	:	
JMP	TOP,I	

} Choose one      } Time Buffer      } Time-out Processor

*Note: Routines using \$TIME must remain main-memory resident during program execution because the system uses a linked list mechanism to keep track of the timers.*

## DOS-III FILES

Two types of files can be included in the DOS-III system: standard files (created by the STORE or EDIT directives) and files created under the Extended File Management Package (if EFMP is included in the system).

### Standard Files

The disc provides quick access and mass storage for user files consisting of source statements, relocatable, absolute and loader-generated object programs, or ASCII or binary data. Each file has a name that is used to reference it.

Programs use the Work Area of the disc for temporary storage. The System Area contains files of systems programs, EXEC modules, a system directory, and system library subroutines.

## **DOS-III Extended File Management Package**

DOS-III installations can use the DOS-III Extended File Management Package (EFMP). This set of optional EXEC modules allows the user to exploit a more powerful file structure than that provided by DOS-III. EFMP files allow logical record sizes of varying lengths for different files, security codes, flexible buffering, sequential reads and writes with a pointer, and detailed status information. In addition, a utility program (UTIL) is available that operates in the User Area. UTIL makes those EFMP functions (except reads and writes), normally only usable through EXEC calls, usable from the keyboard. For more information on EFMP, see Part 2.

## **DOS-III MEMORY MANAGEMENT**

A memory management EXEC module allows user and system programs to allocate and release buffer space within memory. The following memory management capabilities are provided:

- A directive (:MMGT) to specify and list subsystem names and block sizes.
- An initialization call (RCODE=35) to reserve a block of memory under a unique block name.
- A status call (RCODE=36) to interrogate the state of various blocks of memory.
- A buffer allocation call (RCODE=38) to subdivide blocks of memory into individual buffers. A unique buffer identification is assigned each buffer allocated.
- A buffer release call (RCODE=41) to release previously allocated buffer space.

## **GENERATING A DOS-III SYSTEM**

DOS-III is generated and loaded using two programs:

- Configured DSGEN (the system generator)
- BMDL (a bootstrap loader which loads the configured DOS-III from the disc into main memory); or an equivalent program contained on a ROM.

First, DSGEN outputs instructions to the operator asking for information about the system. At the appropriate point in the dialogue, the operator loads in the relocatable binary modules which make up DOS-III and specifies whether the modules are to be disc- or main-memory resident. Finally, DSGEN stores the configured DOS-III system on the disc in absolute form. (The disc is protected from alteration by a hardware override switch.)

DOS-III then resides as a System Area and User Area on the disc. Each area is labeled and contains a directory of all the files contained within the area. The System Area contains system main-memory resident and disc-resident modules, while the User Area contains user files.

To load DOS-III into main memory and begin system execution, the user executes a disc loader. The Loader loads all the modules designated main memory resident into main memory. (The disc-resident modules are brought into main memory when needed by the main-memory resident modules.)

## DISC STORAGE

Disc storage is divided into subchannels. Each subchannel is a logical disc, i.e., the dimensions do not necessarily correspond to the physical characteristics of the disc. Each subchannel contains 203 tracks — typically three of which are reserved as spares. The smallest addressable unit on a disc is a sector. One sector contains 128 sixteen-bit words of storage.

### HP 2883/2884

During system generation, the HP 2883 disc drives can be configured for one of two modes — four subchannels per drive or two subchannels per drive. In either case, the controller supports one or two drives (one drive is required).

For the four subchannel per drive mode, each drive contains a removable pack of twenty disc surfaces divided into four subchannels. Thus, the controller can support up to eight subchannels.

For the two subchannel per drive mode, each drive contains a removable pack of twenty disc surfaces divided into two subchannels. One controller supports up to four subchannels. A second controller (optional) can be added to provide support for up to eight subchannels. Subchannel assignments follow:

2883/2884  
with four  
Subchannels  
per drive

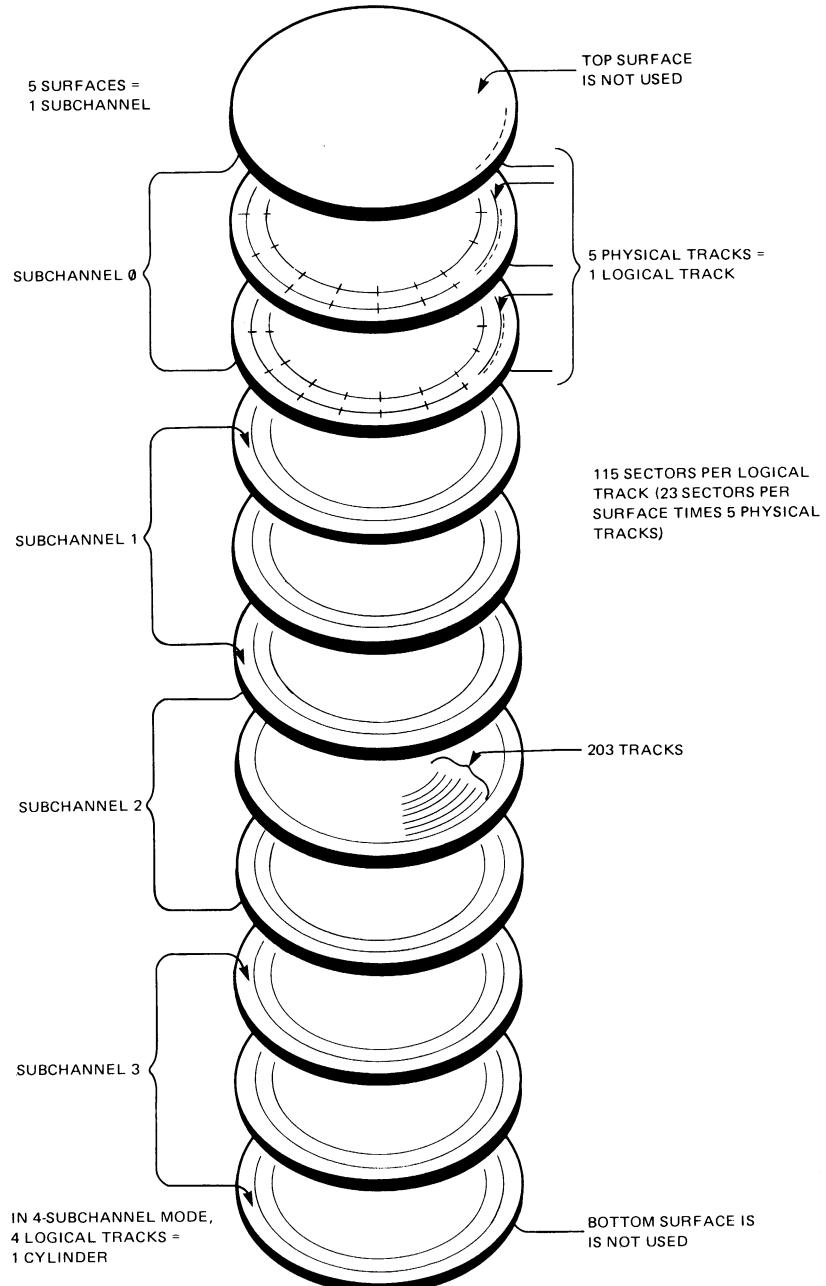
2883/2884  
with two  
Subchannels  
per drive

		Disc Drive Numbers					
0	1	0	1	2	3		
0	4			0	2	4	
1	5			1	3	5	
2	6	Subchannel Assignments				7	
3	7						

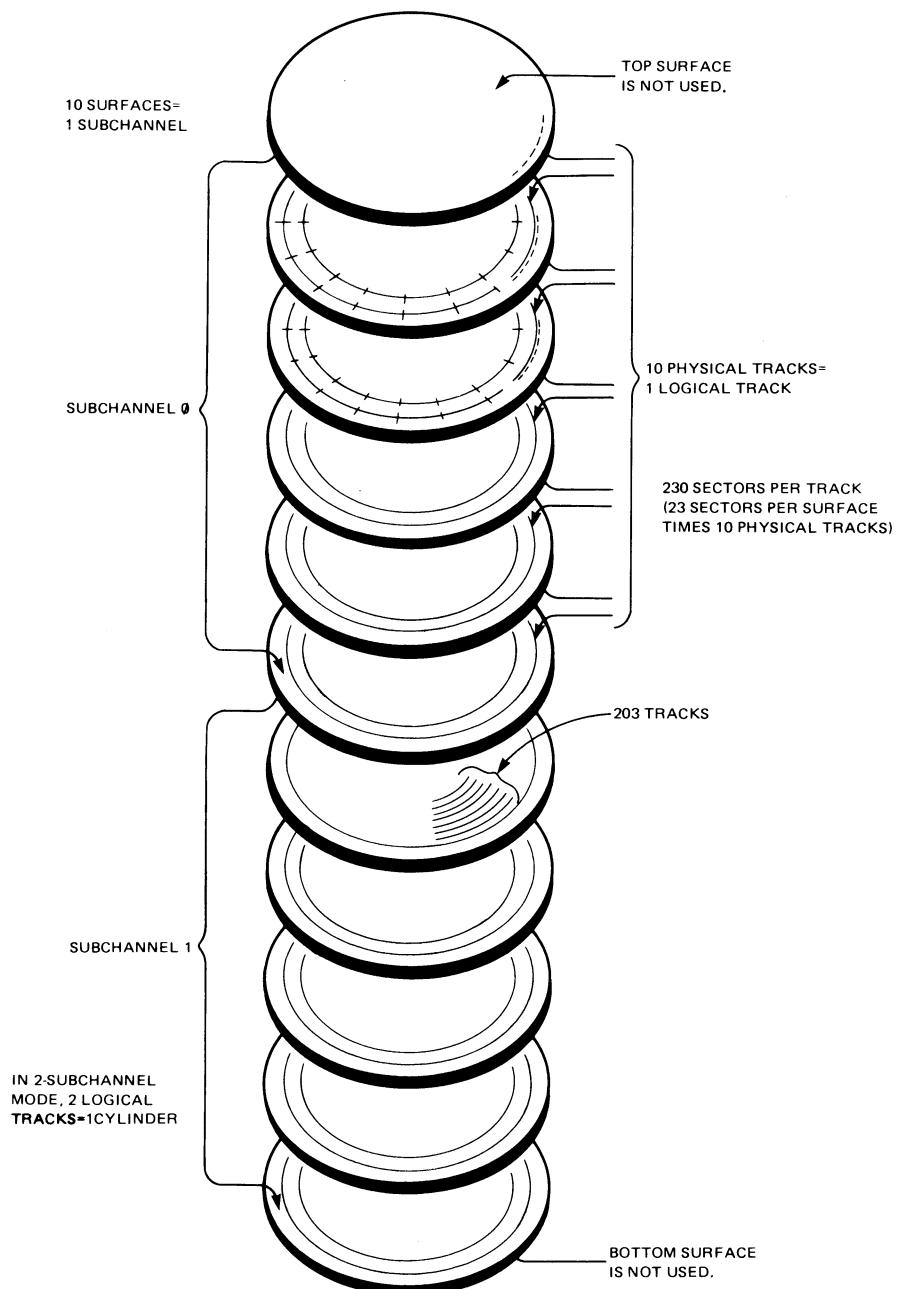
When two controllers are used (two subchannels per drive mode only) they must reside in contiguous I/O channel slots. In addition, the subchannels associated with the second controller (subchannels 4 through 7) can contain only user discs — no generation or bootstrap operations are permitted on these subchannels.

When an HP 2883/2884 is configured to the four-subchannel mode, each track contains 115 sectors. If it is configured to the two-subchannel mode, each track contains 230 sectors. Perhaps the concept of logical disc organization can be more clearly understood by studying the accompanying illustrations.

**HP 2883/2884**  
**4-SUBCHANNEL MODE**  
**LOGICAL ORGANIZATION**



**HP 2883/2884**  
**2-SUBCHANNEL MODE**  
**LOGICAL ORGANIZATION**



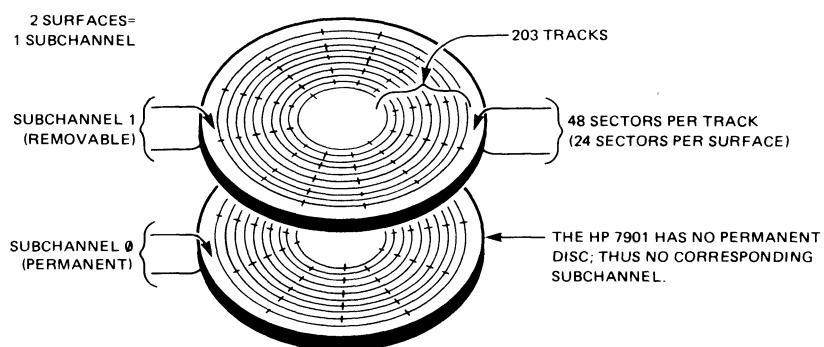
## HP 7900/7901

The controller for the moving-head disc supports up to four disc drives (one is required). Each 7900 drive contains two discs: a fixed disc and a removable cartridge. Each 7901 drive contains one disc: a removable cartridge. Each disc is referenced through a subchannel of the controller. Therefore, the controller has a maximum of eight subchannels (numbered 0 to 7). The subchannels are assigned as follows:

7900				7901			
Disc Drive Numbers				0 1 2 3			
Removable Subchannels				1 3 5 7			
Permanent Subchannels				None			

On the HP 7900/7901 disc drive, each track on the disc contains 48 sectors as shown in the following illustration.

## HP 7900/7901 DISC ORGANIZATION



## DISC USAGE

DOS-III normally allows two subchannels to be available to the user: one subchannel contains the system disc and the other contains the user disc (which may be the same subchannel as the system disc). The user subchannel assignment can be changed during job or program execution. In addition, an optional system search mode is available to allow searching for user files on any specified subchannels.

The disc storage has four parts:

1. The System Area

Executable code created by the system generator and hardware protected; includes DOS-III Supervisor and other system programs.

2. The User Area (optional)

User file directory and user files (data, object programs, source statements, etc.).

3. The Work Area

Temporary storage for the current job.

4. Job Binary Area

Temporary storage for relocatable object code generated by the Assembler and compilers; this is an area of variable size and starts from the end of the disc.

All four of these areas can reside on the system subchannel, or the User Area can be on a separate subchannel. Only one User Area is available to the system at a time. The standard user subchannel is assigned at system generation time; this can be the system disc or another subchannel (removable or permanent disc). The UD directive and an analogous EXEC call allow the user to temporarily change the User Area to another subchannel.

Automatic track switching is provided within each subchannel.

## DOS-III HARDWARE REQUIREMENTS

DOS-III controls the operation of HP 2100A and HP 2100S Computer systems, and HP 21MX Computer Series systems. Minimum hardware requirements depend on the type of computer system selected.

The minimum hardware required for DOS-III operation is:

1. a) An HP 2100A or HP 2100S Computer, with 16,384 words of main memory, and DMA; or,  
b) An HP 21MX-series Computer with 16,384 words of main memory, and a Dual-Channel Port Controller.
2. Moving-head Disc device (HP 7900 Moving-head Disc Drive with fixed disc and removable cartridge; or HP 7901 Moving-head Disc Drive with removable cartridge; or HP 2883 Disc File with one removable pack).
3. System Console device.
4. Paper Tape Reader.

## Hardware Options

The following hardware options are available:

1. Time-base Generator (provides accounting times and time-of-day).
2. Privileged Interrupt Fence.
3. Floating-point hardware (standard for 21MX Computer Series).
4. Additional main memory to a total of 24,576 or 32,768 words.
5. Using extenders, additional I/O channels (up to channel 37<sub>8</sub>).
6. Memory Protect (not available for the HP 2105 Processor).
7. Paper Tape Punch.
8. Line Printer.
9. Card Reader.
10. Magnetic Tape Unit.
11. Additional Disc Drives. (Maximum is four on HP 7900/7901; two on HP 2883 with four sub-channels per drive; and four on HP 2883 with two subchannels per drive.)
12. CRT Display Console.
13. Writable Control Store.
14. Fast FORTRAN Processor.

## **DOS-III SOFTWARE**

### **Required Software**

The minimum software requirements for DOS-III are

1. Absolute Programs
  - a. DOS-III System Generator (DSGEN)
  - b. DOS-III Bootstrap Loader
  - c. SIO Drivers
2. Relocatable Programs
  - a. DOS-III Disc Monitor (DISCM)
  - b. DOS-III Exec Modules
  - c. DOS-III Job Processor (JOBPR)
  - d. DOS-III Disc Driver (DVR31)
  - e. DOS-III System Console Driver (DVR00, DVR05 or DVR26)
  - f. DOS-III Paper Tape Reader Driver (DVR01)

### **Software Options**

In addition, the following programs can be included when DOS-III is generated:

1. DOS-III Relocating Loader
2. DOS-III Assembler
3. DOS-III FORTRAN Compiler
4. RTE/DOS FORTRAN IV Compiler
5. RTE/DOS FORTRAN IV Compiler — 10K Compiler Area
6. RTE/DOS ALGOL Compiler
7. RTE/DOS Relocatable Library (EAU, or floating point)
8. RTE/DOS FORTRAN IV Library (extended-precision arithmetic)

**9. RTE/DOS FORTRAN Formatter**

**10. DOS-III Standard Drivers (either main-memory or disc resident):**

Paper Tape Punch Driver (DVR02)

Digital Plotter Driver (DVR10)

Card Reader Driver (DVR11) — uses DMA or Dual Channel Port Controller

Line Printer Driver (DVR12)

Optical Mark Reader Driver (DVR15)

Magnetic Tape Driver (DVR23) — uses DMA or Dual Channel Port Controller

Terminal Printer Driver (DVR26)

Writable Control Store Driver (DVR33) — uses DMA

Card Reader Punch Driver (DVR34)

Hardwired Serial Interface Driver (DVR67)

**11. DOS-III Physical Drivers**

Synchronous Data Set Interface Driver (DVR70)

Synchronous Modem Interface Driver (DVR71)

Asynchronous Data Set Interface Driver (DVR72)

Asynchronous Multiplexer Interface Driver (DVR73)

Buffered Asynchronous Data Set Interface Driver (DVR74)

**12. DOS-III Logical Drivers**

Asynchronous Terminal Driver Number One (ATD01)

Asynchronous Terminal Driver Number Two (ATD02)

Asynchronous Card Reader Driver Number One (ACR01)

Page Mode Terminal Driver Number One (PMT01)

Page Mode Terminal Driver Number Two (PMT02)

Synchronous Line Control (SLC)

**13. DOS-III Extended File Management Package**

**14. RTE/DOS Fast FORTRAN Processor Subroutine Library**



## ***SECTION II***

## ***DOS-III Directives***

Directives are the direct line of communication between the keyboard or batch input device and DOS-III. Directives may enter DOS-III in two modes: keyboard and batch. In either mode, all directives are listed on the system console. Certain directives can be used in one mode only; others can be used in both modes. In keyboard mode, the operator manually inputs the directives through the system console keyboard. In batch mode, the programmer prepares the directives (commonly on punched cards, paper tapes, or magnetic tape) and inputs them along with programs, data, etc., in a complete job.

### **FORMAT FOR DIRECTIVES**

Directives have the same format, regardless of the mode in which they occur: a colon (:) followed by a directive word (first two characters are significant) and, if necessary, a list of parameters (maximum is 15) separated by commas. For example,

*:PURGE,FILE1,FILE2,FILE3*

When the sequence and position of parameters is significant, missing parameters must be represented by commas if the following parameters are to be recognized. The first blank character not preceded by a comma is the end of the directive. Comments may appear after this blank; they are ignored by DOS-III.

*Note: The total length of an input string cannot exceed 72 characters.*

### **ENTERING DIRECTIVES**

DOS-III has two conventions for notifying the operator that directives may be entered:

1. DOS-III outputs a “commercial at” sign (@) and rings a bell (at the system console). At this time, the operator may enter any directive.

2. DOS-III outputs an asterisk (at the system console). At this time the operator may enter an "operator attention" directive only. The "operator attention" directives are

:ABORT

:DN

:EQ

:LU

:OFF

:PAUSE

:TRACKS

:TYPE

:UP

Should the operator type any other directive, DOS-III outputs the following message:

*IGNORED*

and returns to the executing program.

To attain control of DOS-III (to enter an "operator attention" directive) the operator can strike any system console keyboard key. If the system console is available, DOS-III immediately outputs an asterisk (\*); if the system console is busy, DOS-III will output the asterisk as soon as it releases the system console.

- Notes:*
1. *Operator attention is disabled during the completion phase of :EDIT and during :PURGE.*
  2. *Some system conditions restrict allowable directives; e.g., after an I/O ERR NR EQT# nn, the system is waiting for an :UP,nn, followed by :GO. Under such conditions, otherwise legitimate directives will be ignored.*
  3. *Some operations, such as editing, require perceptible waits while DOS-III processes the directive.*

## ORDER OF DIRECTIVES

The DOS-III directives described in this section are presented in alphabetic order (by function name). If a directive must be used in keyboard mode only, a note to that effect is placed at the top of each page describing the directive. A quick cross-reference index of DOS-III directives, "Summary of Directives," is included at the back of this manual.

## ***ABORT***

### **Purpose**

To terminate the current job before the next JOB or EJOB directive.

### **Format**

*:ABORT*

### **Comments**

Abort carries out all the operations of a batch mode EJOB directive. All I/O devices are cleared.

# **BATCH**

## Purpose

To switch from keyboard mode to batch mode, or to reassign the batch device.

## Format

:*BATCH,logical unit*

where *logical unit* is the logical unit number of the desired batch input device.

## Comments

A BATCH, JOB, TYPE, OR TRACKS directive must be the first directive entered following system start.

See “TYPE” in this section for the opposite procedure of returning batch mode to keyboard mode. Assigning a null device or logical unit numbers 2 or 3 as the batch device results in an ILLEGAL LUN error (see LOGICAL UNIT directive).

# ***CLEAR***

## **Purpose**

To clear the Job Binary Area on the disc, or to issue a clear command to an I/O device.

## **Format**

*:CLEAR[,logical unit]*

where *logical unit* is the logical unit number of the device to be cleared. If *logical unit* is omitted, the disc Job Binary Area is cleared.

## **Comments**

Using logical units 1, 2, or 3 results in an LU error.

The effect of clearing an I/O device is the transmittal of a clear function to the appropriate driver.

# ***COMMENT***

## **Purpose**

To print a message on the system console.

## **Format**

*:COMMENT character string*

where *character string* is a message to be printed on the system console.

## **Comments**

A space (but not a comma) is required between the directive word and the comment string.

The programmer can use :COMMENT or :PAUSE to send a message to the operator at the system console; using :COMMENT causes no suspension of processing. Use :PAUSE when a processing delay is desired, for example to request that the operator mount a magnetic tape.

## **EXAMPLES:**

*:COMMENT BEGINNING OF PAYROLL JOB*

## ***DATE***

### **Purpose**

To set the date and time for accounting purposes whenever DOS-III is activated.

### **Format**

*:DATE,day[,hour,min]*

where *day* is any string of ten or fewer characters (commas not permitted) chosen by the operator (such as 7/10/69, 10.JULY.69, etc.);

*hour* and *min* are the current time in hours and minutes on a 24-hour clock. If not given or a Time-base Generator is not present, they are set to zero.

### **Comments**

The DATE directive is legal only as the first directive in a start-up procedure. The directive is not accepted any other time.

### **EXAMPLES:**

*:DATE,7/10/69,12,23*

*:DATE,WEDNESDAY,7,45*

*:DATE,10JULY1969*

*:DA,,*

## ***DOWN***

### **Purpose**

To declare an I/O device unavailable for use during the remainder of a job.

### **Format**

*:DN,n*

where *n* is the equipment table entry number for the device to be set down.

### **Comments**

The system console and the disc (logical units 1, 2, and 3) cannot be set down.

## **DUMP (DISC-TO-DISC)**

### **Purpose**

1. To dump an entire disc onto another subchannel (:DD)
2. To dump the System Area (including system buffer) onto another subchannel (:DD,X)
3. To dump all or specified files of the User Area (optionally assigning some new file names) onto another subchannel (:DD,U ...) or, onto the current subchannel (assigning new file names).

### **Formats**

1. :*DD*
2. :*DD,X*
3. :*DD,U[,(file A)] ,file 2[,(file B)] ...*

where *X* specifies the System Area,

*U* specifies the User Area,

*file 1, file 2, ...* specify the files to be dumped (the entire User Area if no files are specified),

*file A, file B, ...* specify the optional new names for *file 1, file 2*, etc. (renamed files can be intermixed with unchanged files).

*Note:* No more than 14 parameters can be specified after :*DD,U*.

The destination disc must be specified by a :UD immediately following the :DD. Any other directive will negate the :DD. (For :DD and :DD,X, the directive must be :UD,\*,*n* where *n* is not the system disc.)

## Comments

When the destination for a :DD,U is a system disc, other than the current system, the user files are dumped in the User Area following the system files. This allows the user to dump a system and selected user files to a single disc. (See also "INITIALIZE")

The SS directive does not apply to :DD.

If the files of the source disc cannot completely fit on the destination disc, DOS-III transfers as many whole files as possible and outputs

*TRAC # TOO BIG*

If DOS-III cannot find some of the files specified to be dumped, the message

*file*

*UNDEFINED*

is output. This does not effect dumping of the files which are defined.

If a file specified to be dumped has the same name (after the optional renaming) as an existing file on the destination disc, the message

*file*

*DUPLICATE FILE-NAME*

is output and the file is not dumped. This does not effect dumping of other files.

**Caution:** A DOS-III system created through the :DD directive (disc-to-disc dump) cannot be protected with the Protect/Override switch on the disc drive because the protect bits on the system portion of the original disc are not copied during the dump operation.

## **DUMP (FILE)**

### **Purpose**

To dump a user file to a specified peripheral I/O device in a format appropriate to the file content.

### **Format**

*:DUMP,logical unit,file[,S1[,S2]]*

where *logical unit* is the logical unit number of output device to be used for the dump

*file* is the user file to be dumped

*S1* and *S2* are the first and last relative sectors to be dumped

If *S1* and *S2* are not given, the entire file is dumped. If only *S1* is given, then the file, starting with *S1*, is dumped.

### **Comments**

Files may be dumped on list devices or punch devices (including magnetic tape). The dump format varies with the type of file and the type of device. See Table 2-1.

**Table 2-1. :DUMP Formats**

File Type	Punch Device	List Device
ASCII data	64 characters/record	64 characters/record
Binary data	64 words/record	8 octal words/line
Absolute binary	Absolute binary records	8 octal words/line
Relocatable binary	Relocatable binary records (loadable)	8 octal words/line
Source statements	1 statement/record	1 statement/line

*Note:* Sector numbers on listings are not related to the *S1* and *S2* parameters.

Source statements are packed and do not necessarily start on sector boundaries. Thus, if the *S1* and *S2* parameters are used, dumping begins with the start of the first statement beginning in sector *S1*, and ends with the last statement beginning in sector *S2* (this will probably end in the following sector).

Files in the System Area cannot be dumped.

An error message occurs when *S1* > *S2*, or when either *S1* or *S2* is greater than the length of the file.

Source statements, relocatable binary and absolute binary files can be dumped to a punch device and later restored by using the appropriate STORE directive. In general, however, this cannot be done with ASCII data and binary data files.

*EXAMPLES:*

Where *L* is a source file:

```
:DUMP,1,L  
A  
BB  
CCC  
DDDD  
EEEEE  
FFFFFF  
GGGGGGG  
@
```

Where *SSERH* is a binary file:

(On the system console:)

```
:DU,6,SSERH,1,1  
@
```

(On the list device:)

001	000000	062125	072121	114535	010010	010075	010156	010100
	002400	052100	026014	026036	062006	042154	072023	114535
	010025	010076	010077	010006	010153	114535	010033	010076
	010077	010101	010117	102501	002002	026056	062006	072046
	114535	010050	010123	010076	010127	010124	010006	010122
	114535	010056	010076	010077	010126	010153	036006	036006
	036006	036121	026003	114535	010071	010076	010077	010106
	010120	114535	010074	010074	000006	000022	000002	000001
	000000	020116	047524	020106	047525	047104	020120	051117
	043522	040515	020103	047515	050114	042524	042504	000005
	000011	000000	000000	000016	000002	177746	020040	020040
	020040	020040	020040	020040	020040	020040	020040	020040
	020040	020040	020040	020040	020040	020040	020040	020040
	020040	020040	020040	000003	177777	020040	020501	040440
	020040	041102	041040	020040	041503	041440	020040	042104
	042040	020040	042505	042440	020040	043106	043040	020040

## **DUMP (PROGRAM)**

### **Purpose**

To request that a user program be dumped to the standard list device (logical unit 6) when it completes execution. Two directives are provided: PDUMP for dumping on a normal completion, and ADUMP for dumping when the program aborts.

### **Format**

```
:PDUMP[,FWA[,LWA]][,B][,S]  
:ADUMP[,FWA[,LWA]][,B][,S]
```

where *FWA* is the octal address, relative to the program origin, of the first word to be dumped  
*LWA* is the octal address, relative to the program origin, of the last word to be dumped  
*B* means dump the base page linkage area of the program  
*S* means dump the entire system area.

If *LWA* is missing, the entire program, starting with *FWA*, is dumped. *B* alone dumps all the main program, plus base page linkages, but not the system routines. *S* alone dumps only the system.

If no parameters are given, everything except the system area is dumped.

### **Comments**

The dump directives, PDUMP and ADUMP, must precede the RUN or PROG request in a job. They implicitly refer to the next program to be executed. DOS-III sets a flag when it encounters either PDUMP or ADUMP, then checks the flag the next time a program is executed. Only one of the requests will be honored, depending upon whether the program runs normally or is aborted. The dump is labeled accordingly. These flags are cleared when a program terminates.

Any parameter following *S* in the directive is ignored. If *FWA* is greater than *LWA*, this message is output:

*LIMIT ERROR*

The main program and library subroutines are dumped eight octal words per line, along with the octal starting address for that line. For example,

<i>adr</i> <sub>8</sub>	<i>wd-1</i>	<i>wd-2</i>	<i>wd-3</i>	<i>wd-4</i>	<i>wd-5</i>	<i>wd-6</i>	<i>wd-7</i>	<i>wd-8</i>
<i>adr</i> <sub>8</sub> +10 <sub>8</sub>	<i>wd-1</i>	<i>wd-2</i>	<i>wd-3</i>	<i>wd-4</i>	<i>wd-5</i>	<i>wd-6</i>	<i>wd-7</i>	<i>wd-8</i>

If present, the base page dump follows the main program and library. Base page linkages exist for page boundary crossings and subroutines. For each line, the starting octal address appears first, followed by four pairs of octal numbers. The first number of each pair records the content of the base page word (an address elsewhere in main memory). The second number of each pair records the contents of the address specified by the first item. If the first item is the address of a subroutine, then the second item contains the last address from which the subroutine was called. For example,

	<i>pair-1</i>		<i>pair-2</i>		<i>pair-3</i>		<i>pair-4</i>	
<i>adr</i>	<i>item-1</i>	<i>item-2</i>	<i>item-1</i>	<i>item-2</i>	<i>item-1</i>	<i>item-2</i>	<i>item-1</i>	<i>item-2</i>
<i>adr+4</i>	<i>item-1</i>	<i>item-2</i>	<i>item-1</i>	<i>item-2</i>	<i>item-1</i>	<i>item-2</i>	<i>item-1</i>	<i>item-2</i>

*Note:* :OFF before a program executes clears the dump flags.

:OFF during a program execution causes an abort dump.

:OFF during a dump terminates the dump.

#### EXAMPLE:

:ADUMP,0,15,B (Set up dump flag)

:RUN,PRG9,6 (Run program)

LU 012140

(Main program dump)

ADUMP

12000	160001	002002	130573	170574	006004	160001	002003	026012
12010	130575	170576	006004	160001	170577	006004	160001	170600

(Page Eject)

(Base page dump)

00570	010137	002045	010711	003237	010763	002045	017014	000300
00574	017641	000000	017015	000400	017641	000406	017601	000000
00600	017650	000000	017615	000000	017664	000000	017662	000573
00604	017637	000573	017571	177205	017563	001204	017714	017715
00610	017562	021121	017534	021122	017536	021122	017633	160656
00614	017544	037626	017546	037626	017673	000000	017605	000040

## **DUMP (SECTOR)**

### **Purpose**

To dump any specified sector or sectors of the current user disc on the standard list device (logical unit 6) in either ASCII or octal format.

### **Format**

```
:SA,track,sector[,number]      (ASCII)  
:SO,track,sector[,number]      (OCTAL)
```

where *track* and *sector* give the starting disc address for the dump

*number* gives the number of sectors to be dumped. If *number* is absent, only one sector is dumped.

All three parameters are decimal numbers.

### **Comments**

The ASCII dump format (:SA) is 64 characters per record. The octal dump format (:SO) is eight octal numbers per line. Two ASCII characters equal one computer word (also represented by one octal number). Although :SA dumps 64 characters per record, these do not necessarily appear on one line since the binary numbers are converted to ASCII characters, some of which might be *linefeeds* or *returns*.

**EXAMPLE:**

*(On the system console:)*

:SO,0,1

@

*(On the list device:)*

001	000000	067767	017570	067744	077743	017613	017613	017613
	017613	064120	007004	077310	064117	044055	160001	044051
	010072	073773	053774	077761	053775	077762	077304	044056
	160001	001727	013733	073305	050060	027460	053763	027445
	067304	044066	037310	027415	027505	044052	160001	023773
	033774	170001	063773	073302	002004	073303	063774	073773
	067304	160001	073766	164000	017570	063305	050060	027440
	006004	160001	033773	170001	006004	063730	170001	006004
	003004	170001	067304	077311	027440	060154	001722	013765
	033774	001727	001723	070154	063761	067302	017606	063762
	067303	017606	002400	067774	017606	063311	067775	017606
	067761	006003	027540	044055	160001	023774	033302	170001
	067762	006003	027546	023775	033303	170001	063776	001200
	067777	006003	002004	064155	070155	054175	070175	006400
	050175	064115	074200	047740	074157	064175	074161	124003
	000000	057766	127570	037766	163766	002021	027571	013764

# ***EDIT***

## **Purpose**

To perform listed edit operations on a user source file (follows the :SS condition).

## **Format**

*:EDIT,file,logical unit[,new file]*

where *file* is the name of a source file (the primary file) to be edited according to an edit list (edit operations plus associated source statements) input on the specified *logical unit*. If *new file* appears, the edited source file is stored in a new file (with the name *new file*) on the same subchannel and the old file is not purged. Otherwise, the edited source file destructively replaces the old file. (Follows :SS in searching for duplicate file names.)

## **Comments**

An edit list consists of one or more edit commands and, optionally, a series of associated source statement (i.e., following REPLACE, INSERT). Edit operations are executed when they are entered. When using the system console, the operator must not enter the next operation until the "@" prompt is output on the console.

All edit operations begin with a slash(/), and only the first character following the slash is required. The rest are ignored (until a comma is reached).

In the edit operation formats, the letters *m* and *n* are the sequence numbers of the source statements to be edited, starting with one. Letter *m* signifies the starting statement, and *n* is the ending statement of the operation, inclusively. In all cases, *n* must be greater than or equal to *m*; neither can be less than one, nor greater than the last source statement of the file. The *m* must be greater than the *n* of the previous operation. Sequence numbers refer to the original sequence of the unedited file; inserted statements cannot be referenced until the current editing process is completed and the file automatically resequenced prior to another EDIT directive.

Source statements following /REPLACE or /INSERT on the current batch device cannot contain a colon (:) in column 1, although those entered from the system console can, with the exception of :OFF and :ABORT (which are interpreted as directives instead of data). Source statements can never contain a slash (/) in the first column. Source statements on any device other than the system console and the current batch device can contain anything else in column 1 (including :OFF or :ABORT).

Input is terminated only by an /END.

If the edit file is entered on the system console and either a

*PARAMETER ILLEGAL*

or

*NO SOURCE*

error occurs, the user merely re-enters the statement in error. If the edit list is entered on any other device, the EDIT directive is aborted (if the EDIT directive was entered in keyboard mode) or the entire job is aborted (in batch mode).

## EDIT OPERATIONS

*/DELETE,m[,n]*

Deletes source statements *m* through *n*, inclusively, from the source file. If only *m* is specified, that one statement is deleted.

*/INSERT,m*

Inserts the source statements in the edit list immediately following this command into the primary file following statement *m*.

*/MERGE[,k],secondary file[,m[,n]]*

Merges source statements from the secondary file into the primary file named in the EDIT directive.

*k* is the sequence number of the primary file (named in the EDIT directive) after which source statements of the secondary file are merged. If *k=0*, the secondary file source statements are merged at the beginning of the primary file; if *k* is omitted, the secondary file source statements are merged at the end of the primary file.

*Secondary file* is the name of the source file to be merged with the primary file. If *m* and *n* are specified, then only lines *m* through *n* of the secondary file are merged. If only *m* is specified, then only that one line is merged.

*/REPLACE,m[,n]*

Replaces source statements *m* through *n* (inclusively) in the primary file with source statements following the /R in the edit list. If *n* is omitted, then only statement *m* is replaced.

*Note: Directives cannot be inserted or replaced but can be merged from another file.*

*/SUPPRESS*

Suppresses echoing of the edit operations on the system console, providing that the logical unit specified in the EDIT directive was not the system console. Normally, echoing occurs after each EDIT directive unless /S is entered.

*/UNSUPPRESS*

Resumes echoing of the edit operations on the system console.

*/FND*

Terminates the edit file and returns DOS-III to its previous mode for further directives. (The last edit command must be /END.)

*EXAMPLES:*

*If a file named SOURC contains:*

<i>Statement 1</i>	<i>ASMB,R,B,L</i>
<i>Statement 2</i>	<i>NAM START</i>
<i>Statement 3</i>	<i>A EQU 30</i>
<i>Statement 4</i>	<i>B EQU 20</i>
<i>Statement 5</i>	<i>START NOP</i>
<i>Statement 6</i>	<i>LDA A</i>
<i>Statement 7</i>	<i>END</i>

*and the EDIT directive is*

*:EDIT,SOURC,5*

*and the edit list, which follows :EDIT on the batch device, is*

<i>/R,3</i>
<i>A EQU 100</i>
<i>B NOP</i>
<i>/D,4</i>
<i>/I,6</i>
<i>STA B</i>
<i>/E</i>

*then the new file SOURC equals:*

<i>Statement 1</i>	<i>ASMB,R,B,L</i>
<i>Statement 2</i>	<i>NAM START</i>
<i>Statement 3</i>	<i>A EQU 100</i>
<i>Statement 4</i>	<i>B NOP</i>
<i>Statement 5</i>	<i>START NOP</i>
<i>Statement 6</i>	<i>LDA A</i>
<i>Statement 7</i>	<i>STA B</i>
<i>Statement 8</i>	<i>END</i>

*Assume now that there exists a source file named FILE2:*

<i>Statement 1</i>	<i>ALF,ALF</i>
<i>Statement 2</i>	<i>JMP START</i>

*To merge FILE2 into the new SOURC, the following EDIT directive, along with its edit list, is required:*

```
:ED,SOURC,5  
/M,7,FILE2  
/E
```

*The new file SOURC looks like this:*

<i>Statement 1</i>	<i>ASMB,R,B,L</i>
<i>Statement 2</i>	<i>NAM START</i>
<i>Statement 3</i>	<i>A EQU 100</i>
<i>Statement 4</i>	<i>B NOP</i>
<i>Statement 5</i>	<i>START NOP</i>
<i>Statement 6</i>	<i>LDA A</i>
<i>Statement 7</i>	<i>STA B</i>
<i>Statement 8</i>	<i>ALF,ALF</i>
<i>Statement 9</i>	<i>JMP START</i>
<i>Statement 10</i>	<i>END</i>

## ***END-OF-FILE***

### **Purpose**

To write an end-of-file mark on a magnetic tape.

### **Format**

*:EF[,logical unit]*

where *logical unit* is the logical unit number of the desired magnetic tape (default is 8).

## ***END-OF-JOB***

### **Purpose**

To terminate the current job normally and return to keyboard mode.

### **Format**

*:EJOB*

### **Comments**

The EJOB directive outputs a message recording the total run time of the job and execution time, then returns to keyboard mode.

If :SS condition is active, :EJOB purges temporary files on all specified *user* subchannels. If :SS condition is not active, :EJOB purges temporary files on the current user subchannel. (See STORE directive and "DOS-III Relocating Loader," Section V.) All directives except :TRACKS, :OFF, :TYPE or :BATCH are ignored until the next JOB directive.

:EJOB resets logical units 1 through 9 and resets the :SS condition. :EJOB resets the user disc assignment to the standard subchannel unless that subchannel is not ready or a new cartridge has been inserted (with a different label and without a UD directive).

When the EJOB directive occurs, a message is printed, similar to that of :JOB, giving the total run time of the job and total execution time (if a Time-base Generator is present). For example,

*END JOB START RUN = 0007 MIN. 52.6 SEC. EXEC = 0001 MIN. 21.0 SEC.*

or

*END JOB START*

This message is printed on the system console and on the standard list device (logical unit 6). A top-of-form is issued on the list device prior to the message.

## **EQUIPMENT TABLE**

### **Purpose**

To list one or all entries in the equipment table on the system console (see Appendix A for equipment table format).

### **Format**

*:EQ[,n]*

where *n*, if present, indicates the one entry to be listed.

If *n* is absent, the entire equipment table is listed.

### **Comments**

Each entry is output in the following format:

*EQT nn CH vv DVRmm d r Uu Ss*

where *nn* is the decimal number of the entry

*vv* is the octal channel number of the device

*mm* is the I/O driver number for the device

*d* specifies DMA if equal to D, no DMA if zero

*r* specifies main-memory resident if equal to R, disc-resident if zero

*u* is a single decimal digit used for subchannel addressing

*s* is the availability status of the device:

0 for not busy, and available,

1 for disabled (down),

2 for busy

**EXAMPLE:**

*Following is a listing of a DOS-III Equipment Table.*

```
:EQ
EQT 01 CH 11 DVRG5 S R U0 S0
EQT 02 CH 13 DVR01 S 0 U0 S0
EQT 03 CH 14 DVR31 D R U0 S0
EQT 04 CH 16 DVR02 S R U0 S0
EQT 05 CH 20 DVR12 S R U0 S0
EQT 06 CH 21 DVR11 D 0 U0 S0
EQT 07 CH 22 DVR23 D 0 U0 S0
0
```

## ***GO***

### **Purpose**

To resume a program that has been suspended, and optionally, to transfer up to five parameters to that program.

### **Format**

*:GO{,P<sub>1</sub>,P<sub>2</sub>,...,P<sub>5</sub>}*

where *P<sub>1</sub>* through *P<sub>5</sub>* are optional parameters and must be decimal values between 0 and 32767.

### **Comments**

When a program suspends itself (see “Program Suspension” in Section III), it is restarted by a GO directive. Upon return to a suspended program, the initial address of the five parameters is located in the B register. A FORTRAN program calls the library subroutine RMPAR to transfer the parameters to a specified 5-word array. The first statement after the suspend call, in a FORTRAN program, must be the call to RMPAR. For example,

```
DIMENSION I (5)  
CALL EXEC (7)  
CALL RMPAR (I)
```

An assembly language program should use the B register upon return from the suspend to obtain and save the parameters prior to making any EXEC request or I/O request.

## **INITIALIZE**

### **Purpose**

To label or unlabel the current user disc, and to destroy an existing System Area (and, optionally, a User Area).

### **Format**

*:IN,label*

where *label* is a six-character name to be written on the disc, or “\*” which means unlabel the disc.

### **Comments**

Four basic cases are possible:

1. *:IN,\** An unlabeled disc (a disc containing only a User Area). The user directory and all user files are destroyed.
2. *:IN,\** A labeled disc. The message

*DOS (or TSB) LABEL xxxxxx*

*OK TO PURGE?*

is output. To purge both the System and User Areas, the operator must respond with

*YES*

If the existing label is SYSTEM (the disc contains a DOS or TSB system), the Override/Protect switch must be in the override position (if the disc was created using DSGEN); otherwise, a HLT 31 will occur. If the operator responds with

*NO*

the directive is ignored.

3. :*IN,label* An unlabeled disc. Only the label is changed; no files are destroyed.

4. :*IN,label* A labeled disc. The message

??? *LABEL* *xxxxxx*

*OK TO PURGE?*

is output. To purge an existing DOS or TSB system, move the user files to the beginning of the disc, and assign the new label to the User Area, respond with

*YES*

If the existing label is SYSTEM (the disc contains a DOS or TSB system), the Override/Protect switch must be in the override position (if the disc was created using DSGEN); otherwise, a HLT 31 will occur. If the operator responds with

*NO*

the directive is ignored.

Initialization does not affect the protect bits. They remain set.

Refer to Section VI for an example of how to copy the System from one subchannel to another.

# ***JOB***

## **Purpose**

To initiate a user job and assign it a name for accounting purposes.

## **Format**

*:JOB[,name]*

where *name* is a string of up to five characters (starting with a non-numeric character) which identifies the job.

## **Comments**

A JOB, BATCH, TYPE, or TRACKS directive must be the first directive entered following system start.

When DOS-III processes the JOB directive, it issues a top-of-form to the list device (logical unit 6), prints an accounting message on the system console and the list device recording the job's *name* (as specified in the JOB directive), the date (as specified in the DATE directive), and the current time (if a Time-base Generator is present).

For example,

```
:JOB,START  
JOB START MON 6.16.9      TIME = 0013 MIN. 41.6 SEC.
```

or

```
JOB START MON 6.16.9
```

If an EJOB directive has not been encountered, :JOB also acts as the :EJOB for the previous job. In this case, all actions of the :EJOB are carried out (except for returning to keyboard mode from batch mode) before starting the new job.

# ***LIST***

## **Purpose**

To list file information recorded in the user or system directories; or to list and sequentially number the contents of all or part of a source file.

## **Format**

(*System*) :LIST,*X*,*logical unit*[,*file*<sub>1</sub>,...]  
(*Unaffected by* :SS)  
(*User*) :LIST,*U*,*logical unit*[,*file*<sub>1</sub>,...]  
(*Lists the specified directory entries from all the subchannels defined by* :SS.)  
(*Source*) :LIST,*S*,*logical unit*, *file*[,*m*[,*n*]]  
(*follows* :SS)

where *X* specifies the System Area directory

*U* specifies a User Area directory

*S* specifies a user source file

*logical unit* specifies the list device

*file*<sub>1</sub>,... names up to 13 entries to be listed (if none is specified, the entire directory is listed)

*m* and *n*, if present, specify the first and last statements to be listed. If *n* is absent, then all statements beginning with *m* are listed. If neither appear, then the entire file is listed. The restrictions for *m* and *n* are the same as those for the EDIT directive.

## **Comments**

A top-of-form is issued to the list device prior to listing.

## DIRECTORY LISTING OUTPUT

The first line is a heading, identifying the information that follows:

*NAME TYPE SCTRS DISC ORG PROG LIMITS B.P. LIMITS ENTRY FWAM PB*  
*SUBCHAN = n*

The following lines are then printed:

*name type sctrs trk sec lower<sub>p</sub> upper<sub>p</sub> lower<sub>b</sub> upper<sub>b</sub> entry fwam p-b*

where *name* identifies the file,

*type* tells what kind of file *name* is

AB	= absolute binary program	{	User File Only
AD	= ASCII data		
BD	= binary data		
RB	= relocatable binary program		
SS	= source statements		
LB	= library	{	System File Only
XS	= supervisor module		
DR	= disc resident I/O driver	{	Either File
UM	= user main program		
US	= user program segment		

*sctrs* is the number of sectors in the file,

*trk* is the track origin of the file,

*sec* is the starting sector of the file within the track specified.

The information below does not appear for types AB, AD, BD, LB, RB, and SS.

*lower<sub>p</sub>* is the lower limit (octal) of the program,

*upper<sub>p</sub>* is the upper limit (octal) of the program,

*lower<sub>b</sub>* is the upper limit (octal) of the program base page links,

*upper<sub>b</sub>* is the upper limit (octal) of the program base page links,

*entry* is the absolute octal address where execution begins,

*fwam* is the octal address of the first word of available memory following the program, and

*p-b* is equal to T if the file is temporary and will be purged by :EJOB unless stored by :STORE,P.

If the requested file does not exist, a message appears:

*file* *UNDEFINED*

## SOURCE LISTING OUTPUT

Each source statement is preceded by a four-digit decimal sequence number.

If the requested file is not a source file, the following message appears,

*file*  
*ILLEGAL*

The list is terminated by the message

\*\*\*\* *LIST END* \*\*\*\*

## EXAMPLES:

(on the system console:)

:LI,U,6  
@

(On the list device:)

NAME	TYPE	SCTRS	DISC	ORG	PROG	LIMITS	B.P. LIMITS	ENTRY	FWAM	PB
SUBCHAN=4										
EX9	SS	00080	T001	000						
EXM	RB	00063	T004	008						
BBB	SS	00001	T006	023						
SRCH	RB	00003	T007	000						
SSERH	UM	00002	T007	003	10000	10271	00713	00713	10000	10271 T
ASCII	AD	00200	T007	005						
BINRY	BD	00300	T015	013						

Note: *T* in the "PB" column means that the entry is temporary.

*(On the system console:)*

:ST,P     *(To make all temporary files permanent.)*

@

:LI,U,6

@

*(On the list device:)*

NAME	TYPE	SCTRS	DISC	ORG	PROG	LIMITS	B.P. LIMITS	ENTRY	FWAM	PB
SUBCHAN=4										
EX9	SS	00080	T001	000						
EXM	RB	00063	T004	008						
BBB	SS	00001	T006	023						
SRCH	RB	00003	T007	000						
SSERH	UM	00002	T007	003	10000	10271	00713	00713	10000	10271
ASCII	AD	00200	T007	005						
BINRY	BD	00300	T015	013						

*Note: "PB" no longer equals T.*

*(On the system console:)*

:LI,S,6,EX19,926,936

@

*(On the list device:)*

0926	ASMB,L,R,X,C,N,B	
0927	HED DUMMY \$LIBR AND \$LIBX FOR RTS SIMULATION ON DOS	
0928	NAM DUMRX,6	
0929	ENT \$LIBR,\$LIBX	
0930	SPC 2	
0931	*	CALLING SEQUENCES:    ENTRY              TERMINATION
0932	*	
0933	*	
0934	*	PRIVILEGED                                  JSB \$LIBR        JSB \$LIBX
0935	*	NOP                DEF (PROGRAM ENTRY POINT)
0936	*	
	**** LIST END ****	

## **LOGICAL UNIT**

### **Purpose**

To assign logical unit numbers (4 through 63) for a job or to list the device reference table (logical unit assignments) on the system console.

### **Format**

`:LU[,n1 [,n2] ]`

where  $n_1$  and  $n_2$  (if present) are decimal numbers.

If neither  $n_1$  nor  $n_2$  is present: the entire device reference table is printed.

If only  $n_1$  is present: the equipment table entry number assigned to logical unit number  $n_1$  is printed. (See EQUIPMENT TABLE directive.)

If both  $n_1$  and  $n_2$  are present (and  $n_2$  does not equal zero): the device recorded in equipment table entry  $n_2$  is assigned to logical unit  $n_1$ .

If both  $n_1$  and  $n_2$  are present (and  $n_2$  does equal zero): the logical unit specified by  $n_1$  becomes a null device, and any I/O request on that device is ignored.

### **Comments**

Assignments made by :LU for logical units 4 through 9 are only valid during the current job. Assignments for 10 and above remain after EJOB. At the beginning of each new job, the device reference table for the first nine logical units is reset to the assignments given when the system was generated. This insures a standard I/O organization for all users.

If  $n_2 = 0$  (that device is to be made null), the logical unit specified by  $n_1$  may not be equal to 1, 2, 3, or the logical unit number of the current batch device.

*EXAMPLE:*

```
:LU
LU01 EQT03
LU02 EQT01
LU03 EQT01
LU04 EQT05
LU05 EQT04
LU06 EQT06
LU07 EQT07
LU08 EQT02
LU09 EQT00 (null device)
@

:LU,9,5      (Logical unit 9 becomes punch)
:DU,9,FILE1 (Dumps FILE1 to punch)

:LU,9      (Checks EQT for LU9)
LU09 EQT05
@

:LU,6,0      (Assigns line printer to null device)
:PR,FTN4,99 (Reads from paper tape reader, no list, object to JBIN)
```

## **MMGT**

### **Purpose**

To reserve logical memory address space for specific subsystems.

*Note: This directive applies to memory associated with system programs only.  
Memory associated with user programs is strictly under program control.*

In addition, this directive may be used to obtain a report of memory space previously reserved for subsystems.

### **Format**

*:MMGT[,subsystem-name<sub>1</sub>, wwwww<sub>1</sub>, subsystem-name<sub>2</sub>, wwwww<sub>2</sub>, . . . , subsystem-name<sub>n</sub>, wwwww<sub>n</sub>]*

*subsystem-name* is a 4-character ASCII name defined for a subsystem at system generation.

*wwwww* is the number (decimal) of logical words to be reserved for the associated subsystem.

If no parameters are entered, the directive is interpreted as an inquiry request and a list of subsystem names and the number of reserved words previously set is printed on the console. The list appears in the following form:

<i>SUBSYSTEM</i>	<i>WORDS</i>
<i>subsystem-name<sub>1</sub></i>	<i>wwwww<sub>1</sub></i>
<i>subsystem-name<sub>2</sub></i>	<i>wwwww<sub>2</sub></i>
.	.
<i>subsystem-name<sub>n</sub></i>	<i>wwwww<sub>n</sub></i>

## Comments

The :MMGT directive is entered just prior to the :PROG or :RUN directive and reserved memory space is released at program termination. If the subsystem name specified was not defined at system generation, the system prints:

*subsystem-name — UNDEFINED*

where *subsystem-name* is the 4-character subsystem name. Any defined subsystem names included in the parameter string are accepted.

If an attempt is made to update or display the subsystem table and no subsystems were defined when the system was generated, the system prints:

*NO SUBSYSTEMS DEFINED*

If the cumulative sum of words requested for subsystems exceeds the amount available, the system prints:

*LIMIT ERROR*

Any requests up to the available space limit are accepted. If more than one subsystem name is included in the parameter string, the user may determine which requests have been accepted by entering the :MMGT directive with no parameters. This causes a list of subsystem names together with the number of words reserved for each name to be printed on the console.

*Note: The subsystem names discussed here must be included as entry points (ENT) within the associated subsystem routines which are included as part of the system at generation time.*

## ***OFF***

### **Purpose**

To abort the currently executing user program or system operation without terminating the job.

### **Format**

*:OFF*

### **Comments**

*:OFF* returns the system to keyboard mode.

*:OFF* can be used to terminate undesired lists, edits, disc-to-disc dumps, program loops, Loader operations, assemblies, and compilations.

*:OFF* cancels any pending DD, ADUMP, or PDUMP directives, unless a program is running, in which case, a pending *:ADUMP* is executed.

# **PAUSE**

## **Purpose**

To interrupt the current job, optionally print a comment on the system console, and return to the system console for operator action.

## **Format**

*:PAUSE [character string]*

## **Comments**

PAUSE may be entered through the keyboard even when DOS-III is in batch mode. PAUSE suspends the current job until the operator inputs a GO directive. During this time the operator may mount magnetic tapes or prepare I/O devices. (A series of COMMENT directives or a remark in the PAUSE directive itself can be used to tell the operator what to do during the PAUSE.)

The GO directive returns DOS-III to the job in the previous mode.

## **EXAMPLE:**

*:PAUSE MOUNT MAG TAPE (Operator mounts magnetic tape)*  
*:GO*

# **PROGRAM**

## **Purpose**

To turn on (i.e., load from the disc and begin executing) a program from the System Area or a program from the User Area which was generated with the DOS-III Relocating Loader. (Follows the :SS condition in searching for the program.)

## **Format**

*:PROG, name[ ,P<sub>1</sub>, P<sub>2</sub>, . . . P<sub>5</sub>]*

where *name* denotes a system program, such as FTN for the DOS-M FORTRAN Compiler, FTN4 for the RTE/DOS FORTRAN IV Compiler, ASMB for the DOS-M Assembler, LOADR for the DOS-III Relocating Loader, or ALGOL for the RTE/DOS ALGOL Compiler.

A user program is specified via the file name assigned by the DOS-III Relocating Loader (the name specified in the program's PROGRAM, HPAL, or NAM statement).

*P<sub>1</sub>* through *P<sub>5</sub>* are optional parameters which DOS-III transfers to the program named. *P<sub>1</sub>* through *P<sub>5</sub>* must be positive integers less than 32767. The program must retrieve the parameters immediately. This procedure is described under :GO.

## **Comment**

Consult Section V for the parameters required by FTN, FTN4, ASMB, ALGOL, and LOADR. Additional programs may be added during system generation, if desired.

*Note:* *User programs can be run using :PROG or :RUN. :PROG is useful when the program needs parameters. DOS-III first searches the user files for the program, then the system files. :RUN is useful when an execution time limit is desired (and a Time-base Generator is present).*

## **EXAMPLES:**

*:PROG,FTN,2,99*

*:PROG,MYFIL,0,3,84*

# **PURGE**

## **Purpose**

To remove the directory entry associated with a user file. (Follows the :SS condition.)

## **Format**

*:PURGE[,file<sub>1</sub>,file<sub>2</sub>, . . . ]*

where *file<sub>1</sub>,file<sub>2</sub>, . . .* (up to 15 file names or 72 characters per directive) designate files in the User Area. The directory entry for the specified file name is purged (marked for removal)

If no file names are given, all directory entries for temporary files are purged.

## **Comments**

After the directory entries are purged, the remaining User Area files may be repacked for efficiency by entering the :RPACK directive. However it should be noted that the repacking function is performed automatically each time an :EJOB directive is executed.

If the end of the User Area moves below a track boundary during the purge, the Work Area becomes a track larger. As each file's directory entry is purged, DOS-III prints its name on the system console.

The presence of undefined files in the list has no effect on the purging of named (and existing) entries. However, if an entry cannot be found, this message is output to the system console:

*file UNDEFINED*

The fastest way to purge all files on a single disc is to use :IN,\* (see "Initialize" in Section 2).

***CAUTION: OPERATOR ATTENTION IS DISABLED DURING :PURGE.***

*EXAMPLE:*

*Original contents of user directory: F1, F2, F3, F4, FLONG, and F5 (at least)*

*Directive: :PURGE,FLONG,F1,F2,D3,D7,F3,F4,F5*

*Output: FLONG*

*F1*

*F2*

*D3 -- UNDEFINED*

*D7 -- UNDEFINED*

*F3*

*F4*

*F5*

# ***RENAME***

## **Purpose**

To rename a specified user file and, optionally, change its program type. (Follows the :SS condition.)

## **Format**

*:RNAME,oldname,newname[,type]*

where *oldname* is the name of the user file to be renamed  
*newname* specifies the new name for the file  
*type* specifies the new type for the file.

## **Comments**

If a file name on one of the active subchannels is the same as *newname*, the message

*DUPLICATE FILE NAME*

is output and the file name is not changed. If the file named *oldname* cannot be found on any of the active subchannels, the message

*oldname UNDEFINED*

is output.

The *type* parameter must be a decimal number from 3 to 12. File types 3-5 require 11-word directory entries and types 6-12 require 5-word directory entries. If the file *type* is incompatible in this respect, a

*PARAMETER ILLEGAL*

message results. (File type numbers are described in Appendix A.)

*Note: It is the users responsibility to insure that the format and structure of the file contents are compatible with its new file type.*

# ***REWIND***

## **Purpose**

To rewind a magnetic tape.

## **Format**

*:REWND[*,logical unit*]*

where *logical unit* is the logical unit number of the desired magnetic tape (default is 8).

# **RPACK**

## **Purpose**

To repack the disc, eliminating purged files.

## **Format**

*:RPACK*

## **Comments**

When a :PURGE directive is issued, the directory entry for specific or implied files is purged. The :RPACK directive is used to search the directory for purged entries. If any are detected, the user file area is repacked, eliminating those files.

*Note: This repacking function is automatically performed at the end of each job.*

## **EXAMPLE:**

*:RPACK*

*scans the user directory for purged entries and repacks the disc to eliminate files associated with those entries.*

# **RUN**

## **Purpose**

To run a user or system program. (Follows the :SS condition.)

## **Format**

*:RUN, name[, time] [,N]*

where *name* is a user file containing the desired program

*time* is an integer specifying the maximum number of minutes the program may run (default is five minutes). DOS-III ignores *time* if a Time-base Generator is not present.

*N*, if present, tells DOS-III to allow the program to continue running even if it makes EXEC calls with illegal request codes.

## **Comments**

Programs which have been relocated during the current job but not stored (see STORE directive) permanently in a user file, may be run using this directive.

If a program executes longer than the time limit, the current job is aborted and DOS-III scans to the next JOB directive.

If N is not present in the RUN directive, the current job will be aborted by any illegal request codes. The N option is provided so that programs can be written and tested on DOS-III ultimately to execute with other HP software not having the same request codes.

## **EXAMPLE:**

*:RUN,ROUT,15*

*executes program ROUT up to fifteen minutes, not allowing illegal request codes.*

*TM 13421*

*@*

*System responds, indicating a time-out condition.*

## **SPECIFY SOURCE FILE**

### **Purpose**

To specify the user source file to be used as input by the Assembler and compilers. (Follows the :SS condition.)

### **Format**

*:JFILE,file*

where *file* is the name of a source file on any active subchannel.

### **Comments**

If logical unit 2 is specified as the input device when the compiler or Assembler is turned on (using :PROG) and a :JFILE has been defined, then the compiler or Assembler reads the source statements from the :JFILE.

Only one program can be translated from a file; any statements beyond the end of the source program will be ignored. The JFILE assignment is only valid for the current job, and can be reassigned by another JFILE directive.

When using a 21MX Assembler, up to fifteen files may be specified in the :JFILE directive so long as these files constitute *one* program having *one* END statement.

It is highly recommended that the JFILE directive immediately precede the corresponding PROG directive.

Example 3 in Section VI illustrates using the JFILE directive.

# ***STORE***

## **Purpose**

To create a user file on the current user disc and assign it a name. The STORE directive can create relocatable object program files (type-R), loader-generated object program files (type-P), source statement files (type-S), ASCII data files (type-A), binary data files (type-B), and absolute binary program files (type-X). (Follows :SS in checking for duplicate file names.)

## **Format**

The format varies according to what type file is being created. See Comments below for details:

TYPE-R	<i>:STORE,R,file[,logical unit]</i>
TYPE-P	<i>:STORE,P[,file<sub>1</sub>,file<sub>2</sub> ...]</i>
TYPE-S	<i>:STORE,S,file,logical unit [,C]</i>
TYPE-A	<i>:STORE,A,file,sectors</i>
TYPE-B	<i>:STORE,B,file,sectors</i>
TYPE-X	<i>:STORE,X,file,logical unit</i>

*Note: Control @ should not be used in file names.*

## **Comments**

**TYPE-R FILES.** The directive format is

*:STORE,R,file[,logical unit]*

where *file* is a name consisting of five (or fewer) characters and must not duplicate another *name* already present in the user files.

A user file is created under this name, and relocatable binary programs are read into it from the logical unit specified or from the Job Binary Area of the disc if none is specified. The Job Binary Area remains as it was before the STORE,R directive.

If DOS-III comes to an end-of-tape, it asks:

*DONE?*

If there are more tapes, the operator places the next tape in the reader and replies *NO*; otherwise, he answers *YES*.

*EXAMPLES:*

*:STORE,R,RINE*

*(Stores all of the relocatable programs from the Job Binary Area into the file RINE created for that purpose.)*

*:STORE,R,JUGG,5*

*(Stores relocatable programs from logical unit 5, the standard input device, into the file JUGG.)*

**TYPE-P FILES.** The directive format is

*:STORE,P[,name<sub>1</sub>,name<sub>2</sub>,....]*

where *name<sub>1</sub>,name<sub>2</sub> ...* are programs that the DOS-III Relocating Loader had relocated into executable format during the current job. A program is stored in a file of the same name. Up to 14 programs per directive are allowed. If none are specified, all programs loaded during the current job are stored. DOS-III finds these temporary programs in the user file and converts them to permanent user files by removing their “temporary” flags (see the description of the LIST,U directive).

Programs loaded during the current job but not stored as permanent files (as shown above) may be executed normally (RUN or PROG directive) and appear in the user file directory. At the end of a job, however, they are purged from the directory unless they have been converted to user files by a STORE,P directive.

**EXAMPLES:**

**:STORE,P**

*(Changes all programs loaded during the current job using the Relocating Loader into permanent user files.)*

**:STORE,P,ARITH,MATH,TRIG,ALGEB**

*(Searches for the programs listed and makes them permanent user files.)*

**TYPE-S FILES.** The directive format is

**:STORE,S,file,logical unit [,C]**

where *file* is the name of the user file to be filled with source statements from the *logical unit* specified. *File* is a name of five or fewer characters, and must not duplicate a name already present in the user files. The source statement input must be terminated by a record containing a double colon (::) if the *C* option is omitted; or a triple colon (:::) if the *C* option is included. If the termination record is omitted, DOS-III stores the succeeding data on the disc as if it were source statements.

If DOS-III comes to an end-of-tape before finding the termination record (:: or :::), it outputs

**DONE?**

on the system console.

If there are more tapes, the operator replies **NO**; otherwise, he answers **YES**.

When DOS-III completes the STORE,S it outputs

**nnnn LINES**

where *nnnn* is the number of statements stored.

If the *C* parameter is included in the STORE directive, statements with a colon in column 1 are interpreted as data and transferred to the designated source file. In this case, input is terminated with a triple colon (:::). When the *C* parameter is omitted in the STORE directive, those statements with a colon in column 1 will attempt execution. The *logical unit* specified in the STORE, S directive (when the *C* parameter is used) must not be the current batch device logical unit. If it is, DOS-III outputs the message

**ILLEGAL LUN**

If the user is in keyboard mode, DOS-III outputs an @ and waits for a new directive. If the user is in batch mode, a batch abort occurs.

If the *C* parameter is used and the *logical unit* specified is the system console, then all input received prior to :: is transferred to the designated source file, except OFF and ABORT directives. If either of the two are encountered during keyboard entry, they are interpreted as directives and executed. (:OFF returns control to keyboard mode without terminating the job. :ABORT aborts the current job if the directive was entered from the keyboard, or DOS-III performs a batch abort if the STORE, S directive was entered from the batch device.) Files containing :OFF and :ABORT can be created by storing from a device other than the system console or the current batch device.

*EXAMPLE:*

*:STORE,S,SOURC,5*

*(Reads source statements from the standard input device and stores them in a new file SOURC.)*

**TYPE-A AND TYPE-B FILES.** The directive format is

*:STORE,type,file,sectors*

where *type* is either A (for ASCII character data) or B (for binary data), and *file* is the name assigned to a file containing the number of *sectors* requested. These requests are made prior to executing a program to reserve a file area; no data is involved.

The program must store and retrieve data from the file through a call to EXEC. It is the programmer's responsibility to store the right kind of data in the file. The EXEC call must specify the file name and the relative sector within the file. DOS-III checks only that the file name exists and that it contains the sector specified.

*EXAMPLE:*

*:STORE,A,ASCII,20*

*(Creates a file name ASCII, 20 sectors in length. A sector equals 128 sixteen-bit words.)*

**TYPE-X FILES.** The directive format is

*:STORE,X,file,logical unit*

where *file* is the name of the user file to be filled with absolute binary programs from the device specified by *logical unit*.

When an end-of-tape is encountered, DOS-III outputs

*DONE?*

To continue loading tapes, place the next tape in the reader and type *NO*; otherwise, type *YES*.

## **SYSTEM SEARCH**

### **Purpose**

To specify a list of disc subchannels which may be searched for file names. This is the :SS condition which applies to all EXEC calls and directives that require a file search. (No check is made for existing duplicate file names during searches; the first file found is used.)

### **Format**

- |  |   |
|--|---|
| :SS  | All active subchannels are searched, starting with the current user subchannel, then continuing from the highest to the lowest number.  |
| :SS, <i>n<sub>1</sub></i> , <i>n<sub>2</sub></i> , <i>n<sub>3</sub></i> .... | Where <i>n<sub>1</sub></i> , <i>n<sub>2</sub></i> ... are subchannel numbers. The current user subchannel is searched first, then the subchannels specified, starting with the lowest number. |
| :SS,99   | Only the current user subchannel is searched. This is the default condition. Every job starts out in this condition.  |

### **Comments**

The SS directive can only be used if it was specifically allowed during system generation. (See "Generating and Loading DOS-III," Part 3.) Otherwise, any SS directive will cause the following message:

*BAD CONTROL STATE*

If a file search results in the file being found, the current user subchannel is changed to the subchannel containing the file. If the file was not found, the current user subchannel is restored to its previous assignment

The LIST,U, *file* directive is an exception: this directive does not stop after it finds the file; it continues to look for duplicate entries. When the LIST search is complete, the original user subchannel is always restored.

However, if a search is interrupted before completion, the current user disc may be on any sub-channel. (This should be checked with a :UD directive.)

More than one :SS can occur during a job. The job starts in :SS,99 condition until a different SS directive is issued. Each SS directive remains in effect until another is issued. SS directives do not apply to file searches initiated by the Relocating Loader or to disc dumps initiated by the DD directive.

Whenever the user subchannel assignment is changed (except by a running program through the appropriate EXEC call), the system outputs a message:

*SUBCHAN = n*

*EXAMPLE:*

```
:UD
SUBCHANNEL = 1
LABEL = UNLBL
:RUN MYPRG
FILE NAME UNDEFINED      (file not on subchannel 1)
:SS                      (search all subchannels for file MYPRG)
:RUN
SUBCHANNEL = 0
(MYPRG now begins execution)
```

## ***TOP-OF-FORM***

### **Purpose**

To issue a top-of-form command to a list device.

### **Format**

*:TOF[*,logical unit*]*

where *logical unit* is the logical unit number of the desired list device. If *logical unit* is omitted, then logical unit 6 receives the command.

# **TRACKS**

## **Purpose**

To output information about the next available track on the current user disc.

## **Format**

:TRACKS

## **Comments**

A TRACKS, JOB, BATCH, or TYPE directive must be the first directive entered following system start.

The decimal number corresponding to the first track beyond the end of the current user area (and the number of faulty tracks encountered, if any) is output to the system console.

Faulty tracks are replaced by spares when parity errors occur on read or write.

## **EXAMPLES:**

*The following is an example in which no faulty tracks are reported.*

(INPUT) :TRACKS  
(OUTPUT) NEXT AVAIL TRACK = 0010  
@ (End of directive processing)

*In this example, the system reports that 2 tracks have been replaced by spares.*

(INPUT) :TRACKS  
(OUTPUT) NEXT AVAIL TRACK = 0012  
BAD = 2  
@ (End of directive processing)

*In this example, the system reports that there are no more tracks available in the user area.*

*(INPUT) :TRACKS*

*(OUTPUT) NEXT AVAIL TRACK = NONE*

*@*

*(End of directive processing)*

# ***TYPE***

## **Purpose**

To return from batch mode to keyboard mode.

## **Format**

**:*TYPE***

## **Comments**

A TYPE, JOB, BATCH or TRACKS directive must be the first directive entered following system start.

Control is returned to the system console. :TYPE may be entered through the batch device or the keyboard device; when it is entered from the keyboard, DOS-III waits until the currently executing program is completed or is aborted before returning to keyboard mode. If :TYPE is entered while already in keyboard mode, the directive is ignored.

# **UP**

## **Purpose**

To declare an I/O device ready for use.

## **Format**

*:UP,n*

where *n* is the equipment table entry number corresponding to the device.

## **Comments**

The UP directive (followed by a :GO) is usually used in response to one of the following messages from DOS-III:

*I/O ERR ET EQT #n*

*I/O ERR NR EQT #n*

*I/O ERR PE EQT #n*

where *ET* indicates end of tape,

*NR* indicates device not ready,

*PE* indicates parity error, and

*n* is the equipment table entry number.

If the incorrect *n* is entered, DOS-III outputs a list of all the down devices.

## **USER DISC CHANGE**

### **Purpose**

To change the subchannel assignment for the user disc.

### **Format**

`:UD[,label] [,n]`

where *label* is a six-character disc label (\* for an unlabeled disc)

*n* is the new subchannel.

### **Comments**

Discs are labeled by the INITIALIZE directive.

Each form of the UD directive has a different purpose.

### **EXAMPLES:**

<code>:UD</code> <i>(without label or subchannel)</i>	<i>Interrogates the current user disc subchannel and outputs its label on the system console:</i>  <code>SUBCHAN = <i>n</i></code>  <code>LBL = <i>label</i> (or UNLBL)</code>
<code>:UD,,<i>n</i></code> <i>(no label)</i>	<i>If <i>n</i> is labeled, DOS-III outputs</i>  <code>LBL = <i>label</i> (or UNLBL)</code>  <i>No assignment is made.</i>
<code>:UD, <i>label</i>, <i>n</i></code>	<i>If <i>n</i> is labeled with the specified label, DOS-III assigns <i>n</i> as the user disc. If <i>n</i> is unlabeled or has a different label, DOS-III outputs</i>  <code>LBL = <i>label</i> (or UNLBL)</code>  <i>Operator can then reissue :UD,<i>label</i>,<i>n</i> with the correct label.</i>

<i>:UD,label (no subchannel)</i>	<i>DOS-III searches for the label, starting with the highest number subchannel (determined at system generation). If label is found, DOS-III makes it the user disc and outputs</i>
	<i>SUBCHAN = n</i>
	<i>If label is not found, DOS-III outputs</i>
	<i>DISC NOT ON SYS</i>
<i>:UD,*n</i>	<i>If n is unlabeled, DOS-III assigns n as the user disc.</i>
	<i>If n is labeled, DOS-III makes no assignment and outputs</i>
	<i>LBL = label</i>
<i>:UD,*</i>	<i>Assigns the highest number unlabeled disc as the user disc and outputs</i>
	<i>SUBCHAN = n</i>
	<i>If there are no unlabeled discs, DOS-III outputs</i>
	<i>DISC NOT ON SYS</i>

If the UD directive specifies a subchannel with an incorrect system proprietary code (see “Disc Labels” in Appendix A), DOS-III still makes the assignment, and outputs

*TSB DISC or ??? DISC*

If the UD directive specifies a subchannel whose system generation code does not match that of the current system disc, DOS-III still makes the assignment but outputs

*DISC GEN CODE nnnn NOT SYS GEN CODE mmmm ERR POSS*

The changes made by :UD are only temporary; the user disc is reset at the end of each job.

- Notes:*
1. *Before executing a :DD or :DD,X to a TSB or ??? DISC, the disc should be initialized with :IN,\*; otherwise, bad tracks may be reported erroneously.*
  2. *If a disc pack is changed on a DOS-III system, the subchannel assigned to that pack must be explicitly reassigned using a :UD directive or EXEC call.*

Refer to item 5 in Section VI for an example of copying a System from one subchannel to another.

# **SECTION III**

## **DOS-III EXEC Calls**

DOS-III EXEC calls are the line of communication between an executing program and DOS-III. An EXEC call is a block of words, consisting of an executable instruction and a list of parameters defining the request. The execution of the instruction transfers control to DOS-III. DOS-III then determines the type of request (from the parameter list) and, if it is legally specified, initiates processing of the request.

In FORTRAN, EXEC calls are coded as CALL statements. In ALGOL, procedure calls are used. In Assembly Language, EXEC calls are coded as a JSB EXEC, followed by a series of parameter definitions. For any particular call, the object code generated for the FORTRAN CALL Statement and the ALGOL procedure call is equivalent to the corresponding Assembly Language object code.

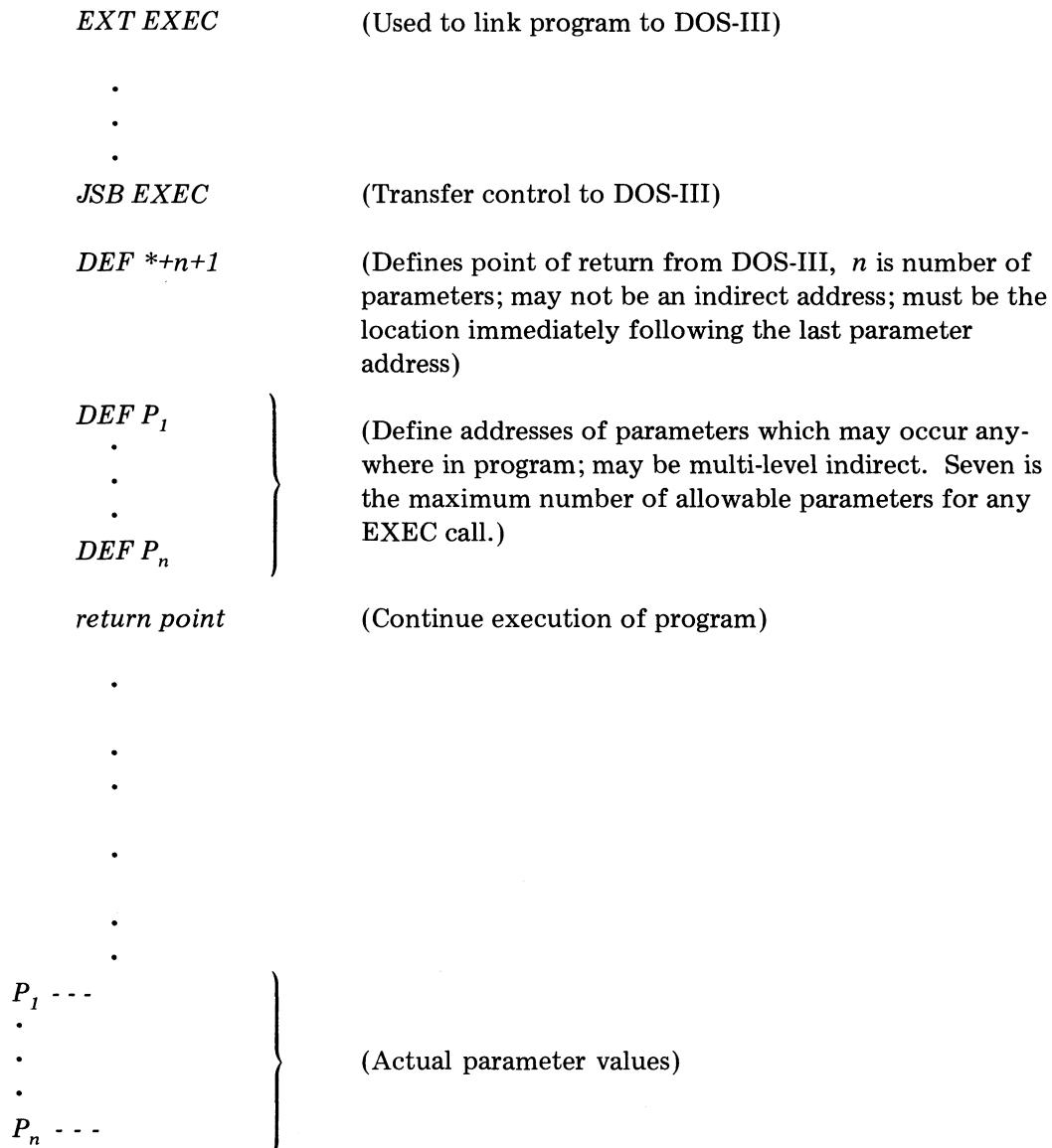
This section describes the basic formats of FORTRAN, ALGOL and Assembly Language EXEC calls; presents each EXEC call in detail; and concludes with a discussion of how parameters are passed to and from a program.

The EXEC calls detailed in this section are presented alphabetically, according to their function. The Request Code (RCODE) value they have in the Assembly-language calling sequence appears at the top of each page.

*Note: DOS-III may include two user-created EXEC modules, loaded along with the DOS-III system EXEC modules during system generation. The purpose of the EXEC modules (called \$EX36 and \$EX37) and the number of parameters needed in the EXEC call are defined by the user. User EXEC module calling sequences are defined in Section XII, "User-written EXEC Modules."*

## ASSEMBLY LANGUAGE EXEC CALLS

The following is a general model of an EXEC call in Assembly Language:



## ALGOL EXEC CALLS

In ALGOL, certain conventions must be followed in making EXEC calls. First, since EXEC is external to the program it must be declared a CODE procedure. Second, parameters that are going to be changed must not be declared VALUE. Third, when arrays are passed as parameters, the first element of the array (not just the array name) must be passed as a type INTEGER and not by VALUE. Fourth, since ALGOL requires that the format of each procedure call be defined, a program must declare a dummy external procedure for each EXEC call requiring a different number of parameters. (These dummy procedures must be compiled as separate procedures to provide proper linkage in the Loader.)

### EXAMPLE:

*The program below (DXFER) reads one sector from the work area and writes the information into a different location in the work area. DXFER calls EXEC through the CODE procedure EXECX (compiled externally). EXECX is compiled in the program DSKIO, although that program name is irrelevant to the linkage between DXFER and EXECX.*

### MAIN PROGRAM

```
HPAL,B,L,“DXFER”
BEGIN
  INTEGER ARRAY BUFFER[1:128];
  BOOLEAN READX;
  INTEGER TRACK,SECTOR;
  FORMAT F1(“SOURCE TRACK,SECTOR?”),
         F2(“DESTINATION TRACK,SECTOR?”);
  PROCEDURE EXECX(RD,TRK,SCTR,BFR);
    VALUE RD,TRK,SCTR;
    BOOLEAN RD;
    INTEGER TRK,SCTR,BFR;
    CODE;
    WRITE(1,F1);
    READ(1,*,TRACK,SECTOR);
    READX←TRUE;
    EXECX(READX,TRACK,SECTOR,BUFFR[1]);
    WRITE(1,F2);
    READ(1,*,TRACK,SECTOR);
    READX←FALSE;
    EXECX(READX,TRACK,SECTOR,BUFFR[1]);
END$
```

## PROCEDURE

```
HPAL,P,B,L,“DSKIO”
PROCEDURE EXECX(RD,TRK,SCTR,BFR);
    VALUE RD,TRK,SCTR;
    BOOLEAN RD;
    INTEGER TRK,SCTR,BFR;
BEGIN
    PROCEDURE EXEC(IO,LU,BFR,BFSZ,TRK,SCTR);
        INTEGER IO,LU,BFR,BFSZ,TRK,SCTR;
        CODE;
    INTEGER REQCD;
    IF RD THEN REQCD←1 ELSE REQCD←2;
    EXEC(REQCD,2,BFR,128,TRK,SCTR);
END;
```

## **FORTRAN EXEC CALLS**

In FORTRAN, the EXEC call consists of a CALL Statement and a series of assignment statements defining the variable parameters of the call:

*CALL EXEC (P<sub>1</sub>, P<sub>2</sub>, . . . , P<sub>n</sub>)*

where P<sub>1</sub> through P<sub>n</sub> are either integer values or integer variables defined elsewhere in the program.

### **EXAMPLE**

*CALL EXEC (7)*  
*or*  
*IRCDE = 7*  
*CALL EXEC (IRCDE)*

*Equivalent calling sequences*

Some EXEC call functions are generated automatically by the FORTRAN compiler or special subroutines. (Refer to "FORTRAN," in Section V and the specific EXEC calls in this section.)

## ***BASE PAGE STORE***

### Purpose

To store values into base page memory locations.

### Assembly Language

```

EXT EXEC
.
.
.
LDA NUMB
LDB ADDR
JSB EXEC      (Transfer control to DOS-III)
DEF *+2       (Point of return from DOS-III)
DEF RCODE     (Request code)
return point   (Continue execution)
.
.
.
RCODE DEC -19   (Request code = -19)
NUMB DEC n      (n is value to be stored)
ADDR DEF LOC    (LOC is a base page location)

```

### FORTRAN

This feature must not be invoked by a FORTRAN program.

### Comments

Base Page Store stores values into base page locations normally protected by memory protect. Prior to using the calling sequence specified above, the user loads the value to be stored into the A register and the absolute address of the base page location in the B register. Base Page Store then performs a store indirect through the B register.

*CAUTION: CARE MUST BE TAKEN NOT TO MODIFY SYSTEM-ESSENTIAL  
BASE PAGE LOCATIONS.*

## ***FILE CREATE***

### Purpose

To allow the user to create a user disc file under program control.

**CAUTION:** *Because of the relationship between disc space used for the work area and disc space used for creating new files, care must be taken to create all files before issuing requests that access the disc work area (work area limits requests, disc allocation requests, work area I/O requests).*

### Assembly Language

<b>EXT</b>	<b>EXEC</b>		
 :			
<b>JSB</b>	<b>EXEC</b>	<i>(Transfer control to DOS-III)</i>	
<b>DEF</b>	<b>*+6</b>	<i>(Point of return from DOS-III)</i>	
<b>DEF</b>	<b>RCODE</b>	<i>(Request code)</i>	
<b>DEF</b>	<b>RSTAT</b>	<i>(Return status)</i>	
<b>DEF</b>	<b>FNAME</b>	<i>(File name)</i>	
<b>DEF</b>	<b>TYPE</b>	<i>(Program type)</i>	
<b>DEF</b>	<b>DSKLN</b>	<i>(File length)</i>	
<b>return point</b>		<i>(Continue execution)</i>	
 :			
<b>RCODE</b>	<b>DEC</b>	<b>32</b>	<i>(Request code = 32)</i>
<b>RSTAT</b>	<b>BSS</b>	<b>1</b>	<i>(Return status from system:</i>
<i>-4 = illegal parameter            -3 = invalid file name            -2 = invalid file type            -1 = insufficient file space            0 = normal termination            &gt;0 = duplicate file name — content is address of old directory entry)</i>			

RCODE=32

<i>FNAME</i>	<i>ASC</i>	3,xxxxxx	(5-character file name)
<i>TYPE</i>	<i>OCT</i>	nnnnnn	(Program type: bit 7 = 0; permanent = 1; temporary bits 5-0 = 6-14 <sub>8</sub> ; program type as defined in Disc Directory "Entry Type," Appendix A)
<i>DSKLN</i>	<i>DEC</i>	<i>s</i>	(Length in sectors)

## FORTRAN

<i>DIMENSION INAM(3)</i>	(File name)
<i>INAM(1) = xxxxxB</i>	(First two characters)
<i>INAM(2) = xxxxxB</i>	(Next two characters)
<i>INAM(3) = xxxxxB</i>	(Last character and blank)
<i>ITYPE = n</i>	(n is numeric program type)
<i>IDSK = s</i>	(s is disc length in sectors)
<i>IRCDE = 32</i>	(Request code)

*CALL EXEC(IRCDE,IRST,INAM,ITYPE,IDS)*

## EXAMPLE:

*DATA NAME/2HDA,2HIL,2HY/*

*C CREATE TEMPORARY ASCII FILE OF 72 SECTORS*

*CALL EXEC(32,LSTAT,NAME,213B,72)*

*IF (LSTAT .NE. 0) GO TO error routine*

*continue normal program path*

## ***FILE NAME SEARCH***

### **Purpose**

To check whether a specific file name exists in the directory of user or system files. (Follows the :SS condition.)

### **Assembly Language**

<i>EXT</i>	<i>EXEC</i>		
.	.		
.	.		
<i>JSB</i>	<i>EXEC</i>	<i>(Transfer control to DOS-III)</i>	
<i>DEF</i>	*+4 (or 5)	<i>(Point of return from DOS-III)</i>	
<i>DEF</i>	<i>RCODE</i>	<i>(Request code)</i>	
<i>DEF</i>	<i>FNAME</i>	<i>(File name)</i>	
<i>DEF</i>	<i>NSECT</i>	<i>(Number of sectors)</i>	
<i>DEF</i>	<i>IPRAM</i>	<i>(Optional parameter)</i>	
<i>return</i>	<i>point</i>	<i>(Continue execution)</i>	
.	.		
.	.		
.	.		
<i>RCODE</i>	<i>DEC</i>	<i>18</i>	<i>(Request code = 18)</i>
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxxx</i>	<i>(xxxxxx is the file name)</i>
<i>NSECT</i>	<i>NOP</i>		<i>(Number of sectors returned here; 0 if not found)</i>
<i>IPRAM</i>	<i>DEC</i>	<i>n</i>	<i>n = 0 user area with wait</i> <i>n = 1 user area without wait</i> <i>n = 2 system area with wait</i> <i>n = 3 system area without wait</i>

**FORTRAN**

<i>DIMENSION NAME (3)</i>	<i>(File name)</i>
<i>IPRAM</i> = 2	<i>(System search, with wait)</i>
<i>IRCDE</i> = 18	<i>(Request code)</i>
<i>NAME (1)</i> = <i>xxxxxB</i>	<i>(First two characters)</i>
<i>NAME (2)</i> = <i>xxxxxB</i>	<i>(Next two characters)</i>
<i>NAME (3)</i> = <i>xxxxxB</i>	<i>(Last character and blank)</i>

*CALL EXEC (IRCDE, NAME, ISECT, IPARAM)*

**Comments**

File searches can be performed on either the system or user area, with or without wait, according to the value of IPARAM. If IPARAM is omitted, the search is performed on the user area with wait. If the search is requested *with* wait, the A register contains the track/sector address of the file, and the B register contains the memory address of the track/sector address, upon return to the user program.

Before executing a File Name Search without wait, NSECT should be initialized to some value other than zero (for example, -1) to distinguish between "file not found" and "operation still in process" conditions on completion of the search. EXEC calls issued while the File Name Search is still in progress are queued by DOS-III and the system goes into the wait loop until the search is completed.

**EXAMPLE:**

*EQUIVALENCE (AREG,IREG(1))*

*DATA NAME/2HFI,2H1/*

*AREG = EXEC(18,NAME,ISECT,0)*

*IF (ISECT .NE. 0) GO TO error routine*

*IREG(1) = track/sector address of the file*

*ISECT = number of sectors in FILE1*

*Note: The FORTRAN function variable (AREG) is a copy of the A-register or the A- and B-registers.*

## ***FILE PURGE***

### Purpose

To allow the user to purge a user disc file directory entry or to purge all temporary file entries.

### Assembly Language

<i>EXT</i>	<i>EXEC</i>		
 .			
<i>JSB</i>	<i>EXEC</i>	<i>(Transfer control to DOS-III)</i>	
<i>DEF</i>	<i>*+3 (or 4)</i>	<i>(Point of return from DOS-III)</i>	
<i>DEF</i>	<i>RCODE</i>	<i>(Request code)</i>	
<i>DEF</i>	<i>RSTAT</i>	<i>(Return status)</i>	
<i>DEF</i>	<i>FNAME</i>	<i>(Optional file name)</i>	
<i>return point</i>		<i>(Continue execution)</i>	
 .			
<i>RCODE</i>	<i>DEC</i>	<i>33</i>	<i>(Request code = 33)</i>
<i>RSTAT</i>	<i>BSS</i>	<i>1</i>	<i>(Return status from system:</i>
<i>-4</i> = <i>illegal parameter</i> <i>-3</i> = <i>invalid file name</i> <i>-1</i> = <i>undefined file name</i> <i>0</i> = <i>normal termination</i>			
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxx</i>	<i>(5-character file name)</i>

## FORTRAN

```
DIMENSION INAME(3)          (File name)
INAME(1) =      xxxxxB      (First two characters)
INAME(2) =      xxxxxB      (Next two characters)
INAME(3) =      xxxxxB      (Last character and blank)
IRCDE   = 33                (Request code = 33)
```

```
CALL EXEC(IRCDE,IRST,INAME)
```

### Comments

If the file name parameter is omitted, all temporary file entries are deleted from the directory.

## ***FILE READ/WRITE***

### Purpose

To transfer information to or from a file on the user disc; the file must be referenced by name.  
(The :SS condition is followed.)

### Assembly Language

*EXT EXEC*

.

<i>JSB EXEC</i>	<i>(Transfer control to DOS-III)</i>
<i>DEF *+7 (or 8)</i>	<i>(Point of return from DOS-III)</i>
<i>DEF RCODE</i>	<i>(Request code)</i>
<i>DEF CONWD</i>	<i>(Control information)</i>
<i>DEF BUFRR</i>	<i>(Buffer location)</i>
<i>DEF BUFFL</i>	<i>(Buffer length)</i>
<i>DEF FNAME</i>	<i>(File name)</i>
<i>DEF RSECT</i>	<i>(Relative sector within file)</i>
<i>DEF IPRAM</i>	<i>(Area which could have been legally transferred if an overflow occurred-optional parameter)</i>
<i>return point</i>	<i>(Continue execution)</i>
.	.
<i>RCODE DEC 14 or 15</i>	<i>(Request code: 14 = read, 15 = write)</i>
<i>CONWD OCT conwd</i>	<i>(See Comments, I/O READ/WRITE EXEC call)</i>
<i>BUFFR BSS n</i>	<i>(Buffer of n words)</i>
<i>BUFFL DEC n or -2n</i>	<i>(Same n; words (+) or characters (-))</i>
<i>FNAME ASC 3,xxxxxx</i>	<i>(User file name = xxxxxx)</i>
<i>RSECT DEC m</i>	<i>(Relative sector number)</i>
<i>IPRAM NOP</i>	<i>(Optional parameter; see Comments)</i>

**FORTRAN**

<i>DIMENSION NAME (3), IBUF(10)</i>	
<i>NAME(1) = xxxxxB</i>	(First two characters of file name)
<i>NAME(2) = xxxxxB</i>	(Second two characters)
<i>NAME(3) = xxxxxB</i>	(Last character and blank)
<i>ICRDE = 14 (or 15)</i>	(Request code)
<i>ICON = conwd</i>	(See comments)
<i>IRSCT = 0</i>	(Relative sector number)

*CALL EXEC (IRCDE, ICON, IBUF, 10, NAME, IRSCT, IPRAM)*

*or*

*CALL EXEC (IRCDE, ICON, IBUF, 10, NAME, IRSCT)*

**Comments**

See the Comments under I/O READ/WRITE EXEC call (RCODE = 1 or 2) for a description of the *conwd* fields needed in the above calling sequences.

To read or write on the *m*th sector of a file, set RSECT = *m*-1. To determine the size of a file, use the FILE NAME SEARCH EXEC call (RCODE = 18).

Data files to be written (or read) should be created with a STORE directive before executing the EXEC call.

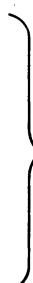
Any type of file may be read, but only ASCII or binary data files may be written.

If the DOS-III installation is likely to have more than one user disc, the program should use the USER DISC CHANGE EXEC call (RCODE = 23) without a subchannel specified to check whether the correct user disc is currently assigned. Alternatively, the user can use an SS directive to set up a system search condition for referencing files on many subchannels.

This call provides an optional parameter, IPRAM, to provide the user with information concerning a file read/write overflow (where the buffer length exceeds the sector contents). If IPRAM is omitted, an overflow causes an IT error. If IPRAM is included and an overflow occurs, control is returned to the user program with IPRAM set equal to the number of words (+) or characters (-) (as defined by BUFFL) that could legally have been transferred. If an overflow occurs, no disc transfer takes place, whether IPRAM is included or not. If IPRAM is included and no overflow occurs, the value of the parameter is set to zero.

**EXAMPLE:**

```
DATA NAME /2HFI,2HLE,2H1/
DIMENSION IBUF(128)
.
.
.
CALL EXEC(14,3,IBUF,128,NAME,0)
```



*Read the first sector of FILE1.*

## ***FILE RENAME***

### Purpose

To allow the user to change a file name (and optionally, its type) under program control.

### Assembly Language

<i>EXT</i>	<i>EXEC</i>	
 :		
<i>JSB</i>	<i>EXEC</i>	<i>(Transfer control to DOS-III)</i>
<i>DEF</i>	<i>*+5 (or 6)</i>	<i>(Point of return from DOS-III)</i>
<i>DEF</i>	<i>RCODE</i>	<i>(Request code)</i>
<i>DEF</i>	<i>RSTAT</i>	<i>(Return status)</i>
<i>DEF</i>	<i>ONAME</i>	<i>(Old file name)</i>
<i>DEF</i>	<i>NNAME</i>	<i>(New file name)</i>
<i>DEF</i>	<i>NTYPE</i>	<i>(Optional new file type)</i>
<i>return point</i>		
 :		
<i>RCODE DEC</i>	<i>34</i>	<i>(Request code = 34)</i>
<i>RSTAT BSS</i>	<i>1</i>	<i>(Return status from system:</i>
<i>-4</i> = illegal parameter		
<i>-3</i> = invalid old or new file name		
<i>-2</i> = invalid old or new file type		
<i>-1</i> = undefined old or new file name		
<i>0</i> = normal termination		
<i>&gt;0</i> = duplicate new file name; content is address of duplicate directory entry)		
<i>(5-character file name to be changed)</i>		
<i>(5-character new file name)</i>		
<i>(New program type:</i>		
<i>bit 7</i> = 0; permanent		
= 1; temporary		
<i>bits 5-0</i> = 6-14 <sub>8</sub> ; program type as defined in Disc Directory "Entry Type," Appendix A)		
<i>ONAME ASC</i> <i>3,xxxxxx</i>		
<i>NNAME ASC</i> <i>3,xxxxxx</i>		
<i>NTYPE OCT</i> <i>nnnnnn</i>		

**FORTRAN**

*DIMENSION INAMO(3), INAMN(3)      (Old file name, new file name)*  
*INAMO(1) = xxxxxB                        (First two characters)*  
*INAMO(2) = xxxxxB                        (Next two characters)*  
*INAMO(3) = xxxxxB                        (Last character and blank)*  
*INAMN(1) = xxxxxB                        (First two characters)*  
*INAMN(2) = xxxxxB                        (Next two characters)*  
*INAMN(3) = xxxxxB                        (Last character and blank)*  
*IRCDE = 34                                (Request code = 34)*  
*ITYPE = n                                (File type)*

*CALL EXEC(IRCDE,IRST,INAMO,INAMN,ITYPE)*

**Comments**

The specified old name may match the new name — no error message is returned, the new program type (if specified) will be changed.

## ***I/O CONTROL***

### Purpose

To carry out various I/O control operations, such as backspace, write end-of-file, and rewind.

### Assembly Language

<i>EXT</i>	<i>EXEC</i>	
.	.	
<i>JSB</i>	<i>EXEC</i>	(Transfer control to DOS-III)
<i>DEF</i>	*+3 (or 4, or 5)	(Point of return from DOS-III)
<i>DEF</i>	<i>RCODE</i>	(Request code)
<i>DEF</i>	<i>CONWD</i>	(Control information)
<i>DEF</i>	<i>PRAM1</i>	(First optional parameter)
<i>DEF</i>	<i>PRAM2</i>	(Second optional parameter)
	<i>return point</i>	(continue execution)
.	.	
<i>RCODE</i>	<i>DEC</i> 3	(Request code = 3)
<i>CONWD</i>	<i>OCT</i> <i>conwd</i>	(See Comments)
<i>PRAM1</i>	<i>DEC</i> <i>n</i>	(Optional value parameter; see "Comments")
<i>PRAM2</i>	<i>BSS</i> <i>m</i>	(Optional buffer address)

### FORTRAN

Use the specific FORTRAN auxiliary I/O statements (see Comments) or an EXEC calling sequence.

<i>DIMENSION IPRM2(m)</i>	(Define buffer of <i>m</i> words)
<i>IRCDE = 3</i>	(Request code)
<i>ICNWD = conwd</i>	(See Comments)
<i>IPRAM = n</i>	(Optional; see Comments)
<i>CALL EXEC (IRCDE,ICNWD,IPRAM)</i>	
or	
<i>CALL EXEC (IRCDE,ICNWD)</i>	
or	
<i>CALL EXEC (IRCDE,ICNWD,IPRAM,IPRM2)</i>	

**Comments****CONWD**

The control word value (*conwd*) has three fields:

BITS	0	0	W	FUNCTION CODE (see below)								LOGICAL UNIT NUMBER							
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0			

**WAIT FIELD (W)**

If W = 1, DOS-III returns to the calling program after starting the control request.

If W = 0, DOS-III waits until the control request is complete before returning.

**FUNCTION CODE FIELD**

Function codes are defined programmatically within the various I/O drivers. Thus the following list of standard function codes is general in nature. Detailed information on specific peripheral-associated function codes is available in the *DOS-III Standard Drivers Reference Manual* (24307-90073).

Function Code (Octal)	Action
000	Clear the device (all drivers)
001	Write end-of-file (magnetic tape), select hopper (optical mark reader)
002	Backspace one record (magnetic tape)
003	Space forward one record (magnetic tape)
004	Rewind (magnetic tape), bell request (optical mark reader)
005	Rewind standby (magnetic tape)
006	Dynamic status (all drivers)
007	Set end-of-paper tape (paper tape punch)
010	Generate paper tape leader (paper tape punch)
011	List output line spacing (line printers) (PARM1 or IPRAM required)
012	Write file gap (magnetic tape)
013	Space forward one file (magnetic tape)
014	Backspace one file (magnetic tape)
017	Extended function code present (card reader punch)

For function code values 000 through  $077_8$ , no DMA is assigned. For function code values 100 through  $177_8$ , DMA is assigned if required by the I/O driver.

**LOGICAL UNIT FIELD**

This field specifies the logical unit number of the device which is to receive the control request.

### OPTIONAL PARAMETERS

Specification of Parameter<sub>1</sub> (PRAM1 or IPRAM) or Parameter<sub>2</sub> (PRAM2 or IPRM2) depends on the contents of the function code field in the control word. Function code 11<sub>8</sub> requires Parameter<sub>1</sub>. This parameter designates the number of lines to be spaced on the specified logical unit. A negative value specifies a page eject on a line printer or the number of lines to be spaced on the System Console. For details on line printer formatting, refer to Section IV in the *DOS-III Standard Drivers Reference Manual* (24307-90073). When Parameter<sub>1</sub> is specified, its value is passed to EQT10 prior to entering the driver. If Parameter<sub>2</sub> is specified, Parameter<sub>1</sub> must be specified. The value of Parameter<sub>2</sub> is passed to the driver via EQT11.

#### **Compiler Considerations**

Within FORTRAN and ALGOL programs, various control operations for magnetic tape may be performed by the following auxiliary I/O statements:

*BACKSPACE*  
*ENDFILE*  
*REWIND*

Refer to the appropriate compiler manual for a detailed description of these statements.

#### **EXAMPLES:**

```
C CLEAR I/O DEVICES 1 TO N
DO 10 LU=1,N
10 CALL EXEC (3,LU)

C SPACE 5 LINES ON THE LINE PRINTER
CALL EXEC (3,1106B,-5)

C SPACE FORWARD ONE FILE MARK
CALL EXEC (3,1310B)

C FOR DATA COMMUNICATION — SET TERMINAL OPTION ENABLE AUTO L.F.
CALL EXEC (3,4000B+LU,1)
```

## I/O READ/WRITE

### Purpose

To transfer information to or from an external I/O device or the work area of the disc. (DOS-III handles track switching automatically.)

### Assembly Language

<i>EXT</i>	<i>EXEC</i>	
.		
.		
.		
<i>JSB</i>	<i>EXEC</i>	(Transfer control to DOS-III)
<i>DEF</i>	*+5 (or 7)	(Point of return from DOS-III; 7 is for disc request)
<i>DEF</i>	<i>RCODE</i>	(Request code)
<i>DEF</i>	<i>CONWD</i>	(Control information)
<i>DEF</i>	<i>BUFFR</i>	(Buffer location)
<i>DEF</i>	<i>BUFFL</i>	(Buffer length)
<i>DEF</i>	<i>DTRAK</i>	(Track number — disc transfer only)
<i>DEF</i>	<i>DSECT</i>	(Sector number — disc transfer only)
	<i>return point</i>	(Continue execution)
.		
.		
<i>RCODE</i>	<i>DEC</i> 1 (or 2)	(Request code: 1 = read, 2 = write)
<i>CONWD</i>	<i>OCT</i> <i>conwd</i>	( <i>conwd</i> is described in comments)
<i>BUFFR</i>	<i>BSS</i> <i>n</i>	(Buffer of <i>n</i> words)
<i>BUFFL</i>	<i>DEC</i> <i>n</i> (or -2 <i>n</i> )	(≤ <i>n</i> ; words (+) or characters (-))
<i>DTRAK</i>	<i>DEC</i> <i>f</i>	(Work area track number, decimal)
<i>DSECT</i>	<i>DEC</i> <i>g</i>	(Work area sector number, decimal)

*Note:* Single I/O transfers within the DOS-III environment cannot exceed 16K words.

RCODE = 1; RCODE = 2

## FORTRAN

DIMENSION IBUF (n)	(Define buffer of n words)
IRCDE = 1 (or 2)	(Request code)
ICON = conwd	(See Comments)
IBUFL = n (or -2n)	(Buffer length in words (+) or characters (-1))
ITRAK = 150	(Disc track number)
ISELECT = 0	(Disc sector number)

CALL EXEC (IRCDE, ICON, IBUF, IBUFL, ITRAK, ISELECT) for disc transfers  
CALL EXEC (IRCDE, ICON, IBUF, IBUFL) for non-disc transfers.

## Comments

### CONWD

The *conwd*, required in the calling sequence, contains the following fields:

BITS	0	0	W	J		A		K	V	M		LOGICAL UNIT #						
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		

FIELD	FUNCTION
W	If 1, tells DOS-III to return to the calling program after starting the I/O transfer. If W = 0, DOS-III waits until the transfer is complete before returning.
J	If 1, and logical unit number is 2 or 3 (disc), a backward track increment will be performed (for example, JBIN read/write). (This field is applicable only to RCODE = 1 or RCODE = 2.)
A	When transferring variable length binary records (M = V = 1), A = 1 indicates absolute binary format.
K	1) When used with console keyboard input, if K=0 "no printing" is specified. If K=1 printing the input as received is specified. 2) When used with disc write requests, if K=0 execute cyclic check after disc write. If K=1 eliminate cyclic check after disc write.
V	1) When reading variable length records from punched tape devices in binary format (M = 1), if V = 0 the record length is determined by buffer length. If V = 1, the record length is determined by the word count in the first non-zero character read in. 2) When outputting ASCII records to a list device (M = 0), if V = 0 the first character in the buffer is interpreted as a carriage control character (see Section IV). If V = 1, single spacing occurs, and the entire buffer (including the first character) is output to the list device.
M	Determines the mode of data transfer. If M = 0, transfer is in ASCII character format, and if M = 1, binary format.

**“Waiting and No Waiting”**

If the program requests the “waiting” option in the *conwd* (*W* = 0), DOS-III will return the transmission log in the B register upon completion. (The transmission log is a positive number, representing the number of words or characters transmitted, depending upon which was originally requested.)

If the program requests the “no waiting” option in the *conwd* (*W* = 1), it can check for the completion of the I/O operation with the I/O STATUS EXEC call (RCODE = 13). When the operation is complete (*STATS*  $\geq 0$ ), the transmission log can be retrieved from the TLOG parameter.

*Notes:* When using “no waiting” I/O and loading program segments:

1. Under :RUN, DOS-III waits for all I/O to complete before loading the segment.
2. Under :PROG, DOS-III does not wait.

If a read or write is issued to a disc address that does not lie in the Work Area, the message *IT nnnnn* is output and the program is terminated.

**Compiler Considerations**

Within FORTRAN and ALGOL programs, I/O transfers to standard devices are programmed by the READ and WRITE statements.

I/O transfers to the Work Area and the disc may be done through the BINRY library routine. The user must specify: an array to be used as a buffer, the length of the buffer in words (equal to the number of elements in an integer array, double that for a real array), the disc logical unit number, track number, sector number, and offset in words within the sector. (If the offset equals 0, the transfer begins on the sector boundary. If the offset equals N, then N words of the sector are skipped before starting the transfer.) BINRY has two entry points, BREAD and BWRIT, for read and write operations respectively. An example below gives the calling procedure.

```
DIMENSION IBUF(10), BUF(20)
LUN = 2
ITRK = 120
ISECT = 36
IOFF = 0
CALL BREAD (BUF, 40, LUN, ITRK, ISECT, IOFF)
      or
CALL BWRIT (IBUF, 10, LUN, ITRK, ISECT, IOFF)
```

## I/O STATUS

### Purpose

To request the status of a particular I/O device, and the amount transmitted in the last operation.

### Assembly Language

<i>EXT EXEC</i>	
·	
·	
·	
<i>JSB EXEC</i>	(Transfer control to DOS-III)
<i>DEF *+4 (or 5)</i>	(Point of return from DOS-III)
<i>DEF RCODE</i>	(Request code)
<i>DEF LUN</i>	(Logical unit)
<i>DEF STATS</i>	(Status returned)
<i>DEF TLOG</i>	(Transmission log returned, optional)
<i>return point</i>	(Continue execution)
·	
·	
<i>RCODE DEC 13</i>	(Request code = 13)
<i>LUN DEC n</i>	(Logical unit number)
<i>STATS NOP</i>	(Status returned here)
<i>TLOG NOP</i>	(Transmission log returned here)

### FORTRAN

<i>IRCDE = 13</i>	(Request code)
<i>LUN = n</i>	(n is decimal logical unit number)
<i>CALL EXEC (IRCDE, LUN, ISTAT, ITLOG)</i>	

### Comments

The status returned in the A register and in STATS is the hardware status of the device specified by the logical unit number. The transmission log in the B register and in TLOG contains the amount of information which was last transferred (a positive number of words or characters, depending on which was requested by the call initiating that transfer).

## ***MEMORY MANAGEMENT (BUFFER ALLOCATION)***

### Purpose

To allocate buffer space within an area reserved under a block name identifier (see “Memory Management (Initialize)”) or from unassigned available memory.

### Assembly Language

<i>EXT</i>	<i>EXEC</i>	
	:	
<i>JSB</i>	<i>EXEC</i>	<i>(Transfer control to DOS-III)</i>
<i>DEF</i>	<i>*+6 (or 7)</i>	<i>(Point of return from DOS-III)</i>
<i>DEF</i>	<i>RCODE</i>	<i>(Request code)</i>
<i>DEF</i>	<i>RSTAT</i>	<i>(Return status)</i>
<i>DEF</i>	<i>LENG</i>	<i>(Desired buffer length)</i>
<i>DEF</i>	<i>SADR</i>	<i>(Buffer starting address is returned here)</i>
<i>DEF</i>	<i>ID</i>	<i>(Buffer identifier is returned here)</i>
<i>DEF</i>	<i>BID</i>	<i>(Optional block name identifier)</i>
	<i>return point</i>	<i>(Continue execution)</i>
	:	
<i>RCODE</i>	<i>DEC</i>	<i>38</i>
<i>RSTAT</i>	<i>BSS</i>	<i>1</i>
		<i>(Request code = 38)</i>
		<i>(Return status from system:</i>
		<i>-4</i> = <i>illegal parameter</i>
		<i>-3</i> = <i>BID not present</i>
		<i>-1</i> = <i>no memory available</i>
		<i>0</i> = <i>normal return</i>
		<i>&gt;0</i> = <i>requested amount not available; contents is actual number of words available</i>
<i>LENG</i>	<i>DEC</i>	<i>n</i>
<i>SADR</i>	<i>BSS</i>	<i>1</i>
<i>ID</i>	<i>BSS</i>	<i>1</i>
<i>BID</i>	<i>ASC</i>	<i>2,xxxx</i>
		<i>(Buffer length in words)</i>
		<i>(Actual starting address from system)</i>
		<i>(Buffer identifier from system 1 ≤ ID ≤ 1023)</i>
		<i>(4-character unique memory management block name identifier)</i>

### Comments

If a block name identifier is specified, the buffer will be allocated space within the area reserved for that identifier. If the block name identifier is omitted, space is allocated from unassigned available memory.

## ***MEMORY MANAGEMENT (BUFFER RELEASE)***

**Purpose**

To release reserved buffer space.

**Assembly Language**

```

EXT  EXEC
.
.
JSB  EXEC          (Transfer control to DOS-III)
DEF  *+4           (Point of return from DOS-III)
DEF  RCODE          (Request code)
DEF  RSTAT          (Return status)
DEF  ID             (buffer identifier)
return point        (Continue execution)
.
.
RCODE  DEC  41      (Request code = 41)
RSTAT  BSS  1       (Return status from system:
                    -4  = illegal parameter
                    -1  = illegal ID
                    0   = normal return
ID      DEC  n      (Buffer identifier 1 ≤ ID ≤ 1023)

```

**Comments**

This request releases space allocated to buffers. If the specified buffer resides within the area reserved under a block name identifier, the logical address space remains reserved. Otherwise, the released space is returned to the system.

# ***MEMORY MANAGEMENT (INITIALIZE)***

**Purpose**

To reserve a block of memory under a block name identifier specified by the user.

**Assembly Language**

<i>EXT</i>	<i>EXEC</i>	
	.	
<i>JSB</i>	<i>EXEC</i>	<i>(Transfer control to DOS-III)</i>
<i>DEF</i>	<i>*+6 (or 7)</i>	<i>(Point of return from DOS-III)</i>
<i>DEF</i>	<i>RCODE</i>	<i>(Request code)</i>
<i>DEF</i>	<i>RSTAT</i>	<i>(Return status)</i>
<i>DEF</i>	<i>LENG</i>	<i>(Desired block length)</i>
<i>DEF</i>	<i>SADR</i>	<i>(Block starting address is returned here)</i>
<i>DEF</i>	<i>BID</i>	<i>(Block name identifier)</i>
<i>DEF</i>	<i>LADR</i>	<i>(Optional starting address parameter)</i>
	<i>return point</i>	<i>(Continue execution)</i>
	.	
<i>RCODE</i>	<i>DEC</i>	<i>35</i>
<i>RSTAT</i>	<i>BSS</i>	<i>1</i>
		<i>(Request code = 35)</i>
		<i>(Return status from system:</i>
		<i>-4</i> = illegal parameter
		<i>-2</i> = another block name identifier assigned to area specified by <i>LADR</i>
		<i>-1</i> = no memory available
		<i>0</i> = normal termination
		<i>&gt;0</i> = space requested not available; content is number of words available)
<i>LENG</i>	<i>DEC</i>	<i>n</i>
<i>SADR</i>	<i>BSS</i>	<i>1</i>
<i>BID</i>	<i>ASC</i>	<i>2,xxxx</i>
<i>LADR</i>	<i>OCT</i>	<i>n</i>
		<i>(Block length in words)</i>
		<i>(Actual starting address of block—from system)</i>
		<i>(4-character memory management block name identifier)</i>
		<i>(Requested starting address—0 = don't care)</i>

*Note: A non-zero LADR value must be an address between ending program address and last word of available memory.*

### **Comments**

This request reserves a block of memory under the block name identifier (BID) specified by the user. Subsequent user requests for allocation of buffer space within this area may be made. If the memory management initialize request (RCODE=35) is not included in a user program prior to buffer allocation requests (RCODE=38) for buffers within the specified BID, an error return condition results. If LADR is specified and is non-zero, the value must be an address between the end of program address and the last word of available memory.

# ***MEMORY MANAGEMENT (STATUS REQUEST)***

## **Purpose**

To determine the number of words reserved under a block name identifier or the number of unallocated words remaining.

## **Assembly Language**

<i>EXT</i>	<i>EXEC</i>	
:		
<i>JSB</i>	<i>EXEC</i>	<i>(Transfer control to DOS-III)</i>
<i>DEF</i>	<i>(+3 (or 4)</i>	<i>(Point of return from DOS-III)</i>
<i>DEF</i>	<i>RCODE</i>	<i>(Request code)</i>
<i>DEF</i>	<i>LENG</i>	<i>(Word count from system)</i>
<i>DEF</i>	<i>BID</i>	<i>(Optional block name identifier)</i>
<i>return point</i>		
:		
<i>RCODE DEC 36</i>		<i>(Request code = 36)</i>
<i>LENG BSS 1</i>		<i>(Number of words allocated to BID or number of available words if BID is not present. If BID parameter is specified but not found, a -3 value is returned)</i>
<i>BID ASC 2,xxxx</i>		<i>(Unique memory management block name identifier)</i>

## **Comments**

When the BID parameter is specified, this request returns the number of words reserved under a user-specified block name identifier (BID). If the BID parameter is specified but not found, a -3 value is returned. If the BID parameter is not specified, the request returns the number of unallocated words remaining in the system.

## ***MEMORY PROTECT CONTROL***

### Purpose

To enable or disable the memory protect option from a user program.

**CAUTION: THE SYSTEM IS NOT PROTECTED WHEN MEMORY PROTECT IS IS DISABLED.**

### Assembly Language

<i>EXT EXEC</i>	
.	
.	
.	
<i>JSB EXEC</i>	(Transfer control to DOS-III)
<i>DEF *+3</i>	(Point of return from DOS-III)
<i>DEF RCODE</i>	(Request code)
<i>DEF MPTK</i>	(Define the memory protect parameter flag)
<i>return point</i>	(Continue execution)
.	
.	
.	
<i>RCODE DEC 30</i>	(Request code = 30)
<i>MPTK DEC n</i>	(If <i>n</i> = 0, memory protect is activated, and is activated following any interrupt completion. If <i>n</i> ≠ 0, then memory protect is deactivated and remains off after interrupt completion)

### FORTRAN

*IRCDE = 30*  
*MPTK = 0 (or 1)*  
*CALL EXEC (IRCDE,MPTK)*

### Comments

Any program termination, either normal or aborted, enables memory protect. Program segments can make memory protect EXEC calls to turn memory protect on or off, but calling and exiting from segments has no effect on memory protect settings.

## ***PROGRAM COMPLETION***

### **Purpose**

To notify DOS-III that the calling program is finished and wishes to terminate.

*Note: Every program must terminate and return to DOS-III using this EXEC call, whether the EXEC call is explicitly coded or indirectly generated by a compiler.*

### **Assembly Language**

```
EXT EXEC  
.  
.  
JSB EXEC      (Transfer control to DOS-III)  
DEF *+2       (Define end of parameter list)  
DEF RCODE     (Request code)  
.  
.  
.  
RCODE DEC 6   (Request code = 6)
```

### **FORTRAN**

```
IRCDE = 6  
CALL EXEC (IRCDE)
```

### **Compiler Considerations**

The FORTRAN and ALGOL compilers automatically generate a PROGRAM COMPLETION EXEC call when they compile an END or STOP statement.

RCODE = 10

## ***PROGRAM LOAD***

### **Purpose**

To load a main program from the disc into main memory and transfer control to its entry point.  
Follows the :SS condition.

### **Assembly Language**

```
EXT EXEC
.
.
JSB EXEC          (Transfer control to DOS-III)
DEF *+3 (to 8)    (Determine number of parameters)
DEF RCODE         (Request code)
DEF PNAME         (Program name)
DEF PRAM1         (First optional parameter)
.
.
.
DEF PRAM5         (Fifth optional parameter)
.
.
.
RCODE DEC 10
PNAME ASC 3,xxxxxx   (Program name)
PRAM1 ---           (Up to 5 words of parameter information
passed to the program. See "Parameter
Processing" at the end of this section.)
.
.
.
PRAM5
```

### **FORTRAN**

```
DIMENSION NAME(3)          (Program name)
IRCDE = 10
NAME(1) = xxxxxB            (First two characters)
NAME(2) = xxxxxB            (Next two characters)
NAME(3) = xxxxxB            (Last character and blank)
CALL EXEC (IRCDE,NAME[,p1...])
```

**RCODE = 10**

### **Comments**

During main program loading, the system interrogates a system flag called AEPF (location 135<sub>8</sub>). This flag is normally zero unless specifically set by a user program. If AEPF is not zero, the contents of AEPF are treated as an alternate entry point address. The system transfers control to the alternate entry point by performing a JMP AEPF,I (jump indirect). AEPF is then cleared. If AEPF = 0, control transfers to the program main entry point.

The Assembly language user can alter the contents of AEPF (and any other base page location) by using the BASE PAGE STORE EXEC call (RCODE = -19).

## ***PROGRAM SUSPENSION***

### **Purpose**

To suspend the calling program from execution until restarted by the GO directive.

### **Assembly Language**

```
EXT EXEC  
.  
.  
JSB EXEC      (Transfer control to DOS-III)  
DEF *+2       (Point of return from DOS-III)  
DEF RCODE     (Request code)  
return point  (Continue execution)  
.  
.  
RCODE DEC 7   (Request Code = 7)
```

### **FORTRAN**

```
IRCDE = 7  
CALL EXEC (IRCDE)
```

### **Comments**

DOS-III prints a message on the system console when it processes the PROGRAM SUSPENSION EXEC call:

*name* SUSP

When the operator restarts the program with a :GO, up to five parameters may be passed to the suspended program. (See "Parameter Processing" at the end of this section.)

**RCODE = 7**

### **Compiler Considerations**

The FORTRAN and ALGOL compilers automatically generate a PROGRAM SUSPENSION EXEC call when they compile a PAUSE statement.

RCODE = 8

## ***SEGMENT LOAD***

### **Purpose**

To load a segment of the calling program from the disc into the segment overlay area and transfer execution control to the segment's entry point. (See Section V, "DOS-III Subsystems," for information on segmented programs.) Follows the :SS condition.

### **Assembly Language**

<i>EXT EXEC</i>	
•	
•	
•	
<i>JSB EXEC</i>	(Transfer control to DOS-III)
<i>DEF *+3 (to 8)</i>	(Determine number of parameters)
<i>DEF RCODE</i>	(Request code)
<i>DEF SNAME</i>	(Segment name)
<i>DEF PRAM1</i>	(First optional parameter)
•	
•	
•	
<i>DEF PRAM5</i>	(Fifth optional parameter)
•	
•	
•	
<i>RCODE DEC 8</i>	(Request code = 8)
<i>SNAME ASC 3,xxxxx</i>	(xxxxx is the segment name)
<i>PRAM1 ---</i>	(Up to 5 words of parameter information
<i>PRAM5 ---</i>	passed to the segment. See "Parameter Processing" at the end of this section.)

### **FORTRAN**

<i>DIMENSION NAME (3)</i>	(Segment name)
<i>IRCDE = 8</i>	
<i>NAME (1) = xxxxxB</i>	(First two characters)
<i>NAME (2) = xxxxxB</i>	(Next two characters)
<i>NAME (3) = xxxxxB</i>	(Last character and blank)
<i>CALL EXEC (IRCDE, NAME [,p<sub>1</sub>...])</i>	

### Comments

In the FORTRAN or ALGOL calling sequence, the user must convert the name of the segment from ASCII to octal and store it in the NAME array, two characters per word. The RTE/DOS FORTAN IV Compiler, however, can convert this automatically through Hollerith constants.

During program segment loading, the system interrogates a system flag called AEPF (location 135<sub>8</sub>). This flag is normally zero unless specifically set by a user program. If AEPF = 0, control transfers to the program segment main entry point. If AEPF is not zero, the contents of AEPF are treated as an alternate entry point address. The system transfers control to the alternate entry point by performing a JMP AEPF,I (jump indirect). AEPF is then cleared. (The Assembly language user can alter the contents of AEPF (and any other base page location) by using the BASE PAGE STORE EXEC call (RCODE = -19).)

See "Segmented Programs," in Section V, for a description of segmented programs.

## ***SEGMENT RETURN***

### Purpose

To return control from a segment to the main program at the instruction immediately following the program segment load call. (This provides a subroutine-like return from a segment to a main program.)

### Assembly Language

<i>EXT EXEC</i>	
•	
•	
•	
<i>JSB EXEC</i>	<i>(Transfer control to DOS-III)</i>
<i>DEF *+2 (to 7)</i>	<i>(Point of return from DOS-III)</i>
<i>DEF RCODE</i>	<i>(Define the request code)</i>
<i>DEF PRAM1</i>	<i>(Define the first parameter)</i>
•	
•	
•	
<i>DEF PRAM5</i>	<i>(Define the fifth optional parameter)</i>
•	
•	
•	
<i>RCODE DEC 29</i>	<i>(Request code = 29)</i>
<i>PRAM1 . . .</i>	<i>(Up to five words of parameter information are passed from the segment to the main program. See "Parameter Processing" at the end of this section)</i>
<i>PRAM5 . . .</i>	

### FORTRAN

```
IRCDE = 29
CALL EXEC (IRCDE [,P1, . . . ,P5])
```

## ***TIME REQUEST***

### Purpose

To request the current time.

### Assembly Language

```

EXT EXEC
.
.
.
JSB EXEC          (Transfer control to DOS-III)
DEF *+3           (Point of return from DOS-III)
DEF RCODE          (Request code)
DEF ARRAY          (Time value array)
return point       (Continue execution)
.
.
.
RCODE DEC 11      (Request code = 11)
ARRAY BSS 5        (Time value array)

```

### FORTRAN

```

DIMENSION ITIME (5)
IRCDE = 11
CALL EXEC (IRCDE, ITIME)

```

### Comments

When DOS-III returns, the time value array contains the time on a 24-hour clock:

ARRAY	or ITIME (1)	= Tenth of seconds
ARRAY + 1	or ITIME (2)	= Seconds
ARRAY + 2	or ITIME (3)	= Minutes
ARRAY + 3	or ITIME (4)	= Hours
ARRAY + 4	or ITIME (5)	= Not used, but must be present (always = 0)

If DOS-III does not contain Time-base Generator, all values in the time array are set to zero.

## ***WORK AREA LIMITS***

### **Purpose**

To ascertain the first and last tracks of the Work Area on the system or current user disc and the number of sectors per track.

### **Assembly Language**

<i>EXT</i>	<i>EXEC</i>	
.	.	
.	.	
.	.	
<i>JSB</i>	<i>EXEC</i>	<i>(Transfer control to DOS-III)</i>
<i>DEF</i>	<i>*+5 (or 6)</i>	<i>(Point of return from DOS-III)</i>
<i>DEF</i>	<i>RCODE</i>	<i>(Request code)</i>
<i>DEF</i>	<i>FTRAK</i>	<i>(First track)</i>
<i>DEF</i>	<i>LTRAK</i>	<i>(Last track)</i>
<i>DEF</i>	<i>SIZE</i>	<i>(Number of sectors/track)</i>
<i>DEF</i>	<i>DISC</i>	<i>(Optional parameter — see Comments)</i>
<i>return</i>	<i>point</i>	<i>(Continue execution)</i>
.	.	
.	.	
.	.	
<i>RCODE</i>	<i>DEC 17</i>	<i>(Request code = 17)</i>
<i>FTRAK</i>	<i>NOP</i>	<i>(Returns first work track number here)</i>
<i>LTRAK</i>	<i>NOP</i>	<i>(Returns last work track number here)</i>
<i>SIZE</i>	<i>NOP</i>	<i>(Returns number of sectors per track here)</i>
<i>DISC</i>	<i>DEC n</i>	<i>(n = 0 for system disc; n ≠ 0 for current user disc)</i>

### **FORTRAN**

```

IRCDE = 17                               (Request code)
CALL EXEC (IRCDE, IFTRK, ILTRK, ISIZE, IDISC)
      or
CALL EXEC (IRCDE, IFTRK, ILTRK, ISIZE)

```

RCODE = 17

### Comments

This call returns the limits of the Work Area, which is that area of the system or user disc which programs use for temporary storage with the I/O READ/WRITE EXEC call (RCODE = 1 or 2). If the DISC parameter is omitted from the calling sequence, or if DISC = 0, the system disc information is returned. If DISC ≠ 0, user disc information is returned.

## ***WORK AREA STATUS***

### Purpose

To ascertain whether a specified number of consecutive operable tracks exist in the Work Area of the system disc.

### Assembly Language

<i>EXT EXEC</i>	
•	
•	
•	
<i>JSB EXEC</i>	(Transfer control to DOS-III)
<i>DEF *+5</i>	(Point of return from DOS-III)
<i>DEF RCODE</i>	(Request code)
<i>DEF NTRAK</i>	(Number of tracks desired)
<i>DEF TRACK</i>	(Starting track desired)
<i>DEF STRAK</i>	(Actual starting track)
<i>return point</i>	(Continue execution)
•	
•	
<i>RCODE DEC 16</i>	(Request code = 16)
<i>NTRAK DEC n</i>	(Consecutive tracks desired)
<i>TRACK NOP</i>	(Desired track; from LIMITS call)
<i>STRAK NOP</i>	(Actual starting track available, 0 if n tracks not available)

### FORTRAN

<i>IRCDE = 16</i>	(Request code)
<i>NTRAK= n</i>	(Consecutive tracks desired)
<i>ITRAK = m</i>	(Desired starting track)
<i>CALL EXEC (IRCDE, NTRAK, ITRAK, ISTRK)</i>	

### Comments

This call is used with the WORK AREA LIMITS EXEC call (RCODE = 17) to establish the nature of the Work Area. The READ/WRITE EXEC call (RCODE = 1 or 2) then transmits information to and from this area, using the track numbers determined by this call. DOS-III handles track switching automatically.

DOS-III checks whether there are  $n$  consecutive tracks starting at the track specified. If  $n$  tracks are available, DOS-III returns the starting track number to the program. If DOS-III does not locate  $n$  consecutive tracks, it returns 0 in STRAK or ISTRK.

# ***USER DISC CHANGE***

## Purpose

To change the subchannel assignment for the user disc.

## Assembly Language

<i>EXT EXEC</i>	
•	
•	
<i>JSB EXEC</i>	(Transfer control to DOS-III)
<i>DEF *+3 (or 4)</i>	(Point of return from DOS-III)
<i>DEF RCODE</i>	(Request code)
<i>DEF LABEL</i>	(Disc label)
<i>DEF SUBCH</i>	(Disc subchannel; optional)
<i>return point</i>	(Continue execution)
•	
•	
•	
<i>RCODE DEC 23</i>	(Request code = 23)
<i>LABEL ASC 3,xxxxxx</i>	(Label = xxxxxxx)
<i>SUBCH DEC (0 to 7)</i>	

## FORTRAN

<i>DIMENSION LABEL (3)</i>	(New label)
<i>IRCDE = 23</i>	
<i>LABEL (1) = xxxxxxB</i>	(First two characters)
<i>LABEL (2) = xxxxxxB</i>	(Next two characters)
<i>LABEL (3) = xxxxxxB</i>	(Last two characters)
<i>ICHNL = M</i>	(0 through 7)

*CALL EXEC (IRCDE, LABEL, ICHNL)*  
*or*  
*CALL EXEC (IRCDE, LABEL)*

**Comments**

If both the label and subchannel are specified, DOS-III checks whether the subchannel has that label. If it does, the assignment is made and DOS-III returns. If not, DOS-III outputs

*LBL = name*      (*name* is label on the subchannel)  
*or*  
*UNLBL*  
*UD nnnnn*      (*nnnnn* = address of EXEC call)  
*xxxxx SUSP*      (*xxxxx* = name of program)

The operator can load a correctly labeled disc on the subchannel and input

:GO

to return to the *beginning* of the EXEC call (not the normal return point) so that the program can reissue the EXEC call. If the operator does not have a properly labeled disc (or the subchannel is a permanent disc), he should use :OFF or :ABORT.

If only a label is specified, DOS-III searches for the label, starting with the highest subchannel. If DOS-III finds the label, it makes the assignment. If DOS-III cannot find the label, it suspends the program and outputs

*DISC NOT ON SYS*  
*UD nnnnn*  
*xxxxx SUSP*

The operator can then abort the program or load a properly labeled disc then input

:GO

to return to the *beginning* of the EXEC call.

If the label equals "\*" and a subchannel is specified, DOS-III checks whether the subchannel is unlabeled. If it is, DOS-III makes the assignment. If the subchannel is labeled, DOS-III suspends the program and outputs

*LBL = name*  
*UD nnnnn*  
*xxxxx SUSP*      (*xxxxx* is the program)

The operator can then abort the program or load an unlabeled disc on the proper channel then input

:GO

to return to the *beginning* of the EXEC call.

If the label equals "\*" and a subchannel is *not* given, DOS-III searches for an unlabeled disc, starting with the highest subchannel. DOS-III assigns the first unlabeled disc as the user disc, or if no unlabeled discs are found, it suspends the program and outputs

*DISC NOT ON SYS*  
*UD nnnnn*  
*xxxxx SUSP*

The operator can then abort the program or load an unlabeled disc then input

*:GO*

to return to the beginning of the EXEC call.

*Notes:* 1. *If the EXEC call specifies a subchannel with an incorrect system proprietary code (see Appendix A), DOS-III still makes the assignment but outputs*

*TSB DISC or ??? DISC*

2. *If the EXEC call specifies a subchannel whose system generation code (see Section VII) does not match that of the system disc, DOS-III still makes the assignment, but outputs*

*DISC GEN CODE nnnn NOT SYS GEN CODE mmmm ERR POS*

3. *The changes made by this EXEC call are only temporary, and will be reset at the end of each job to the user subchannel specified during system generation.*

4. *If the specified subchannel is not active (physically present), DOS-III suspends the program and outputs*

*I/O ERR NR USER DISC*

*or*

*I/O ERR PE USER DISC*

*UD nnnnn (nnnnn = address of EXEC call)*

*xxxxx SUSP*

## PARAMETER PROCESSING

Certain user programs require parameters for their execution. DOS-III allows passing of parameters in the following environments:

- (1) from a main program to a main program
- (2) from a main program to a segment
- (3) from a segment to a main program
- (4) from a user to a suspended program

Parameter transferral from program to program (1-3) is handled programmatically by specifying parameters in an EXEC calling sequence. Parameter transferral from a user directly to a program (4) is handled by passing parameters back to the suspended program through the GO directive.

All the programs receiving parameters retrieve them in the same way. The parameters to be passed (if any) are located in the base page parameter buffer RONBF (see Appendix A). In the Assembly language environment, the B register contains the address of the parameter buffer. In the FORTRAN/ALGOL environment, a library routine (RMPAR) is provided to transfer parameters to a user-defined buffer. (This call must be the first statement executed upon entry.)

### ASSEMBLY LANGUAGE EXAMPLE

```
EXT  EXEC
    .
    .
    .
JSB  EXEC          (Call EXEC to suspend program)
DEF  *+2
DEF  RCODE
LDA  B,I          (Get parameter from GO directive)
SZA,RSS
JMP  NOPAR
    .
    .
RCODE DEC 7
B      EQU 1
```

### FORTRAN EXAMPLE

```
DIMENSION I(5)          (Define user parameter buffer)
CALL EXEC (7)           (Suspend program)
CALL RMPAR (I)          (Get parameters from :GO)
```

# ***SECTION IV***

## ***Input/Output***

In DOS-III, centralized control and logical referencing of I/O operations effect simple, device-independent programming. Each I/O device is interfaced to the computer through one or more I/O channels which are linked by hardware to corresponding main memory locations for interrupt processing. By means of several user-defined I/O tables, multiple-device drivers, and program EXEC calls, DOS-III relieves the programmer of most I/O problems.

*Note: Refer to Section XIV, ‘Privileged Mode,’ for a discussion of privileged mode processing.*

### **USER PROGRAM I/O**

The user program requests I/O by means of an EXEC call (see Section III) which specifies the logical unit, control information, type of operation, buffer location and buffer length.

*Note: Within the DOS-III environment, it is possible to transfer up to 16K words in a single operation.*

All references to I/O devices are made through logical unit numbers. This relieves the programmer of the burden of knowing which physical device or which I/O channel is actually going to perform the I/O transfer.

DOS-III has the following standard function assignments for logical unit numbers:

	Logical Unit Number	Function
Restored after each :JOB.	1	System console
	2	System mass storage
	3	User mass storage
	4	Standard punch device
	5	Standard input device
	6	Standard list device
	7	Unassigned
	8	Recommended for magnetic tape
	9	Can be assigned to any device
	10	by user
:		
	$63_{10}$	

The user determines the number of logical units when the system is generated. At the beginning of each JOB, logical units 1 through 9 are restored to the values established at system generation (see Section X), whereas 10 through 63 are restored only on a start-up from the disc.

## SYSTEM I/O PROCESSING

System I/O processing is controlled by three I/O tables:

- 1) Equipment Table (EQT) — which records all devices, I/O channels, driver entry points, DMA requirements, and disc location (if disc-resident).
- 2) Logical Unit Table (LUT) — which assigns an equipment table number to each of its entries, thus allowing the programmer to reference changeable logical units instead of fixed physical units.
- 3) Interrupt Table (INT) — which relates each I/O channel to its corresponding equipment table entry.

For a detailed description of these tables see Appendix A.

When the system recognizes an EXEC call that performs I/O, the request is sent to the I/O supervisor EXEC module (\$EX18). \$EX18 determines if the driver for the requested device is main-memory resident; if not, the driver is loaded into main memory from the disc. Once the driver is in main-memory, the addresses of its EQT entries are placed in the base page communication area and control is transferred to the driver's initiation section. After the driver initiates the I/O operation, it returns to \$EX18. If the I/O was requested "without wait", DOS-III immediately returns control to the user program; if the I/O was requested "with wait", DOS-III waits until the I/O transfer is complete before returning to the user program.

Once a driver has been initiated, interrupts from the device are channeled through a central interrupt processing routine (\$CIC). (All interrupt locations in main memory contain a JSB \$CIC.) \$CIC determines which device interrupted, resets the addresses of the EQT entries into the base page communication area (if necessary), and transfers control to the driver's continuation section. The driver either continues or completes the I/O operation, and control is then returned to the executing user program.

## INPUT/OUTPUT DRIVERS

The I/O driver routines, either main-memory or disc-resident, handle the actual transfers of information between the computer and external devices. They are responsible for initiating and continuing operations on all devices of equivalent type. When a transfer is initiated, DOS-III places the EQT entry addressed into the base page communication area and executes a subroutine jump to the driver entry point. The driver configures itself for the particular channel (in this way the same driver can handle several devices of the same type on many channels), initiates the transfer, and returns to DOS-III. When an interrupt occurs on the channel, indicating continuation or completion of the transfer, DOS-III again transfers control to the driver. DOS-III requires only three drivers: the Moving-Head Disc Driver (DVR31), the System Console Driver (DVR00, DVR05, or DVR26), and the Paper Tape Reader Driver (DVR01).

The following standard drivers are fully compatible with DOS-III:

Driver Number	Description	Part Number	DMA?
DVR00	System Console Driver (TTY)	20985-60001	No
DVR01	Paper Tape Reader Driver	20987-60001	No
DVR02	Paper Tape Punch Driver	20989-60001	No
DVR05	System Console Driver (TTY)	24157-60001	No
DVR10	Digital Plotter Complete Driver	07210-16001	No
DVR10	Digital Plotter Minimum Driver	07210-16002	No
DVR11	Card Reader Driver	24272-60001	Yes
DVR12	Line Printer Driver	24307-16011	No
DVR15	Optical Mark Reader Driver	24307-16017	No
DVR23	Magnetic Tape Unit Driver	13024-60001	Yes
DVR26	Terminal Printer Driver	24307-16018	No
DVR31	Disc Driver	24156-60001	Yes
DVR33	Writable Control Store Driver	24278-60001	Yes
DVR34	Card Reader Punch Driver	12989-16002	No
DVR67	Hardwired Serial Interface Driver	24341-16001	No

The driver name consists of the letters "DVR" prefixed to the equipment type code. In addition, the programmer can write drivers for special devices, following the guidelines in Section XIII, "Planning I/O Drivers." The driver is only responsible for updating the status field in the EQT entry; DOS-III handles the availability field.

## SPECIAL DRIVER CONSIDERATIONS

Since the various peripheral devices are unique, the drivers designed for use with these devices are also unique. This diversification creates the need for special considerations when planning input/output operations. The *DOS-III Standard Drivers Reference Manual* (24307-90073) deals at length with such subjects as creating plotter drawings (Section II), line printer formatting (Section IV), magnetic tape error recovery (Section VI), and using the writable control store driver (Section VIII).

# ***SECTION V***

## ***DOS-III Subsystems***

This section describes conventions for using the following DOS-III subsystems:

- ALGOL Compiler
- Assembler
- FORTRAN and FORTRAN IV Compilers
- Relocating Loader
- Relocatable libraries, including the DEBUG subroutine

and concludes with a discussion of program segmentation.

### **SOURCE PROGRAM FILES**

Using the DOS-III STORE,S and EDIT directives, the operator creates and edits files of source programs written in FORTRAN, ALGOL, or Assembly language. In load-and-go operations the FORTRAN Compiler, FORTRAN IV Compiler, ALGOL Compiler, and Assembler generate relocatable binary code onto temporary disc storage. The Relocating Loader can then relocate and merge the code with referenced subroutines of the Relocatable Library. Once loaded, a program is executed by the PROG or RUN directive.

### **LOAD-AND-GO FACILITY**

DOS-III provides the facility for "load-and-go," which is defined as compilation or assembly, loading, and execution of a user program without using intervening object paper tapes. To accomplish this, the compiler or assembler generates relocatable object code from source statements and stores it on the disc in the Job Binary Area. Then separate directives initiate loading (PROG, LOADR) and execution (RUN,*program*).

DOS-III can store the object code of several programs and associated segments and subroutines on the disc. The Relocating Loader retrieves them from the disc, and relocates them into executable absolute program units.

## **ALGOL COMPILER**

The ALGOL Compiler consists of a main program and a data segment which operate under the control of DOS-III. The compiler resides on the disc and is read into main memory when called for by a PROG directive.

Source programs written in ALGOL are accepted either from an input device or from a user disc file and are translated by the ALGOL Compiler into relocatable object programs optionally punched on paper tape (and optionally stored in the Job Binary Area of the disc). The object program can be loaded using the DOS-III Relocating Loader and executed using the RUN or PROG directive.

## **ALGOL I/O**

The HP ALGOL I/O statements should specify the proper logical unit numbers for the DOS-III configuration. (See Section IV.)

### **Compiler Operation**

The ALGOL Compiler is initiated with a PROG directive, and inputs the source program from an input device, or, if from a source file, from a file specified by a JFILE directive. The PROG directive for the ALGOL Compiler should take the following form:

## ***PROG,ALGOL***

*:PROG,ALGOL[P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>,99]*

where *P<sub>1</sub>* = logical unit number of input device (default is 5; set to 2 for source file input indicated by a JFILE directive)

*P<sub>2</sub>* = logical unit number of list device (default is 6)

*P<sub>3</sub>* = logical unit number of punch device (default is 4)

*P<sub>4</sub>* = lines/page on the source listing (default is 56)

*99* = the job binary parameter. If present, the object program is stored in the Job Binary Area for later loading. Any requested punch output still occurs. (The 99 may occur anywhere in the parameter list, but terminates the list.)

All parameters are optional. If *p<sub>1</sub>* through *p<sub>4</sub>* are not present, the default operations are assumed. If 99 is not present, the binary output is not placed in the Job Binary Area.

### **Messages During Compilation**

When the end of a source tape is encountered, the following is output on the system console:

*I/O ERR ET EQT #n*

EQT #n is unavailable until the operator declares it up:

*:UP,n*

*:GO*

Compilation continues after the :GO. More than one source tape can be compiled into one program by loading the next tape before giving the :GO.

At the end of the compilation, the following message is output to the system console:

*\$END, ALGOL*

If the Job Binary Area (where binary code is stored because of a 99 parameter in the PROG directive) overflows, the following message is output and compilation continues:

*JBIN OVF*

The compilation will be completed, but there will be no further loading of binary code into the job binary area.

The compiler terminates if

- Logical unit 2 has been given for input and no :JFILE has been declared. The following message is output:

*NO SOURCE*

- The first statement of the source file specified by the PROG directive  $p_1$  parameter does not begin with the word HPAL. (Or the control statement contains an error.)  
The following message is output:

*HPAL??*

- A colon occurs in the first position of a source statement line. The following message is output:

*IE nnnnn*

where *nnnnn* is the memory location of the input request.

## Language Considerations

The HP ALGOL control statement has this format:

*HPAL* [,*L,A,B,P*] , “*name*” [,*P*<sub>1</sub>] [,*P*<sub>2</sub>]

where *HPAL* is mandatory

*L,A,B,P* are symbols (any combination is allowed) representing:

- L* produce source program listing
- A* produce object code listing
- B* produce object tape
- P* a procedure only is to be compiled

“*name*” is the program name (the quotes and a program name are mandatory)

- P*<sub>1</sub> is a decimal digit between 0 and 9 specifying the name of the error routine to be called if an error occurs in ALOG, SQRT, .RTOR, SIN, COS, .RTOI, EXP, .ITOI, TAN. The name of the error routine is ERR*n*, where *n* = *P*<sub>1</sub>, or *n* = 0 if *P*<sub>1</sub> is not specified. ERR0 is supplied in the Relocatable Library; all other error routines must be supplied by the user.
- P*<sub>2</sub> is a decimal digit specifying the type of the program: 3 for a main program, 5 for a segment, and 6 or 7 for a utility subroutine or procedure. If *P*<sub>2</sub> is not specified, the type is set to 3 for main programs and to 7 for procedures ( P option in the control statement).

If no symbols are specified, the program will run but will not produce any output other than diagnostic messages and job binary (if requested). A program name in quotes (the NAM-record name which must be a legitimate identifier without blanks) must follow the symbols.

Sense switch control is not used with DOS-III.

### EXAMPLE

*HPAL,L,B,“TEST”,1,3*

## **ASSEMBLER**

The Assembler, a segmented program that executes in the main-memory User Program Area, operates under control of DOS-III. The Assembler consists of a main program (ASMB) and six segments (ASMBD, ASMB1, ASMB2, ASMB3, ASMB4, ASMB5), and resides on the disc. The main program is read into main memory when called by a PROG directive.

Source programs, accepted from either an input device or a user source file on the disc, are translated into absolute or relocatable object programs; absolute code is punched in binary records, suitable for execution only outside of DOS-III. ASMB can store relocatable code in the Job Binary Area of the disc for on-line execution, as well as punch it on paper tape.

A source program passes through the input device only once, unless there is insufficient disc storage space. In the latter case, DOS-III informs the user that two passes are required.

### **Assembler I/O**

The Assembly Language I/O EXEC calls should specify the proper logical unit numbers for the DOS-III configuration. (See Section IV.)

When preparing input for the batch device, the programmer must remember to never put a colon (:) in column one of the source statement. DOS-III aborts the current program if a directive (signified by : in column one) occurs during data input.

If the memory protect hardware option is present (and enabled), it protects the resident supervisor from alteration. It interrupts the execution of a user program under these conditions:

- Any operation that would modify the protected area or jump into it.
- Any I/O instruction, except those referencing the switch register or overflow register.
- The halt instruction.

Memory protect gives control to DOS-III when an interrupt occurs, and DOS-III checks whether it was an EXEC call. If not, the user program is aborted.

### **Assembler Operation**

The DOS-III Assembler is initiated with a PROG directive. However, before entering the PROG directive, the operator must place the source program in the input device. If the source program is on the disc, the operator must first specify the file with a JFILE directive, and set parameter  $p_1 = 2$  in the PROG directive. The PROG directive for Assembler should take the following form:

## ***PROG,ASMB***

*:PROG,ASMB[,P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>,99]*

where *P<sub>1</sub>* = logical unit number of input device (default is 5; set to 2 for source file input indicated by a JFILE directive)

*P<sub>2</sub>* = logical unit number of list device (default is 6)

*P<sub>3</sub>* = logical unit number of punch device (default is 4)

*P<sub>4</sub>* = lines/page on the source listing (default is 56)

*99* = the job binary parameter. If present, the object program is stored in the Job Binary Area for later loading. Any requested punch output still occurs. (The 99 may occur anywhere in the parameter list, but terminates the list.)

All parameters are optional. If p<sub>1</sub> through p<sub>4</sub> are not present, the default operations are assumed. If 99 is not present, the binary output is not placed in the Job Binary Area.

### **Messages During Assembly**

When the end of a source tape is encountered, the following is output on the system console:

*I/O ERR ET EQT #n*

EQT #n is unavailable until the operator declares it up:

*:UP,n*

*:GO*

Compilation continues after the :GO. More than one source tape can be compiled into one program by loading the next tape before giving the :GO.

The following message on the system console signifies the end of assembly:

***\$END ASMB***

If another pass of the source program is required, this message is output at the end of pass one.

***\$END ASMB PASS***

The operator must replace the program in the input device and enter:

***:GO***

If an error is found in the Assembler control statement, the following message is output on the system console:

***\$END ASMB CS***

and the current assembly stops.

If an end-of-file condition on source input occurs before an END statement is found, the console signals:

***\$END ASMB XEND***

and the current assembly stops.

If source input from logical unit 2 (disc) is requested, but no file has been declared (see :JFILE, Section II), the system console signals:

***\$END ASMB NPRG***

and the current assembly stops.

If the Job Binary Area, where binary code is stored by a 99 parameter, overflows, assembly continues but the following message is output on the system console:

***JBIN OFV***

However, no further binary code is stored in the Job Binary Area.

The next message is printed on a separate line just above each error diagnostic printed in the program listing during pass 1.

# *nnn*

*nnn* is the “tape” number on which the error (reported on the next line of the listing) occurred. A program may consist of more than one tape. The tape counter starts with one and increments by one whenever an end-of-tape condition occurs (paper tape) or a blank card is encountered. When the counter increments, the numbering of source statements starts over at one.

Each error diagnostic printed in the program listing during pass 2 of the assembly is associated with a different message (printed on a separate line just above each diagnostic):

PG *ppp*

*ppp* is the page number (in the listing) of the *previous* error diagnostic. PG 000 is associated with the first error found in the program.

## Language Considerations

**ASSEMBLER CONTROL STATEMENT.** Although only relocatable code can be run under DOS-III, the DOS-III Assembler is able to assemble absolute code if it is specified. Absolute code is never stored in the Job Binary Area. To get absolute code, the control statement must include an “A” parameter. The “R” parameter, however, is not required for relocatable code. An “X” causes the assembler to generate non-Extended Arithmetic Unit code.

## EXAMPLES

ASMB,L,B	<i>List and Punch Relocatable Binary.</i>
ASMB,R,L,B,X	<i>List and Punch Relocatable, non-EAU Binary.</i>
ASMB,T,L	<i>List and Print Symbol Table.</i>
ASMB,A,B,L	<i>List and Punch Absolute Binary.</i>

**NAM STATEMENT.** The NAM statement allows up to eight optional parameters. Only the first two parameters are significant in DOS-III.

*NAM name [,type] [,link mode]*

where *name* is the program name (it should not equal any file name).

*type* is the program entry type code (octal):

- 0 — System main memory resident (default)
- 1 — Disc resident executive supervisor module
- 2 — Reserved for system
- 3 — User program, main
- 4 — Disc resident device driver
- 5 — User program segment
- 6 — Library routine
- 7 — Subroutine
- 10 — Relocatable binary
- 11 — ASCII source statements
- 12 — Binary data
- 13 — ASCII data
- 14 — Absolute binary

*link mode* is the mode of linkage to be performed:

- 0 — current page linking
- non-zero — base page linking (default)

If *type* is 0, 1, 2, or greater than 7, the assembler and DSGEN will accept it, but the Relocating Loader will not.

The *link mode* parameter specifies the mode of linking that will occur at system generation time. If zero, current page linking occurs. If non-zero, base page linking occurs. If omitted, the default condition (non-zero) is assumed and base page linking occurs.

In addition to the *name* defined by NAM, each program, with the exception of the main program, has one or more *entry points* defined by an ENT statement. For the main program (*type* = 3), the transfer address of the END statement is sufficient. The program *name* is used for programmer-to-DOS-III communication, while the *entry point* is used for program-to-program communication.

*Note: DOS-III Assembly language does not contain the ORB statement because information cannot be directly loaded into the protected base page area by user programs. However, programs can read information from base page using absolute address operands up to 1777<sub>8</sub>.*

## **FORTRAN COMPILERS**

The FORTRAN Compilers operate under control of the DOS-III Supervisor. The compilers reside on the disc and are read into main memory only when needed.

FORTRAN and FORTRAN IV are problem-oriented programming languages. Source programs, accepted from either an input device or a user disc file, are translated into relocatable object programs, optionally punched on paper tape, and optionally stored in the Job Binary Area of the disc. The object program can be loaded using the DOS-III Relocating Loader and executed using the RUN or PROG directive.

## **FORTRAN I/O**

FORTRAN I/O statements should specify the proper logical unit numbers for the DOS-III configuration. (See Section IV.)

When preparing input data for the batch device, the user should never put a colon (:) in column one of the record because the colon in the first position signifies a directive. DOS-III aborts the job if a directive occurs during data input.

## **Compiler Operation**

The FORTRAN compilers are initiated with a PROG directive, and input the source program from an input device, or, if from a source file, from a file specified by a JFILE directive. The PROG directive for FORTRAN compilers should take the following form:

## ***PROG,FTN[4]***

*:PROG,FTN[,P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>,99]*

*:PROG,FTN4[,P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>,99]*

*P<sub>1</sub>* = logical unit number of input device (default is 5; set to 2 for source file input indicated by a JFILE directive)

*P<sub>2</sub>* = logical unit number of list device (default is 6)

*P<sub>3</sub>* = logical unit number of punch device (default is 4)

*P<sub>4</sub>* = lines/page on the source listing (default is 56)

*99* = the job binary parameter. If present, the object program is stored in the Job Binary Area for later loading. Any requested punch output still occurs. (The 99 may occur anywhere in the parameter list, but terminates the list.)

All parameters are optional. If p<sub>1</sub> through p<sub>4</sub> are not present, the default operations are assumed. If 99 is not present, the binary output is not placed in the Job Binary Area.

### **Messages During Compilation**

When the end of a source tape is encountered, the following is output on the system console:

*I/O ERR ET EQT #n*

EQT #n is unavailable until the operator declares it up:

*:UP,n*

*:GO*

Compilation continues after the :GO. More than one source tape can be compiled into one program by loading the next tape before giving the :GO.

At the end of compilation, the following message is output on the system console:

*\$END, FTN[4]*

If the Job Binary Area (where binary code is stored because of a 99 parameter in the PROG directive) overflows, the following message is output and compilation continues:

*JBIN OFV*

There is no further loading into the Job Binary Area.

The compiler terminates if

- logical unit 2 has been given for input and no JFILE has been declared. (\$END,FTN[4] is not output.)
- There are not enough work tracks for the compiler. The following message is output:

*# TRACKS UNAVAILABLE*

- A colon occurs in the first column of a source program entered through the batch device. (Blank cards in the source program are ignored.) The following message is output.

*IE nnnnn*

where *nnnnn* is the memory location of the input request.

## Language Considerations

**FORTRAN CONTROL STATEMENT.** Besides the standard options described in the FORTRAN manual, two compiler options, T and *n*, are available. A “T” lists the symbol table for each program in the compilation. If a “*u*” follows the address of a variable, that variable is undefined (the program does not assign a value to it). The A option includes this T option. If *n* appears, *n* is a decimal digit (1 through 9) which specifies an error routine. The user must then supply an error routine, *ERRn*. If this option does not appear, the standard library error routine, *ERR0*, is used. The error routine is called when an error occurs in ALOG, SQRT, .RTOR, SIN, COS, .TROI, EXP, .ITOI, or TAN.

## **Extended and Auxiliary Statements**

In addition to the standard FORTRAN statement, the FORTRAN compiler running under DOS-III supports the following extensions and additions:

1. extended PROGRAM statement
2. additional DATA statement
3. additional EXTERNAL statement

Execution of the following two FORTRAN statements results in special processing in the DOS-III environment:

1. PAUSE
2. STOP

## ***PROGRAM STATEMENT***

The program statement includes an optional type parameter.

*PROGRAM name [,type] [,link mode]*

- name* is the five-character name of the program (and its main entry point). When the program is executed using a RUN or PROG directive, this *name* is used.
- type* is a decimal digit specifying the program type. Only types 3 (main), 5 (segment), and 6 or 7 (library) are significant in DOS-III. The type is set to 3 if not given.
- link mode* is the mode of linkage to be performed: 0 indicates current page linking and any non-zero digit indicates base page linking (default).

## **DATA STATEMENT**

The DATA statement sets initial values for variables and array elements. The format of the DATA statement is

*DATA k<sub>1</sub>/d<sub>1</sub>/,k<sub>2</sub>/d<sub>2</sub>/,...,k<sub>n</sub>/d<sub>n</sub>/*

where *k* is a list of variables and array elements separated by commas, *d* is a list of (optionally signed) constants, separated by commas and optionally preceded by *j\** (*j* is an integer constant).

The elements of *d<sub>1</sub>* are serially assigned to the elements of *k<sub>1</sub>*. The form *j\** means that the constant is assigned *j* times. The *k<sub>1</sub>* and *d<sub>1</sub>* must correspond one-to-one.

Elements of *k<sub>1</sub>* must not be from COMMON.

Arrays must be defined (i.e., DIMENSION) before the DATA statements in which they appear. DATA statements may occur anywhere in a program following the specification statements.

### *EXAMPLE*

*DIMENSION A(3), I(2)*

*DATA A(1),A(2),A(3)/1.0,2.0,3.0/,I(1),I(2)/2\*1/*

## **EXTERNAL STATEMENT**

With the EXTERNAL statement, subroutines and functions can be passed as parameters in a subroutine or function call. For example, the routine XYZ can be passed to a subroutine if XYZ is previously declared EXTERNAL. Each program may declare up to five EXTERNAL routines.

The format of the EXTERNAL statement is

*EXTERNAL v<sub>1</sub>,v<sub>2</sub>, . . . ,v<sub>5</sub>*

where *v* is the entry point of a function, subroutine, or library program.

### **EXAMPLE**

```
•  
•  
•  
EXTERNAL XYZ,FL1  
Z = Q-RMX(XYZ,FL1,3.56,4.75)  
•  
•  
•  
END  
•  
•  
•  
FUNCTION RMX(X,Y,A,B)  
RMX = X(A)*Y(B)  
END
```

ERROR E-0018 means too many externals.

*Note: If a library routine, such as SIN, is used as an EXTERNAL, the compiler changes the first letter of the entry point to “%”. Special versions of the library routines already exist with the first character changed to “%”.*

## ***PAUSE AND STOP***

PAUSE causes the following message to be output to the system console:

*PAUSE xxxx*

where *xxxx* is an optional octal number.

To restart the program, the operator uses a GO directive.

STOP causes the program to terminate after the following message:

*STOP program name xxxx*

where *xxxx* is an octal number.

## ***ERRO LIBRARY ROUTINE***

ERR0, the error print routine referred to under the FORTRAN or ALGOL control statement, outputs the following message to the system console whenever an error occurs in a library routine:

*name: nn xx*

where *name* is the name of the user's program,  
*nn* is the routine identifier, and  
*xx* is the error type.

The compiler generates calls to ERR0 automatically. If the FORTRAN (or ALGOL) control statement includes an *n* option, the call will be to ERR*n*, a routine which the user must supply.

## DOS-III RELOCATING LOADER

The DOS-III Relocating Loader accepts relocatable object programs which have been translated by the Assembler, ALGOL Compiler, or FORTRAN Compilers. It generates an executable main-memory image of each such program. The relocatable programs may enter the loader as

- Job Binary Area programs translated during the current job
- User files
- Punched tapes, magnetic tapes
- Subroutines from the disc-resident Relocatable Library

Each main program is relocated to the start of the User Area and linked to its external references, such as library routines. Segments will overlay the area following the main program and its subroutines. Programs may run under control of the DEBUG library routine. The main program, plus its subroutines and its longest segment, can be as large as the User Area. With a RUN or PROG directive, the program is called by name from the disc and executed. With the STORE,P directive, the program may be stored as a permanent user file to be run during a later job. If the Loader is to be re-executed during a single job, the Job Binary Area must be cleared (using the CLEAR directive) to prevent duplicate program names.

## ***PROG,LOADR***

The DOS-III Relocating Loader is initiated by a PROG directive from the batch or keyboard device.

### **Format**

*:PROG,LOADR [P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>,P<sub>5</sub>]*

- P<sub>1</sub>* = 0 for loading from JBIN and relocatable library (default)
  - = 2 for loading from JBIN, user files, and relocatable library
  - = n for loading from JBIN, user files, relocatable library, and paper tape or magnetic tape (logical unit *n*)
- P<sub>2</sub>* = list device logical unit number (default is 6)
  - P<sub>3</sub>* = 0 for no DEBUG, ≠ 0 for DEBUG (default is 0)
  - P<sub>4</sub>* = 0 for base page linking, ≠ 0 for current page linking (default is 0)
  - P<sub>5</sub>* = 0 for system default program bounds (e.g., UBFWA-UBLWA and UMFWA-UMLWA); = 1 for user-specified program bounds (default is 0)

### **Comments**

**INPUT PARAMETER [P<sub>1</sub>].** Note the hierarchy here. If *n* is specified, the JBIN area is still scanned first, then user files are requested and, finally, the peripheral relocatable input is accepted.

If P<sub>1</sub> ≠ zero, the Loader first expects a list of relocatable file names. In keyboard mode, the Loader requests:

*ENTER FILE NAME(S) OR /E*

then waits for input. After each list of files is entered, the message repeats until a /E is entered.

In batch mode the list of files is entered as

*file-name 1, file-name 2, . . . ,/E*

following the PROG directive (or following the bounds parameters if P<sub>5</sub> = 1). If there are no user files, a /E record must be entered.

The file list is a series of records containing file names separated by commas, ending with a /E. All programs in each file are loaded unless a particular subset of the file is specified:

*file-name (prog 1, prog 2 . . . )*

Only the programs specified within the parentheses are loaded from the *file-name*. The file list is simply a “/E” if no files are to be loaded. (The search for these files is made only on the current user disc; the Loader is unaffected by :SS.)

**DEBUG PARAMETER [P<sub>3</sub>].** Selecting the DEBUG option causes DEBUG to be appended to each main program and segment. The Loader sets the primary entry point of each to DEBUG, rather than the user routine. When the program is run, DEBUG takes control of the program’s execution and seeks instructions from the system console.

**CURRENT PAGE LINKING PARAMETER [P<sub>4</sub>].** If requested to do so ( $P_4 \neq$  zero), the Loader attempts to place necessary program links on the current page of memory as opposed to the base page, to provide more area on the base page for large programs.

*Note: While using the Loader with the current page linking option, remember that:*

- a. *Current page linking cannot be used on programs which use main memory following the program area for writing data (at execution time). For instance, the Assembler builds its symbol table immediately following the last word of the largest segment.*
- b. *Programs should be broken into subroutines of less than 2K because links are generated only at the beginning and end of the program. Links cannot be inserted into the middle of a program since the boundary between program and links may fall in the middle of a skip or jump sequence. If the program spans more than two pages, the middle page(s) will have no area available for current links and will use base page links; thus, the potential for greater efficiency will be lost.*

**PROGRAM BOUNDS SPECIFICATION PARAMETER [P<sub>5</sub>].** The user has the option of specifying the base page bounds and the main memory bounds for the relocatable modules being loaded. If parameter P<sub>5</sub> in the PROG,LOADR directive is zero, the program bounds are determined by the system pointers:

UBFWA	lower base page bound
UBLWA	upper base page bound
UMFWA	lower main memory bound
UMLWA	upper main memory bound

If P<sub>5</sub> is equal to one, the user can specify his own memory bounds. In batch mode, the Loader reads the bounds from the input device immediately following the :PROG, LOADR directive. The bounds are in the form of two records: the first record is interpreted as the lower and upper base page bounds, specified by two octal constants separated by a comma. If an error occurs in the first

record, the Loader outputs an L18 error message. The second record is interpreted as the lower and upper main memory bounds, specified by two octal constants separated by a comma. If an error occurs in the second record, the Loader outputs an L19 error message. If any of the bounds are omitted, the appropriate system default value is used. In keyboard mode, the two records are entered in response to the messages

```
BP      BND      [L,U] ?
PROG   BND      [L,U] ?
```

If an error occurs while entering the bounds in keyboard mode, the user can re-enter the bounds (after an L18 or L19 error message). If an L18 or L19 error message occurs in batch mode, the Loader aborts the job.

## I/O Drivers

The Loader will accept Type 4 programs (Disc Resident Device Drivers) and store them as such in the user directory. Type 4 programs cannot be combined with any other program type during any given load operation.

## Loader Operation

The DOS-III Relocating Loader is a two-pass Loader. The first pass consists of setting the bounds, inputting and scanning relocatable programs to build the necessary tables (program name table and a table of entry points and externals), and matching entry points with externals. The second pass involves the relocation of the programs into an absolute core image format on the disc.

**INPUTTING AND SCANNING THE PROGRAMS.** Programs are scanned (and input, if necessary) according to P<sub>1</sub> in the PROG,LOADR directive. (Only non-disc relocatable programs must be *input*; there are stored temporarily on the Work Area of the disc for processing during the second pass.) Since main programs are matched with segments during the scan, each main program must be loaded before any of its segments.

If paper tape input is requested, the following messages are output to the system console:

```
LOAD TAPE
LOADR SUSP
@
```

The loader suspends. The operator places a tape in the input device and types

```
:GO
```

When an end-of-tape condition occurs, three messages are output to the system console:

*I/O ERR ET EQT# nn*                           *(paper tape only—not magnetic tape)*  
*LOAD TAPE*  
*LOADR SUSP*  
@

The operator places the next tape in the input device, enters :UP,*nn* and :GO to read the next tape. Enter :UP,*nn* and :GO,1 to indicate that all tapes have been read in.

If a checksum error occurs when loading relocatable programs from paper tape, the Loader prints an L01 error message and returns to the paper tape load point with the messages

*LOAD TAPE*  
*LOADR SUSP*  
@

The operator can attempt to reload the program by placing the tape in the reader at the beginning of the program and typing :GO.

#### Matching Entries with Externals

After matching all possible entry points and external references in the user programs, the loader scans the Relocatable Library (disc-resident) looking for entry points to match the undefined external references. If undefined external references still exist,

*UNDEFINED EXTS*

is output and the external references are listed, one per line.

To load additional programs from a peripheral device, the operator types

:GO,0[*n*]

where *n* is the logical unit number of the input device, if different from P<sub>1</sub> of the PROG,LOADR directive.

To continue without fulfilling external references, the operator types

:GO,1

To specify a file name from the keyboard, enter

:GO,2

and the appropriate prompt is output:

*ENTER FILE NAME(S) OR /E*

**RELOCATING PROGRAMS.** The main and segment names (from the PROGRAM, HPAL, or NAM records) become user file names once the programs are loaded. To ensure unique file names, the Loader compares all program and segment names against the names of existing user files (current user disc only). If duplicate names occur, an error message is printed and loading stops.

The Loader converts each main program into an absolute main memory image, stores it on the disc, places the name in the user directory where it remains during the current job, and lists (on the logical unit specified by the P<sub>2</sub> parameter) the program address map and entry points. After each main program, any associated segments are loaded in the same way. When the Loader is completely finished, the following message is output:

*LOADR COMPLETE*

During the current job, the absolute main memory images appear in the user file area (see LIST directive, Section II) and can be executed by name (see RUN and PROG directives). At the end of the job, however, they disappear from the file area, unless they are made permanent files by means of the STORE, P directive.

If no programs are entered, the Loader outputs the following messages and terminates:

*NO PROGRAMS LOADED*

*LOADR COMPLETE*

Loader error messages are given in Section XV.

## *EXAMPLE*

*In the following example, DOS-III is in keyboard mode.*

:CLEAR @	<i>Eliminate any programs from the job binary area</i>
:PROG,LOADR,5 ENTER FILE NAME(S) OR /E	<i>Paper tape input is specified</i>
ALGLM,/E	<i>One disc file is specified</i>
LOAD TAPE	<i>Place paper tape in input device</i>
LOADR SUSP	
@:GO I/O ERR ET EQT# 02	<i>Return to Loader</i>
LOAD TAPE	<i>End of paper tape</i>
LOADR SUSP	
@:UP,2	<i>Declare input device ready</i>
@:GO,1	<i>Specify no more paper tapes</i>

The following is then output on the standard list device (logical unit 6):

RELOCATING LOADER

NAME	PROG BOUNDS	BP BOUNDS
------	-------------	-----------

ALGOL

*HPAL	26601		<i>Main program</i>
*%HPST	27005		<i>Main's entry points</i>
•EAU.	30370	01402	<i>Subroutine</i>
*.MPY	30370		<i>Subroutine's entry points</i>
*.DIV	30375		
*.DLD	30402		
*.DST	30407		
%WRIT	30440	01407	
*%WRIT	30626		
*%WRIF	30522		
*%WBUF	30725		
SREAD	31141	01411	
*%READ	31141		
*%JFIL	31612		
*%RDSC	31563		
DUMRX	31677	01412	
*\$LIBR	31677		
*\$LIBX	31724		
•OPSY	31757	01412	
*.OPSY	31757		
(BOUNDS)	16000 32017	00716 01415	<i>Main programs bounds</i>

ALGL1

*ALGL1	32461		<i>Segment</i>
*%LNAL	32020		<i>Segment's entry points</i>
*%ABAL	32017		
(BOUNDS)	32017 32463	01415 01416	<i>Segment's bounds</i>

LOADR COMPLETE

*Console message to indicate normal Loader completion*

@:ST,P

*Make newly created programs permanent disc files*

## THE RELOCATABLE LIBRARIES

There are two System libraries, or collections of relocatable subroutines that can be used by DOS-III: the RTE/DOS Relocatable Library (EAU or Non-EAU versions) and the RTE/DOS FORTRAN IV Library. These libraries contain mathematical routines such as SIN and COS, and utility routines such as BINRY. A program signifies its need for a subroutine by means of an "external reference." External references are generated by EXT statements in Assembly language, by CALL statements and external function references in FORTRAN, and by CODE procedures in ALGOL.

When the system is generated, several combinations of libraries are possible. Every system should contain an RTE/DOS Relocatable Library: either an EAU version or a non-EAU version, depending on the computer hardware. This library does not contain a formatter, but the FORTRAN IV Library contains a formatter that handles extended precision numbers. If extended precision arithmetic is not needed, a separate RTE/DOS Basic FORTRAN Formatter is available to take the place of the FORTRAN IV Library.

All of these libraries and the subroutines they contain are documented in the manual *Relocatable Subroutines (02116-91780)*.

## DEBUG LIBRARY SUBROUTINE

RTE/DOS DEBUG, a subroutine of the Relocatable Library, allows the programmer to check for logical errors during program execution. If the third parameter specified in the PROG, LOADR directive is non-zero, the DEBUG subroutine is appended to the user program being loaded. The primary entry point (where execution begins) is set to DEBUG. When the program is executed with a RUN directive, the DEBUG subroutine has control and displays the message:

*BEGIN 'DEBUG' OPERATION*

The programmer may enter any DEBUG operation directive. Illegal entries are ignored but result in the message:

*ENTRY ERROR*

Re-enter the DEBUG operation directive correctly.

## DEBUG OPERATIONS

<i>B,n</i>	Instruction breakpoint at octal address <i>n</i> (Note: if <i>n</i> = JSB EXEC, a memory protect violation occurs)
<i>D,A,n<sub>1</sub>[,n<sub>2</sub>]</i>	ASCII dump of octal main memory address <i>n<sub>1</sub></i> or from <i>n<sub>1</sub></i> through <i>n<sub>2</sub></i>
<i>D,B,n<sub>1</sub>[,n<sub>2</sub>]</i>	Binary dump of octal main memory address <i>n<sub>1</sub></i> or from <i>n<sub>1</sub></i> through <i>n<sub>2</sub></i>
<i>M,n</i>	Sets absolute base of relocatable program unit at octal address <i>n</i>
<i>R[,n]</i>	Execute user program starting at octal address <i>n</i> or execute starting at next location in user program (used after a breakpoint or to initiate the program at the transfer point in the user program)
<i>S,n,d</i>	Set octal value <i>d</i> in octal address <i>n</i>
<i>S,n,d<sub>1</sub>,d<sub>2</sub>, . . . ,d<sub>n</sub></i>	Set octal values <i>d<sub>1</sub></i> through <i>d<sub>n</sub></i> in successive memory locations beginning at octal address <i>n</i>
<i>W,A,d</i>	Set A-register to octal value <i>d</i>
<i>W,B,d</i>	Set B-register to octal value <i>d</i>
<i>W,E,d</i>	Set E-register to octal value <i>d</i> (0=off; non-zero = on)
<i>W,O,d</i>	Set Overflow to octal value <i>d</i> (0 = off; non-zero = on)
<i>X,n</i>	Clear breakpoint at octal address <i>n</i>
<i>A</i>	Abort DEBUG operation.

## SPECIAL CONSIDERATIONS

Because of the extended instruction group coding available to the programmer using an HP 21MX Computer Series system, the current RTE/DOS DEBUG subroutine should not be used within these systems.

For systems based on an HP 21MX series processor, a modified version of the subroutine called HP 21MX RTE/DOS DEBUG is available and should be used in place of the current subroutine. HP 21MX RTE/DOS DEBUG can be used only on HP 21MX Computer Series systems, it cannot be executed successfully on systems based on an HP 2100A or HP 2100S processor.

During the Program Input Phase of RTE or DOS-III system generation, load the HP 21MX RTE/DOS DEBUG subroutine from paper tape (relocatable binary code) immediately after loading the RTE/DOS Relocatable Library. An error message indicating the existence of a duplicate program name will be displayed but the system generator will proceed to replace the current RTE/DOS DEBUG subroutine with the HP 21MX version.

Externally, with a few differences, the HP 21MX RTE/DOS DEBUG subroutine appears the same as the current version in the RTE/DOS Relocatable Library. The differences are as follows:

1. HP 21MX RTE/DOS DEBUG allows the programmer to set breakpoints on instructions which are extensions to the base set microcode. Breakpoints set on standard HP 21MX instructions—specifically, base set, base set extension (extended instruction group), single precision floating point arithmetic, or extended arithmetic unit (EAU) instructions — are processed normally; that is, the break occurs before execution of the instruction and is not cleared if the programmer resumes execution of his program. Breakpoints set on instructions which are extensions to the standard instruction set — FFP, user written instructions, and so forth — result in the breakpoint being cleared after execution of the break.

*Note: In the current RTE/DOS DEBUG subroutine, setting a breakpoint on a non-EAU multiple-word instruction results in the incorrect execution of the instruction at the breakpoint.*

2. HP 21MX RTE/DOS DEBUG displays the contents of the X-register and Y-register as part of the standard breakpoint message.
3. HP 21MX RTE/DOS DEBUG provides two additional operation directives which allow the programmer to set the X-register or Y-register to specific values. These directives are:

W,X,*d*            Set X-register to octal value *d*

W,Y,*d*            Set Y-register to octal value *d*

## SEGMENTED PROGRAMS

User programs may be structured into a main program and several segments, as shown in Figure 5-1. The main program begins at the start of the user program area. The area for the segments starts immediately following the last location of the main program. The segments reside on the disc and are read into main memory by EXEC calls, when needed. Only one segment may be in main memory at a time. When a segment is read into main memory, it overlays the segment previously in main memory.

The main program must be type 3, and the segments must be type 5. When using DSGEN to configure the system or loading programs with the Loader, the main program must be entered prior to its segments. One external reference from each segment to the main routine is required for DSGEN or the Loader to link the segments and main programs. Also, each segmented program should use unique external reference symbols. Otherwise, DSGEN or the Loader may link segments and main programs incorrectly.

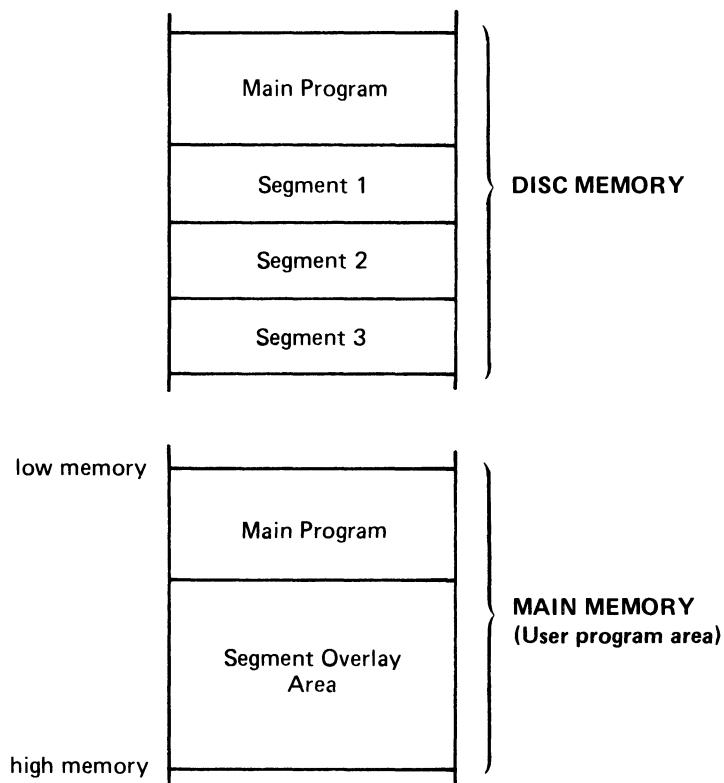


Figure 5-1. Segmented Programs

Figure 5-2 shows how an executing program may call in any of its segments from the disc using the SEGMENT LOAD EXEC call (1-2). DOS-III locates the segment on the disc (3-4), loads it into main memory (5) and begins executing it. The segment may call in another of the main program's segments using a similar EXEC call (6).

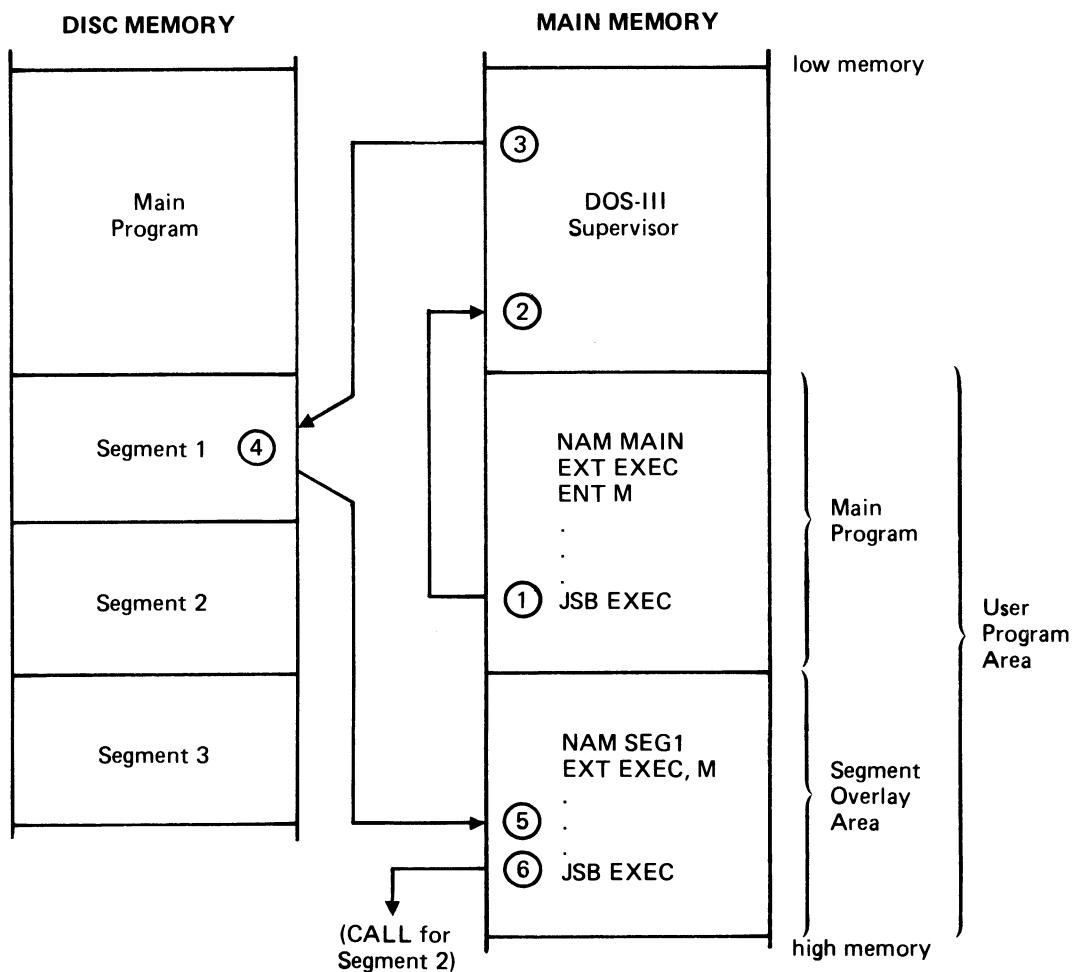


Figure 5-2. Main Calling Segment

Figure 5-3 shows how DOS-III processes the call from the segment (7) by locating the segment on the disc (8-9), loading it into main memory (10), and beginning execution of it.

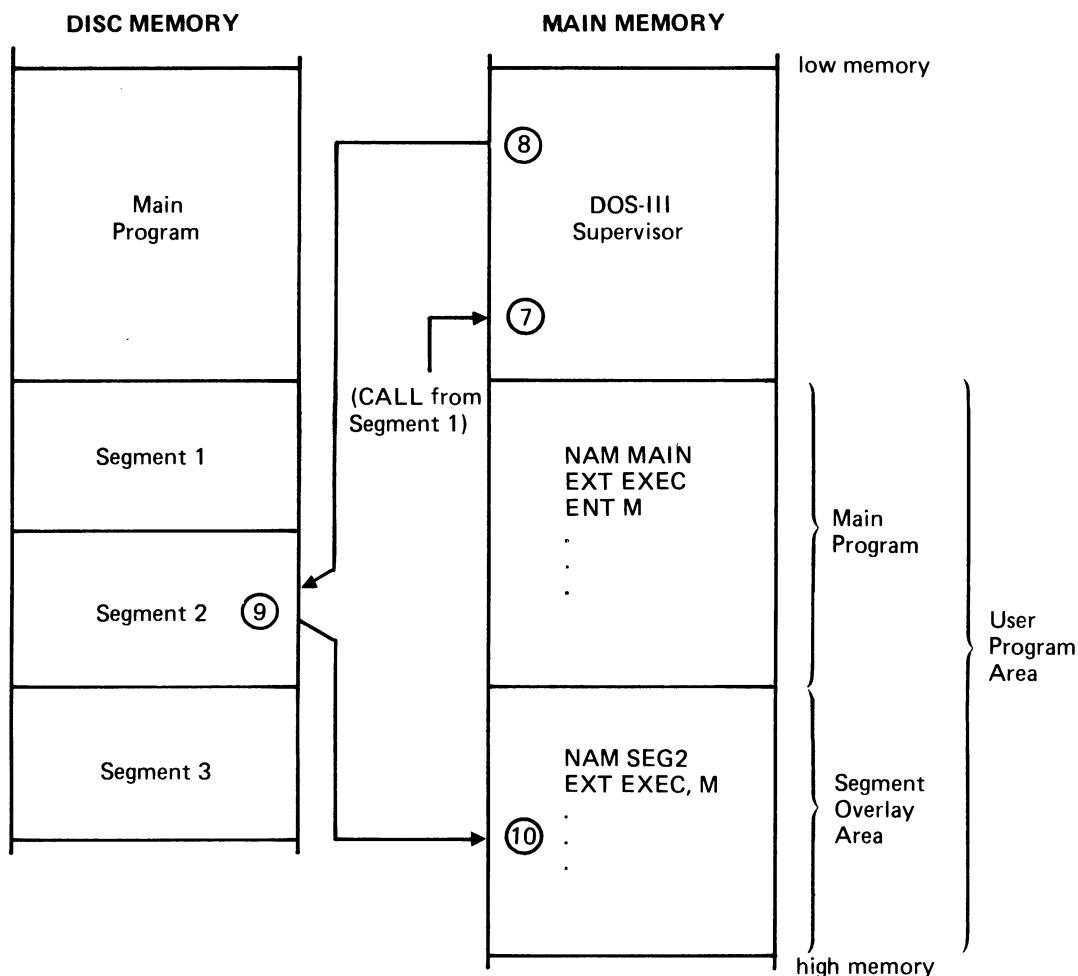
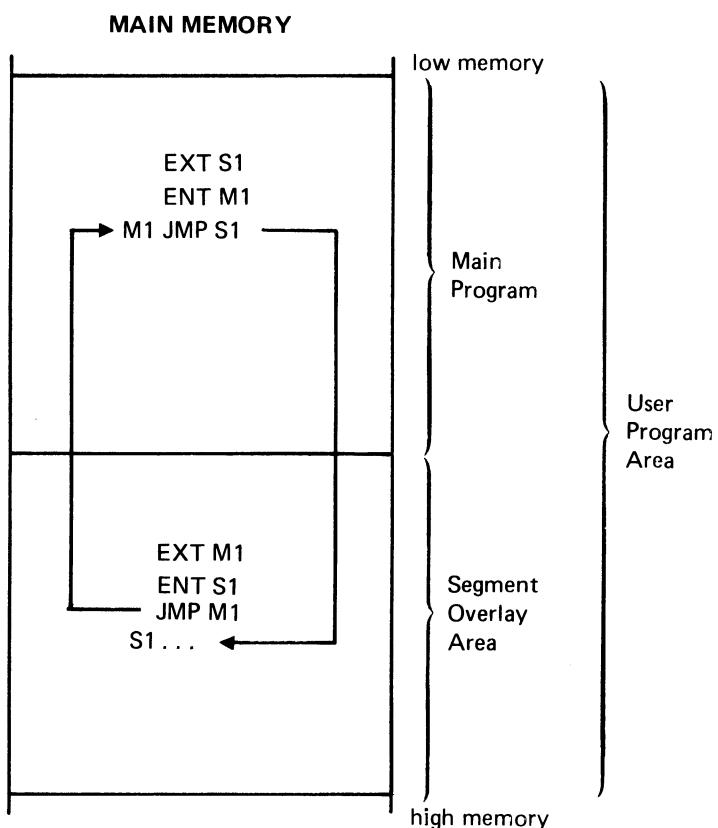


Figure 5-3. Segment Calling Segment

When a main program and segment are currently residing in main memory, they operate as a single program. Jumps from a segment to a main program (or vice versa) can be programmed by declaring an external symbol and referencing it via a JMP or JSB instruction. (See Figure 5-4.) A matching entry symbol must be defined as the destination in the other program. DSGEN or the Loader associates the main programs and segments, replacing the symbolic linkage with actual absolute addresses (i.e., a jump into a segment is executed as a jump to a specific address). The programmer should be sure that the correct segment is in main memory before any JMP instructions are executed.



**Figure 5-4. Main-to-Segment Jumps**

## **FORTRAN Segments**

Segmented user programs may be written in FORTRAN, but certain conventions are required. A segment must be defined as type 5 in the PROGRAM statement. The segment must be initiated by using the SEGMENT LOAD EXEC call (RCODE = 8) from the main or another segment. A dummy CALL to the main must appear in each segment to ensure that proper linkage will be established between the main and its segments.

Once a segment is loaded, control is passed to it and execution begins at its primary entry point (or at the address specified in base page location 135<sub>8</sub>). The segment, in turn, may call another segment using another SEGMENT LOAD EXEC call. Communication between the main program and segments may be through COMMON or via parameters passed in the SEGMENT LOAD or SEGMENT RETURN EXEC calls.

Any segment may return to the main program at the statement immediately following the initial SEGMENT LOAD EXEC call (RCODE = 8) by executing a SEGMENT RETURN EXEC call (RCODE = 29). (See Section III for a description of these EXEC calls.) However, segments may not return directly to other segments.

## **ALGOL Segments**

ALGOL programs can be segmented if certain conventions are followed. A segment must be defined as type 5 in the HPAL control statement. The segment must be initiated by using the SEGMENT LOAD EXEC call (RCODE = 8) from the main or another segment. In order to establish the proper linkage between a main program and its segments, each segment must declare the main a CODE procedure. For example, if MAIN is the main program, each segment must declare the following:

*PROCEDURE MAIN;CODE;*

Once a segment is loaded, control is passed to it and execution begins at its primary entry point (or at the address specified in base page location 135<sub>8</sub>). The segment, in turn, may call another segment using another SEGMENT LOAD EXEC call. Communication between the main program and its segments may be through parameters passed in the EXEC call.

Any segment may return to the main program at the statement immediately following the initial SEGMENT LOAD EXEC call by executing a SEGMENT RETURN EXEC call (RCODE = 29). (See Section III for a description of these EXEC calls.) However, segments may not return directly to other segments.



# **SECTION VI**

## ***Typical DOS-III Job Decks***

### **1. ASSEMBLE A PROGRAM AND STORE IN FILE**

```
:JOB,ASMBS  
:PROG,ASMB,5,6,4,56,99  
ASMB,B,L  
    NAM TEST,3  
    :  
    .  
    END ENTER  
:STORE,R,AFILE  
:JOB,NEXTJ
```

*Source Program*

### **2. LOAD AND EXECUTE A RELOCATABLE FILE**

```
:JOB,LOADE  
:PROG,LOADR,2  
AFILE,/E  
:STORE,P,TEST  
:RUN,TEST  
10  
23  
:  
:  
:  
51  
:JOB,NEXTJ
```

*Data*

### 3. STORE, EDIT, COMPILE, LOAD AND RUN A PROGRAM

```
:JOB, EVERY  
:STORE,S,SOURC,5  
FTN,B,L  
PROGRAM ZOOM  
DIM I(10)  
. .  
END$ } Source Program  
  
:::  
:LIST,S,6,SOURC  
:EDIT,SOURC,5  
/I,2  
. .  
/E } Edit List  
  
:JFILE,SOURC  
:PROG,FTN,2,6,4,56,99  
:PROG,LOADR  
:RUN,ZOOM  
123.62  
. .  
00001 } Data for first run  
:RUN,ZOOM  
321.5  
. .  
0.56 } Data for second run  
:JOB,NEXTJ
```

### 4. LIST ONLY ERROR STATEMENTS ON SYSTEM CONSOLE IN A COMPILE

```
:PR,FTN4,,1  
FTN4  
PROGRAM EX1  
. .  
END  
$
```

## 5. COPY A SYSTEM FROM SUBCHANNEL 1 TO SUBCHANNEL 0

:JO  
JOB TODAY TIME=0831 MIN. 43.3 SECS.  
@  
:UD,,0                           *Interrogates the system as to what label*  
LBL=SYSTEM                       *is on subchannel 0.*  
@  
  
:UD,SYSTEM,0                   *Change current user disc to subchannel 0*  
@  
:UD                              *Verify*  
SUBCHAN=0  
LBL=SYSTEM  
@  
:IN,\*                           *Purge system and user files on subchannel 0*  
DOS LABEL SYSTEM  
OK TO PURGE?  
YES  
@  
:UD                              *Verify purge*  
SUBCHAN=0  
UNLBL  
@  
  
:UD,\*,1                       *Change current user disc to subchannel 1*  
@  
:UD                              *Verify*  
SUBCHAN=1  
UNLBL  
@  
:DD,X                            }  
@  
:UD,\*,0                        *Copy system to subchannel 0*  
@  
:UD  
SUBCHAN=0  
LBL=SYSTEM  
@  
:EJ  
END JOB     RUN=0008 MIN. 01.7 SEC. EXEC=0000 MIN. 00.0 SEC.  
@



**PART 2**

***DOS-III Extended File  
Management Package (EFMP)***



# ***SECTION VII***

## ***EFMP Organization***

The DOS-III Extended File Management Package (EFMP) extends the file handling capabilities of DOS-III by allowing the user to create and use files with different record lengths, security codes, and other conveniences. EFMP consists of a series of additional EXEC modules and a utility program; it maintains a file structure that operates within, and in addition to, the standard DOS-III file structure.

### **ENVIRONMENT**

EFMP functions in the DOS-III environment. It is implemented through a set of EXEC modules which are incorporated into DOS-III at system generation time: the EXEC modules are invoked using the standard EXEC call mechanism.

### **FUNCTIONS AND STRUCTURE**

The EFMP modules themselves allow any program executing in the user area to Initialize EFMP areas, Create/Destroy, Open/Close, Read/Write, Reset, Repack, Copy, Change Name, and Post files on the moving-head disc. Also, EFMP makes available detailed status information on all files and packs known to it. EFMP may be accessed conversationally from the keyboard by using UTIL, a utility program that executes in the User Area.

### **DOS-III Files vs. EFMP Files**

DOS-III maintains files that are referenced by five-character names and relative sector numbers. The user can access these files in either a keyboard mode (via directives) or in a programming mode (via EXEC calls). In keyboard mode, the user creates a file with the STORE directive and operates on that file with directives such as :EDIT and :DUMP. In programming mode, the DOS-III files are accessed by EXEC calls such as FILE READ/WRITE and FILE NAME SEARCH.

In addition to the file structure, DOS-III maintains a subchannel (or user disc) identification scheme. User discs are first formatted either during system generation or by a special function of the system generator. These functions format the hardware tracks and set up information such as the Label Presence Code and System Proprietary Code. After a disc pack is formatted, the INITIALIZE directive is used to set up labels (six-character codes), change labels, and purge old discs.

EFMP operates within this file structure of DOS-III to set up and maintain additional—but distinctly different—files. Areas of discs within DOS-III (hereafter referred to as EFMP areas) are turned over to EFMP exclusively. The user must identify them with a pack number of the form PN<sub>xxx</sub>, where <sub>xxx</sub> is a decimal integer. The procedure for doing this is described under “Set Up.”

Within an EFMP area, EFMP creates files of its own that are not known to DOS-III. They are identified by a fixed-length name, contain a grouping of specified length records, and have a security code. Since only the DOS-III files can be created and accessed by directives, all EFMP files must be used through the EFMP EXEC calls or the UTIL program. EFMP files are limited in size only by the requirement that they fit within one subchannel or pack.

*Note: All references to files within this Part will mean EFMP files, not DOS-III files, unless specifically stated otherwise.*

### Duplicate Pack Numbers

EFMP pack numbers are always unique on any given platter, but not necessarily unique across platters. To minimize the possibility of accessing a duplicate pack number, the user should (if possible):

1. Create unique pack numbers.
2. Have platters containing EFMP areas mounted on the subchannel designated as the current user subchannel.

### EFMP Buffers and Tables

To provide maximum flexibility in main memory size and speed of file accessing, EFMP allows the user to define (at execution time) the size and location of the tables and buffers required in main memory by EFMP. Two areas are defined by the user and provided in his program space:

1. Opened File Table
2. Temporary Record Buffers

The Opened File Table contains all information necessary for EFMP to identify and access files belonging to the user. The minimum size of the Opened File Table is one sector (128 words) and allows up to seven files to be opened concurrently.

EFMP uses the Temporary Record Buffers as an intermediate storage area between the disc and the user's record buffer. The user defines the number of Temporary Record Buffers and the size of each. There must be at least one buffer and it must be at least two sectors (256 words) long. Particular files and buffers can be linked to increase the access speed of files. The effect of varying the number and size of these buffers cannot be predicted exactly and must be determined empirically by trial and error.

***CAUTION: SINCE THESE TABLES AND BUFFERS EXIST IN THE USER AREA AND ARE NOT PROTECTED, EXTREME CAUTION MUST BE TAKEN NOT TO MODIFY THEM IN ANY WAY.***

### **Logical Read vs. Physical Read**

A logical read occurs each time the user requests a record from a file. At that time EFMP checks the appropriate Temporary Record Buffer to determine if the requested record is already in main memory. If in main memory, the record is transferred to the user's record buffer without actually physically reading the disc. If the record is not present in main memory, the necessary disc transfers are performed (physical reads—and writes, if necessary) to bring the record into main memory. If the Temporary Record Buffer is larger than the record size, several records are brought into main memory at once.

### **Logical Write vs. Physical Write**

A logical write occurs each time a user requests that a record be written to a file. At that time, EFMP determines if that record is present in the Temporary Record Buffer; if it is, EFMP simply transfers the data in the user's record buffer to the Temporary Record Buffer and flags it as "must be written." Each succeeding read or write is treated in the same manner until a logical record transfer occurs for which the record is not in main memory, or until the last record in the Temporary Record Buffer is logically written. In these cases, the EFMP must physically write the records in the Temporary Record Buffer (i.e., post them) on the disc.

If the record is not present in main memory on a write request, EFMP locates the record on the disc and transfers it physically into the Temporary Record Buffer. The data to be written is then transferred from the user buffer to the Temporary Record buffer and flagged as "must be written." The read before write is necessary because records do not necessarily fall on sector boundaries in the disc. If a CLOSE or POST request occurs, all buffers flagged are written to the disc.

### **Update-Writes vs. Append-Writes**

The purpose of an update-write is to change the contents of an existing record; the purpose of append-write is to add new records onto the end of a file. EFMP writes a record as an update-write whenever the record specified exists in a previously accessed section of a file.

EFMP writes a record as an append-write whenever the record specified is beyond the previously accessed section of a file. In this case, EFMP automatically inserts zeros into all records (if any) between the highest record previously written and the new record.

## **SET UP**

There are two prerequisites for EFMP. First, the EFMP EXEC modules must be included in DOS-III when the system is generated. Second, when DOS-III is running, the user must create EFMP areas on formatted DOS-III packs or cartridges.

An EFMP area is created by issuing a STORE, B directive in this format:

:STORE,B,PNxxx,sectors

where *xxx* is a unique decimal number,

*PNxxx* is the unique pack number, and

*sectors* is the number of sectors of the EFMP area.

*Note: EFMP changes the file from Type-B to Type-A during initialization (see "Initialize").*

WORD	CONTENTS	
0	first character	second character
1	third character	fourth character
2	fifth character	(not used)
3	starting relative sector	
4	file length (in records)	
5	record length (in words)	
6	security code	
7	user-supplied status	
8	highest record number accessed	
	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	BITS

Figure 7-1. EFMP File Disc Directory Format

# ***SECTION VIII***

## ***EFMP EXEC Calls***

The method of communication between a user program and EFMP is through the standard DOS-III EXEC call format (discussed in Section III of this manual).

One standard DOS-III request code (RCODE = 24) is reserved for EFMP requests. The DOS-III operating system combines this request code with an EFMP function number to determine which action the user EXEC call is requesting. The EFMP function numbers are one element in each of the EFMP EXEC calling sequences.

### **FORMAT FOR EFMP EXEC CALLS**

In this section, only the Assembly language calling sequences are given for the EFMP EXEC calls. The methods for converting these calling sequences to FORTRAN or ALGOL are described in Section III.

The EFMP EXEC calls described in this section are presented in ascending order, by EFMP function number. The STATUS EXEC call (EFMPF = 10) has several status function numbers: these are presented in ascending order, by status function number.

*Note: A complete list of EFMP error codes can be found in PART 5 of this manual, "Error Codes and Messages."*

# ***DEFINE***

## Purpose

To define, before any other EFMP calls are made, the number of 16-bit words within the user program to be used by EFMP for its internal buffers and tables.

## Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+9</i>	<i>Return address</i>
<i>DEF</i>	<i>R CODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function number</i>
<i>DEF</i>	<i>OPNTB</i>	<i>Opened-file table address</i>
<i>DEF</i>	<i>OPNSZ</i>	<i>Opened-file table size</i>
<i>DEF</i>	<i>TRBUF</i>	<i>Temp. record buffer address</i>
<i>DEF</i>	<i>NOTRB</i>	<i>Number of temp. record buffers and number of active pack numbers</i>
<i>DEF</i>	<i>TRBSZ</i>	<i>Temp. record buffer size</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>R CODE</i>	<i>DEC</i> 24	
<i>EFMPF</i>	<i>DEC</i> 1	
<i>OPNTB</i>	<i>BSS</i> <i>n</i>	<i>Opened-file table (n is the size)</i>
<i>OPNSZ</i>	<i>DEC</i> <i>n</i>	<i>Size of opened-file table (in 16-bit words, see Comment 1)</i>
<i>TRBUF</i>	<i>BSS</i> <i>m</i>	<i>Beginning of temp. record buffers, see Comment 2</i>
<i>NOTRB</i>	<i>DEC</i> <i>p</i>	<i>No. of temp. record buffers, see Comment 2</i>
<i>(NOTRB+1)</i>	<i>DEC</i> <i>n</i>	<i>n = the maximum number of unique EFMP pack numbers active (MAXPK), see Comment 4</i>
<i>TRBSZ</i>	<i>DEC</i> <i>q</i>	<i>Size of each temp. record buffer (in sectors)</i>
<i>ERRNO</i>	<i>BSS</i> 1	<i>Return point for error codes</i>

## Comments

1. The size of the Opened-file table (*n*) can be calculated by this formula:

$$n = 4*(MAXPK) + 3*(NOTRB) + 16*(\text{Max. no. of files to be opened})$$

The minimum size of this table is 128 words. This allows approximately seven files to be opened concurrently.

**EFMPF = 1**

2. There must be at least one temporary record buffer and it must be at least two sectors long (256 words). There may, however, be more buffers and they may be more than two sectors in size. All of the space for these buffers must be allocated starting at the location TRBUF. Increasing the number of buffers allows disc efficiency to be increased by assigning a buffer exclusively to one file. Increasing the size of each buffer increases the speed of disc accessing by allowing more than one sector to be transferred per disc access.

The total size of the Temp. Record Buffers (m) can be calculated by the following formula:

$$m = NOTRB * TRBSZ * 128$$

(The minimum value for TRBSZ is 2.)

3. All the tables and buffers are fixed by DEFINE until the end of a program, or until another DEFINE. Each time a DEFINE occurs, all information contained in tables and buffers is lost, all pointers are reset, and EFMP assumes a fresh start. At the end of each program, DOS-III calls EFMP to perform a POST on any records flagged as "must be written."
4. MAXPK indicates the maximum number of unique EFMP pack numbers a user will have active at any one time. A pack number is active when one or more of its files are opened by a user through an OPEN call (or for PN000 through a CREATE call).

# ***CREATE***

## Purpose

To set up a directory on disc with all of the information necessary to create a file that can be accessed at a later time.

## Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+9</i>	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function number</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>FLGTH</i>	<i>File length (in records)</i>
<i>DEF</i>	<i>RLGTH</i>	<i>Record length (in words)</i>
<i>DEF</i>	<i>SCODE</i>	<i>Security code and user status</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>RCODE</i>	<i>DEC</i>	24
<i>EFMPF</i>	<i>DEC</i>	2
<i>FNAME</i>	<i>ASC</i>	3,xxxxxx <i>xxxxxx is the name to be applied to the file (first two characters cannot be zero or 177400<sub>8</sub>)</i>
<i>PAKNO</i>	<i>DEC</i>	<i>p</i> <i>p is the pack number, see Comments</i>
<i>FLGTH</i>	<i>DEC</i>	<i>q</i> <i>q is the number of records in the file; (1 ≤ q ≤ 32,767)</i>
<i>RLGTH</i>	<i>DEC</i>	<i>r</i> <i>r is the number of words in a record; r must be less than or equal to 1/2 the size of the temp. record buffer</i>
<i>SCODE</i>	<i>OCT</i>	<i>s</i> <i>s is any 16-bit combination to be checked by EFMP during OPEN and DESTROY</i>
<i>(SCODE+1)</i>	<i>OCT</i>	<i>t</i> <i>t is any 16-bit combination of status information desired by the user (referred to as USTAT elsewhere)</i>
<i>ERRNO</i>	<i>BSS</i>	1 <i>Return point for error codes</i>

### Comments

1. If PAKNO is a number between 1 and 999 it indicates the EFMP area in which the file is to be created. When EFMP creates a file, it reserves the necessary area on the disc after the last previous file generated. No attempt is made to search for an area between files. If PAKNO is equal to -1, the file is to be created in any EFMP area that is available.
2. If PAKNO equals zero, the file is placed on the Work Area of the disc and no area will be reserved in the EFMP areas. When such a temporary file is created, the only directory information that is maintained is in the Opened-File Table. A disc-based directory is not maintained. Also, since the directory information is established in main memory during the CREATE function, the OPEN function is not required. The only reason for using an OPEN call for a temporary file is to assign it to a specific Temporary Record Buffer or to change the starting record number to a value other than 1. If no OPEN call is given, the first Temporary Record Buffer is used.
3. When the Work Area is used for temporary files, EFMP reserves this whole area and identifies it as PN000. In order to keep PN000 from using the entire Work Area, the user must enter a STORE,B,PN000 directive for the system disc with the desired number of sectors. When EFMP has terminated, the user should PURGE the file PN000 from the Work Area.

# ***DESTROY***

## Purpose

To eliminate the directory information for a particular file from main memory and the disc. The user must specify the correct security code for the file. The disc area is repacked only for temporary files. To repack the EFMP areas use the REPACK EFMP call.

## Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+7</i>	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>SCODE</i>	<i>Security code</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>RCODE</i>	<i>DEC</i>	<i>24</i>
<i>EFMPF</i>	<i>DEC</i>	<i>3</i>
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxxx</i>
<i>PAKNO</i>	<i>DEC</i>	<i>n</i>
		<i>If n = 0, then FNAME refers to a temporary file (if n ≥ 1 and n ≤ 999, FNAME is to be located in this EFMP area; if n = -1, EFMP searches all of its areas until it finds a file that matches FNAME)</i>
<i>SCODE</i>	<i>OCT</i>	<i>s</i>
		<i>s is the security code for the file established by the CREATE EFMP call; security code ignored on temporary files</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>
		<i>Return point for error codes</i>

# OPEN

## Purpose

To make a previously created file accessible by extracting the necessary file information from the disc directories and placing it in main memory. The number of files that can be opened at any one time is limited by the size of the Opened File Table (see DEFINE).

## Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+9</i>	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>RCDNO</i>	<i>Record number</i>
<i>DEF</i>	<i>SCODE</i>	<i>Security code</i>
<i>DEF</i>	<i>BUFNO</i>	<i>Buffer number</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>RCODE</i>	<i>DEC</i>	<i>24</i>
<i>EFMPF</i>	<i>DEC</i>	<i>4</i>
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxxx</i>
<i>PAKNO</i>	<i>DEC</i>	<i>n</i>
		<i>If n = 0, the file is a temporary file on the work area; if n is between 1 and 999, EFMP looks for FNAME in the appropriate area; if n = -1, EFMP searches all available areas for the requested file</i>
<i>RCDNO</i>	<i>DEC</i>	<i>r</i>
		<i>If r = 0, EFMP sets the next record to be accessed (for sequential READS or WRITES) to the highest record previously accessed + 1. Otherwise, r can be any number between 1 and the maximum record number contained in the file. This allows sequential access to be initialized at any record.</i>
<i>SCODE</i>	<i>OCT</i>	<i>s</i>
		<i>s is the security code established by the CREATE call. It must match.</i>
<i>BUFNO</i>	<i>DEC</i>	<i>b</i>
		<i>b must be a number between 1 and the maximum number of Temp. Record Buffers available. For any other number, EFMP uses 1</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>
		<i>Return point for error codes</i>

# ***CLOSE***

## Purpose

To remove information about a particular file from the Opened-File Table. This allows an additional file to be opened. Also, CLOSE updates the user status information (USTAT) and the highest record accessed on the disc.

## Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+6</i>	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function number</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>USTAT</i>	<i>User status</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>RCODE</i>	<i>DEC</i>	24
<i>EFMPF</i>	<i>DEC</i>	5
<i>FNAME</i>	<i>ASC</i>	3,xxxxxx
<i>USTAT</i>	<i>OCT</i>	<i>u</i>
		<i>See Comment 2</i>
		<i>User status information (any 16-bit combination) to be written into the disc directory for the file</i>
<i>ERRNO</i>	<i>BSS</i>	1
		<i>Return point for error codes</i>

## Comments

1. If a CLOSE is requested for a temporary file, the directory information in the Opened-File Table is deleted and the Work Area is automatically repacked. If a file has been copied to the Work Area, the user status (USTAT) and highest record assessed are *not* updated on the original copy of the file.
2. To CLOSE all files in the Opened-File Table set the first word of FNAME equal to a binary zero.

***READ*****Purpose**

To retrieve a specified record (random access) or the next record (sequential access) from a file that has previously been opened and written.

**Assembly Language**

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	*+7	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>RCDNO</i>	<i>Record number</i>
<i>DEF</i>	<i>BUFFR</i>	<i>Buffer for data</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>RCODE</i>	<i>DEC</i> 24	
<i>EFMPF</i>	<i>DEC</i> 6	
<i>FNAME</i>	<i>ASC</i> 3,xxxx	
<i>RCDNO</i>	<i>DEC</i> <i>n</i>	<i>n</i> is a record number between 1 and 32,767. For sequential access and backspacing, see Comments.
<i>BUFFR</i>	<i>BSS</i> <i>m</i>	<i>m</i> is the length of the buffer in words. It must be at least the record length.
<i>ERRNO</i>	<i>BSS</i> 1	<i>Return point for error codes</i>

**Comments**

If RCDNO = 0, a sequential read or write is implied. This feature provides the program with the next record available relative to the last read or write performed (or OPEN operation). If RCDNO is a negative number, it specifies a backspace, relative to the current record (last record accessed plus 1), before the read or write. If an attempt is made to backspace the record number indicator to a value less than one, the EFMP issues an error and terminates the read or write. Unless needed, care should be taken so as not to backspace the record number indicator beyond the range of records held in the Temporary Record Buffer at that time, since this will initiate a posting operation and a physical disc access.

# ***INITIALIZE***

## **Purpose**

To initialize an EFMP area previously created by means of a DOS-III STORE directive.

## **Assembly Language**

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+6</i>	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function number</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>DIRSZ</i>	<i>Directory size</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
<i>return</i>		<i>Continue execution</i>
<i>RCODE</i>	<i>DEF</i>	<i>24</i>
<i>EFMPF</i>	<i>DEC</i>	<i>7</i>
<i>PAKNO</i>	<i>DEC</i>	<i>p</i> <i>(1 ≤ p ≤ 999)</i>
<i>DIRSZ</i>	<i>DEC</i>	<i>n</i> <i>(n = number of entries, one entry/file; see Comment 2)</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i> <i>Return point for error codes</i>

## **Comments**

1. Pack number PN000 cannot be initialized.
2. The directory occupies the first sector(s) of the EFMP area.

The number of sectors allocated to a directory is determined as follows:

The variable *n* is used to calculate the number of sectors to be reserved for the directory. It does not indicate the maximum number of file entries allowed in the directory. If the *n*th file entry does not completely fill the last sector of the directory, the space remaining may be used to contain additional file entries.

$$\#Sectors = \frac{(1 + n) * 9}{128}$$

(add 1 to #Sectors if remainder is > zero)

***WRITE*****Purpose**

To write into a specified record (random access) or into the next record (sequential access) of a file that has previously been opened.

**Assembly Language**

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+7</i>	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function number</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>RCDNO</i>	<i>Record number</i>
<i>DEF</i>	<i>BUFFR</i>	<i>Buffer for data</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>RCODE</i>	<i>DEC</i> 24	
<i>EFMPF</i>	<i>DEC</i> 8	
<i>FNAME</i>	<i>ASC</i> 3,xxxxxx	
<i>RCDNO</i>	<i>DEC</i> n	<i>Same as for the READ EXEC CALL</i>
<i>BUFFR</i>	<i>BSS</i> m	<i>Same as for READ</i>
<i>ERRNO</i>	<i>BSS</i> 1	<i>Return point for error codes</i>

# ***RESET***

## Purpose

To reset the highest record accessed pointer for a file to a lower value. The information beyond the pointer is lost. The file must be open before it can be reset. (PAKNO below provides an additional check.)

## Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+7</i>	
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>RCDNO</i>	<i>Record number</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
<i>return</i>		<i>Continue execution</i>
	:	
	:	
<i>RCODE</i>	<i>DEC</i>	<i>24</i>
<i>EFMPF</i>	<i>DEC</i>	<i>9</i>
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxxx</i>
<i>PAKNO</i>	<i>DEC</i>	<i>n</i>
		<i>If n = 0, EFMP searches the work area to find the desired file name; if n is a number between 1 and 999, EFMP searches EFMP area PNn to find the desired file name; if n = -1, EFMP searches all EFMP areas</i>
<i>RCDNO</i>	<i>DEC</i>	<i>m</i>
		<i>m is a number between 0 and 32,767 to which the highest record accessed pointer will be set ( m must be lower than the current value)</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>
		<i>Return point for error codes</i>

# ***STATUS***

## Purpose

To allow the user program access to various types of status information relative to EFMP. Several separate status functions (identified by unique Status Function Numbers) are provided; all have basically the same form of calling sequence, but they vary in the parameters used.

## Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+9</i>	<i>Return address</i>
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>FSTAT</i>	<i>Status function number</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>DUMMY</i>	<i>Not used</i>
<i>DEF</i>	<i>STATB</i>	<i>Status buffer</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
<i>return</i>		<i>Continue execution</i>
	:	

*Note:* Above is the general format for Status EFMP calls. The use and meaning of each parameter in the calling sequence varies from status call to status call. The parameters for each call are given separately below. Common to all status functions are

<i>RCODE</i>	<i>DEC</i>	24
<i>EFMPF</i>	<i>DEC</i>	10
<i>DUMMY</i>	<i>BSS</i>	1

**FSTAT = 1**

## ***STATUS***

### **Purpose**

To provide the user with all information, except the security code, contained in the directory for a file.

### **Parameters**

<i>FSTAT</i>	<i>DEC</i>	<i>1</i>	
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxxx</i>	
<i>PAKNO</i>	<i>DEC</i>	<i>m</i>	<i>If m = 0, EFMP searches the Work Area for the requested file. If m is between 1 and 999, EFMP searches the EFMP area of that pack number. For m = -1, EFMP searches all available EFMP areas for the requested file.</i>
<i>STATB</i>	<i>BSS</i>	<i>10</i>	<i>The pack number is returned in the first word if PAKNO = -1. The remaining nine words will receive the directory status information in the same format as the directory itself (see Figure 7-1).</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>	<i>Return point for error code.</i>

**FSTAT = 2**

## ***STATUS***

### **Purpose**

To determine if a file is open.

### **Parameters**

<i>FSTAT</i>	<i>DEC</i>	<i>2</i>	
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxxx</i>	
<i>PAKNO</i>	<i>OCT</i>	<i>0</i>	<i>Not used</i>
<i>STATB</i>	<i>BSS</i>	<i>2</i>	<i>The first word returns the pack number if the file is open. The second word returns a value of 0 if the file is open or 1 if the file is not open.</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>	<i>Return point for error codes.</i>

# **STATUS**

## Purpose

To check the security code of a file.

## Parameters

<i>FSTAT</i>	<i>DEC</i>	3	
<i>FNAME</i>	<i>ASC</i>	3,xxxxxx	
<i>PAKNO</i>	<i>DEC</i>	<i>m</i>	<i>Same as function number 1</i>
<i>STATB</i>	<i>BSS</i>	3	<i>The first word returns the pack number if appropriate. The second word is used by the user program to give the security code to be checked. The third word returns 0 if the code checks or 1 if it does not check.</i>
<i>ERRNO</i>	<i>BSS</i>	1	<i>Return point for error codes.</i>

## ***STATUS***

### **Purpose**

To determine the number of available full sectors left between the highest record accessed in a file and the end of the file.

### **Parameters**

<i>FSTAT</i>	<i>DEC</i>	4	
<i>FNAME</i>	<i>ASC</i>	3,xxxxxx	
<i>PAKNO</i>	<i>DEC</i>	<i>m</i>	<i>Same as function number 1</i>
<i>STATB</i>	<i>BSS</i>	2	<i>The first word returns the pack number if appropriate. The second word returns the number of sectors available.</i>
<i>ERRNO</i>	<i>BSS</i>	1	<i>Return point for error codes.</i>

**FSTAT = 5**

## ***STATUS***

### **Purpose**

To determine the number of available sectors left between the last file in an EFMP area and the end of the EFMP area.

### **Parameters**

<i>FSTAT</i>	<i>DEC</i>	5	
<i>FNAME</i>	<i>OCT</i>	0	<i>Not used</i>
<i>PAKNO</i>	<i>DEC</i>	<i>m</i>	<i>Same as function number 1, but cannot equal -1</i>
<i>STATB</i>	<i>BSS</i>	2	<i>The first word must be present, but is not used.</i> <i>The second word returns the number of sectors available.</i>
<i>ERRNO</i>	<i>BSS</i>	1	<i>Return point for error codes.</i>

**FSTAT = 6**

## ***STATUS***

### **Purpose**

To obtain the name of the  $n$ th file in an EFMP area where  $n$  is an integer between 1 and the maximum number of files in an EFMP area.

### **Parameters**

<i>FSTAT</i>	<i>DEC</i>	<i>6</i>	
<i>FNAME</i>	<i>BSS</i>	<i>3</i>	<i>Return point for file name or all zeroes if no file is present</i>
<i>PAKNO</i>	<i>DEC</i>	<i>m</i>	<i>m is a number between 1 and 999</i>
<i>STATB</i>	<i>DEC</i>	<i>n</i>	<i>n indicates the nth file</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>	<i>Return point for error codes</i>

FSTAT = 7

## **STATUS**

### Purpose

To obtain the name of the nth pack number on a specific subchannel where n is an integer (specifying the ordinal position of the pack number) between 1 and the maximum number of pack numbers on a subchannel.

### Parameters

<i>FSTAT</i>	<i>DEC</i>	7	
<i>FNAME</i>	<i>DEC</i>	<i>m</i>	<i>m</i> = the desired subchannel
:			On return, <i>FNAME</i> is zero if the EFMP area of
:			the pack number is initialized and 1 if the EFMP
:			area of the pack number is not initialized.
<i>PAKNO</i>	<i>BSS</i>	1	Return point for the pack number
<i>STATB</i>	<i>DEC</i>	<i>n</i>	<i>n</i> indicates the <i>n</i> th pack number.
<i>ERRNO</i>	<i>BSS</i>	1	Return point for error codes.

## ***REPACK (PURGE)***

### Purpose

To repack the existing files on an EFMP area(s), removing empty spaces left when files have been destroyed.

### Assembly Language

	<i>JSB</i>	<i>EXEC</i>	
	<i>DEF</i>	*+5	
	<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
	<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
	<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
	<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
		<i>return</i>	<i>Continue execution</i>
		.	.
	<i>RCODE</i>	DEC 24	
	<i>EFMPF</i>	DEC 11	
	<i>PAKNO</i>	DEC <i>n</i>	<i>For n between 1 and 999, only the specified EFMP area is repacked; for n = -1, all the EFMP areas available to EFMP are repacked</i>
	<i>ERRNO</i>	BSS 1	<i>Return point for error codes</i>

**CAUTION:** *IF THE EFMP DISC DIRECTORY CONTAINS A LARGE NUMBER OF FILES AND THE SIZES OF THE TEMPORARY RECORD BUFFERS ARE SMALL, REPACKING MAY REQUIRE CONSIDERABLE TIME. THEREFORE, REPACK SHOULD BE PERFORMED WHEN SUFFICIENT TIME IS AVAILABLE. UNDER NO CIRCUMSTANCES SHOULD AN ABORT BE PERFORMED DURING A REPACK.*

***COPY*****Purpose**

To transfer a copy of an opened file and its directory from an EFMP area to the Work Area of DOS-III, from one EFMP area to another EFMP area or from the Work Area to an EFMP area.

**Assembly Language**

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+6</i>	
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	.
<i>RCODE</i>	<i>DEF</i>	<i>24</i>
<i>EFMPF</i>	<i>DEC</i>	<i>12</i>
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxxx</i>
<i>PAKNO</i>	<i>DEC</i>	<i>n</i>
		<i>See Comment 1</i>
		<i>If n = 0, EFMP copies the file onto the Work Area; if n is between 1 and 999, EFMP copies the file into the specified EFMP area; if n is between -1 and -999, EFMP copies the file from the Work Area to an EFMP area specified by the 10's complement of n (see Comment 2)</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>
		<i>Return point for error codes</i>

**Comments**

1. Remember that a file must be opened before it can be copied. This is necessary to determine from which pack to copy the file. When a file has been copied to the Work Area, all reads and writes referencing that file use the Work Area version until the file is closed. (Files copied from the Work Area to an EFMP area continue to use the Work Area version for reads and writes.) Temporary copies of files do not have security codes. Therefore, files copied from the Work Area to a pack have a security code of 0. When a file is copied from pack to pack, the original security code is retained. See "CLOSE" for further notes on Work Area files.

**EFMPF = 12**

2. If there is already a file with the same name in the destination EFMP area directory, an error code is returned and the copy is aborted. In this case, the user can first destroy the name in the destination EFMP area, and then perform the copy again.
3. When copying from one EFMP area to another EFMP area not on the drive (and only a single removable pack is available), EFMP automatically requests that the user continually swap packs until the entire file has been copied. EFMP outputs:

*INSERT DESTINATION [SOURCE] PACK AND PRESS RUN.*

and halts the computer with 102076 in the DISPLAY register.

After the user inserts the appropriate pack and presses RUN, a check is made to determine if the proper pack has been entered. If EFMP cannot find the correct pack, the message is repeated. To allow the user an orderly exit in case the correct pack is not available, the following question is asked after each question:

*ENTER C OR T*

where C means to continue copying, and

T means to terminate the copy and return to the program.

4. Care *must* be taken to insert the original pack (if it has been removed during the copy function) into its original subchannel.

## ***CHANGE FILE NAME***

### Purpose

To change a file name (file need not be opened).

### Assembly Language

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+7</i>	
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>FNAME</i>	<i>File name</i>
<i>DEF</i>	<i>PAKNO</i>	<i>Pack number</i>
<i>DEF</i>	<i>SCODE</i>	<i>Security code</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
<i>RCODE</i>	<i>DEC</i>	<i>24</i>
<i>EFMPF</i>	<i>DEC</i>	<i>13</i>
<i>FNAME</i>	<i>ASC</i>	<i>3,xxxxx Current file name</i>
	<i>ASC</i>	<i>3,zzzzz New file name</i>
<i>PAKNO</i>	<i>DEC</i>	<i>n n = 0, indicates that the file is on the Work Area; if n is between 1 and 999, n indicates the EFMP area containing the file; if n = -1, EFMP searches all available EFMP areas for the current file name</i>
<i>SCODE</i>	<i>OCT</i>	<i>m Security code, see CREATE</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1 Return point for error codes</i>

***POST*****Purpose**

To physically write on the disc all buffers that have been flagged as “must be written” in the Temporary Record Buffer. (That is, convert all outstanding logical writes into physical writes.)

**Assembly Language**

<i>JSB</i>	<i>EXEC</i>	
<i>DEF</i>	<i>*+4</i>	
<i>DEF</i>	<i>RCODE</i>	<i>Request code</i>
<i>DEF</i>	<i>EFMPF</i>	<i>EFMP function code</i>
<i>DEF</i>	<i>ERRNO</i>	<i>Error number</i>
	<i>return</i>	<i>Continue execution</i>
	.	
	.	
	.	
<i>RCODE</i>	<i>DEC</i>	<i>24</i>
<i>EFMPF</i>	<i>DEC</i>	<i>14</i>
<i>ERRNO</i>	<i>BSS</i>	<i>1</i>
		<i>Return point for error codes</i>

**Comments**

The POST operation updates the highest record accessed pointer in the disc directories, but not the user status word (USTAT).



# ***SECTION IX***

## ***EFMP Utility Program***

The EFMP Utility Program (UTIL) allows the user to access most of the EFMP functions through the keyboard. UTIL accepts commands or directives from the operator and converts these into EFMP calling sequences. After EFMP has processed the call, UTIL reports back (to the operator) a successful operation or an EFMP error.

This section describes how to initiate the UTIL program using the DOS-III PROG directive and then describes the following UTIL commands (presented in alphabetic order):

*BRIEF  
CHANGE  
CLOSE  
COPY  
CREATE  
DESTROY  
END  
INITIALIZE  
OPEN  
POST  
REPACK  
RESET  
STATUS-1  
STATUS-2  
STATUS-3  
STATUS-4  
STATUS-5  
STATUS-6  
STATUS-7*

*All are EFMP functions, except BRIEF and END,  
which are UTIL program functions.*

*Note:* UTIL requires the FORTRAN IV version of the Formatter program to operate properly.

## **:PROG, UTIL**

### **Purpose**

To initiate execution of the UTIL program.

### **Format**

**:PROG, UTIL,*n***

where *n* = 0 to print a list of commands or

*n* ≠ 0 to skip printing the list.

List of commands message (all parameters are decimal):

```
/INI,PAKNO,DIRSZ  
/CRE,FNAME,PAKNO,FLGTH,RLGTH,SCODE,USTAT  
/DES,FNAME,PAKNO,SCODE  
/OPE,FNAME,PAKNO,RCDNO,SCODE  
/CLO,FNAME,USTAT  
/RES,FNAME,PAKNO,RCDNO  
/STA,DF,FNAME,PAKNO  
/STA,FO,FNAME  
/STA,SC,FNAME,PAKNO,SCODE  
/STA,LR,FNAME,PAKNO  
/STA,LF,PAKNO  
/STA,NF,PAKNO,STATB  
/STA,AP  
/REP,PAKNO  
/COP,FNAME,PAKNO  
/CHA,FNAM1,FNAM2,PAKNO,SCODE  
/POS  
/BRI,FNAME,SCODE  
/END
```

UTIL begins by outputting a message to indicate that it is ready for a directive:

*UTIL READY*

After it processes the directive, UTIL outputs the results of the operation (where appropriate) or any error codes that may have been returned by EFMP. When it is ready for another directive, UTIL outputs

*UTIL READY*

If an incorrect directive is entered, UTIL outputs

*ILLEGAL OPERATION*

*UTIL READY*

UTIL is terminated when the operator inputs the command /END.

UTIL outputs any error messages on the system console; normal output is output on the list device.

# **BRIEF**

## **Purpose**

To increase or decrease the amount of disc storage reserved for a file. BRIEF is a UTIL program function, not an EFMP function.

## **Format**

*/BRI, fname, scode*

*fname* is the name of the file, and

*scode* is the security code of the file.

BRIEF first outputs the status of the file:

*AVAILABLE RECS. = m*

*RECORDS USED = r*

*NEW RECORD COUNT?*

The operator inputs either:

*/E* to terminate the command and prepare UTIL for more commands,

or

*n* to change the available record count to *n*

BRIEF stores the contents of *fname* on the Work Area, destroys the current file, repacks the EFMP area, and creates and opens a new file. The contents of *fname* are transferred from the Work Area to the new file and BRIEF prints out a message:

*AVAILABLE RECS. = n*

*RECORDS USED = r*

BRIEF then terminates.

## **Comment**

BRIEF creates and uses a temporary file named “ΔΔΔΔΔΔ” (all blanks).

# **CHANGE**

## **Purpose**

To change the name of a file (i.e., to invoke the CHANGE FILE NAME function of EFMP).

## **Format**

*/CHA,fnam1,fnam2,pakno,scode*

*fnam1*    is the current file name

*fnam2*    is the new file name.

See CHANGE FILE NAME EFMP CALL for explanation of other parameters.

## **EXAMPLE**

*/CHA,LOB70,XXXXX,120,0*

*Example print-out:*

**FILE LOB70 OLD FILE  
FILE XXXXX NEW FILE  
THE FILE IS ON PACK# 120  
THE SECURITY CODE IS 0**

# **CLOSE**

## **Purpose**

To close a previously opened file (i.e., to invoke the CLOSE function of EFMP).

## **Format**

*/CLO,fname,ustat*

See CLOSE EFMP CALL for explanation of parameters. Note, however, that all the files in the Opened-File Table *cannot* be closed by setting the first word of FNAME (in the CLOSE calling sequence) to a binary zero.

## **EXAMPLE**

*/CLO,LOB70,0*

*Example print-out:*

*FILE LOB70            CLOSED  
THE USER STATUS WORD IS        0*

# ***COPY***

## **Purpose**

To copy a file (i.e., to invoke the COPY function of EFMP).

## **Format**

*/COP, fname, pakno*

See COPY EFMP CALL for explanation of parameters and messages.

## ***EXAMPLE***

*/COP,LOB70,120*

*Example print-out:*

```
FILE    LOB70    COPIED
THE FILE IS TEMPORARY IN WORK AREA
FILE    LOB70    COPIED
THE FILE IS ON PACK#    120
```

# ***CREATE***

## **Purpose**

To create a new file (i.e., to invoke the CREATE function of EFMP).

## **Format**

*/CRE,fname,pakno,flgth,rlgth,scode,ustat*

See CREATE EFMP CALL for explanation of parameters.

## **EXAMPLE**

*/CRE,C0,120,8,8,0,0*

*Example print-out:*

```
FILE   C0   CREATED
THE FILE IS ON PACK#   120
THE FILE LENGTH IS    8 RECORDS
THE RECORD LENGTH IS   8 WORDS
THE SECURITY CODE IS   0
THE USER STATUS WORD IS  0
```

# ***DESTROY***

## **Purpose**

To destroy a file by eliminating its directory entry (i.e., to invoke the DESTROY EFMP function).

## **Format**

*/DES,fname,pakno,scode*

See DESTROY EFMP CALL for explanation of parameters.

## ***EXAMPLE***

*/DES,C0,120,0*

*Example print-out:*

**FILE      C0      DESTROYED**

## ***END***

### **Purpose**

To terminate the operation of the UTIL program. END is an UTIL program function, not an EFMP function.

### **Format**

*/END*

# ***INITIALIZE***

## **Purpose**

To initialize an EFMP area previously allocated space by means of a DOS-III STORE directive.

## **Format**

*/INI,pakno,dirs<sub>z</sub>*

See INITIALIZE EFMP CALL for explanation of parameters.

## ***EXAMPLE***

*/INI,100,20*

*Example print-out:*

**PACK #100 INITIALIZED**

# ***OPEN***

## **Purpose**

To OPEN a previously CREATED file (i.e., to invoke the OPEN function of EFMP).

## **Format**

*/OPE,fname,pakno,rcdno,scode*

See OPEN EFMP CALL for explanation of parameters.

## ***EXAMPLE***

*/OPE,LOB70,120,1,0*

*Example print-out:*

*FILE LOB70 OPENED  
THE FILE IS ON PACK# 120  
THE RECORD # IS 1  
THE SECURITY CODE IS 0*

# ***POST***

## **Purpose**

To post files (i.e., to invoke the POST function of EFMP).

## **Format**

*/POS*

*Example print-out:*

***ALL FILES POSTED***

# ***RESET***

## **Purpose**

To reset the highest record number accessed for a file (i.e., to invoke the RESET function of EFMP).

## **Format**

*/RES, fname, pakno, rcdno*

See RESET EFMP CALL for explanation of the parameters.

## **EXAMPLE**

*/RES,LOB70,120,0*

*Example print-out:*

```
FILE    LOB70    RESET
THE FILE IS ON PACK#    120
THE RECORD # IS      0
```

# **REPACK**

## **Purpose**

To repack existing EFMP areas (i.e., to invoke the REPACK EXEC CALL function of EFMP).

## **Format**

*/REP,pakno*

See REPACK EFMP CALL for explanation of parameters.

## **EXAMPLES**

*/REP,42 (repacks EFMP area in pack 42)*  
*/REP, -1 (repacks all EFMP areas)*

*Example print-out:*

**PACK # 42 REPACKED**

*or*

**ALL PACKS AVAILABLE REPACKED**

## **STATUS-1**

### **Purpose**

To print out directory information about a file (i.e., to invoke STATUS function number 1 of EFMP).

### **Format**

*/STA,DF, fname, pakno.*

See STATUS EFMP CALL (FSTAT = 1) for explanation of the parameters and results.

### **EXAMPLE**

*/STA,DF,LOB70,120*

*Example print-out:*

```
FILE    LOB70    STATUS
THE FILE IS ON PACK#    120
STARTING TRACK # IS    6
STARTING SECTOR # IS    9
THE FILE LENGTH IS    12 RECORDS
THE RECORD LENGTH IS    128 WORDS
THE USER STATUS WORD IS    0
HIGHEST RECORD # ACCESSED IS    0
```

## ***STATUS-2***

### **Purpose**

To determine if a file is OPEN (i.e., to invoke STATUS function number 2 of EFMP).

### **Format**

*/STA,FO, fname*

See FSTAT = 2 for explanation of the parameters and results.

### **EXAMPLE**

*/STA,FO,LOB70*

*Example print-out:*

*FILE LOB70      STATUS  
FILE IS OPEN*

## **STATUS-3**

### **Purpose**

To check the security code of a file (i.e., to invoke STATUS function number 3 of EFMP).

### **Format**

*/STA,SC, fname, pakno, scode*

See FSTAT=3 for explanation of parameters and results.

### **EXAMPLE**

*/STA,SC,LOB70,120,0*

*Example print-out:*

```
FILE    LOB70    STATUS
THE FILE IS ON PACK#    120
THE SECURITY CODE IS    0
CODE CHECKS
```

*Note: The security code returned is a restatement of the security code entered; it is not necessarily the correct security code.*

## **STATUS-4**

### **Purpose**

To determine the number of available full sectors left between the highest record accessed in a file and the end of the file (i.e., to invoke STATUS function number 4 of EFMP).

### **Format**

*/STA,LR, fname, pakno*

See FSTAT=4 for explanation of parameters and results

### **EXAMPLE**

*/STA,LR,LOB70,120*

*Example print-out:*

```
FILE    LOB70    STATUS
THE FILE IS ON PACK#    120
# OF AVAILABLE SECTORS IS    12
```

## **STATUS-5**

### **Purpose**

To determine the number of available sectors left between the last file in an EFMP area and the end of the EFMP area (i.e., to invoke STATUS function number 5 of EFMP).

### **Format**

*/STA,LF,pakno*

See FSTAT=5 for explanation of parameters and results.

### **EXAMPLE**

*/STA,LF,120*

*Example print-out:*

*FOR PACK# 120  
# OF AVAILABLE SECTORS IS 4610*

## **STATUS-6**

### **Purpose**

To obtain the name of the *n*th file in an EFMP area where *n* is an integer between 1 and the maximum number of files in an EFMP area (i.e., to invoke STATUS function number 6 of EFMP).

### **Format**

*/STA,NF,pakno,statb*

See FSTAT=6 for explanation of parameters and results.

### **EXAMPLE**

*/STA,NF,120,1*

*Example print-out:*

```
FILE    LOB70    STATUS
THE FILE IS ON PACK#   120
FILE #    1 IN THE DIRECTORY
```

## ***STATUS-7***

### **Purpose**

To obtain the name of the  $n$ th pack number on a specific subchannel where  $n$  is an integer (specifying the ordinal position of the pack number) between 1 and the maximum number of pack numbers on a subchannel.

### **Format**

*/STA,AP,subch,statb*

See FSTAT = 7 for explanation of parameters and results.

### **EXAMPLE**

*/STA,AP,1,1*

*Example print-out:*

*PACK #120 IS AVAILABLE AND INITIALIZED*

**PART 3**

***Generating and Loading DOS-III***



# ***SECTION X***

## ***Generating DOS-III***

HP 24307B DOS-III Disc Operating System software must be generated and then loaded into the computer's memory before DOS-III system operation is possible. Generating a DOS-III system consists of two operations:

1. Configuring the system to the available hardware.
2. Storing the configured system on disc memory.

In addition, the discs included in the system must be formatted before they can be used by DOS-III.

This section describes the procedures required to format a disc and to generate DOS-III system software. Both disc formatting and system generation are performed using a stand-alone program, DSGEN.

Depending on the type of moving-head disc device selected for the DOS-III system, generation can be performed either from relocatable modules and drivers punched on paper tape or contained on a master disc cartridge. Systems including an HP 7901, HP 2883, or HP 2884 disc device initially must be generated from paper tape. Systems including an HP 7900 disc device are delivered with a master disc cartridge (HP part number 24307-13001) labeled DSGEN. The DSGEN disc cartridge contains a DOS-III software system together with a set of relocatable modules and drivers. The cartridge may be used to generate DOS-III software. A procedure for preparing to generate DOS-III software from the DSGEN disc cartridge is described later in this section (see "DSGEN Disc Cartridge System Generation").

### **DSGEN**

DSGEN (the DOS-III System Generator) is an absolute program which is loaded into main memory: 1) by the paper tape portion of the main-memory loader, BMDL, when using an HP 2100A/S computer or, 2) by the Bootstrap loaders contained in either the paper tape loader ROM or in the disc loader ROM when using an HP 21MX computer. Since DSGEN input/output is independent of the DOS-III system it generates, the I/O operation of DSGEN requires SIO drivers which are distributed with the DOS-III software. The SIO drivers must be configured to the user's hardware configuration. A copy of the configured DSGEN program can be punched on paper tape using SIO System Dump, if desired. SIO drivers and SIO System Dump are absolute programs — not part of DOS-III — needed only for DSGEN operation. An optional utility program which uses SIO drivers is the Prepare Tape System (PTS). PTS can be used to transfer relocatable modules from paper tape to magnetic tape to expedite the DSGEN program input phase. DSGEN has two independent functions:

1. To format new disc cartridges (or packs).
2. To generate a DOS-III software system that fits the user's main-memory size, I/O equipment, and programming needs.

## DSGEN CONFIGURATION FROM PAPER TAPE

DSGEN is executed in a Software Input/Output environment to generate DOS-III. First, ensure that equipment power is on and disc storage is unprotected (Disc Protect Override or Format enabled). At this point in DSGEN configuration, the procedure for loading paper tape depends on the computer being used.

### HP 2100A/S

The main-memory loader, BMDL, is used to load programs from paper tape into memory. BMDL is described in detail in Section XI. A simplified procedure follows:

- A. Place the paper tape into the paper tape reader and press READ to ready the reader.
- B. On the computer front panel, set the P-register to the BMDL starting address  $37700_8$  for 16K words of memory;  $57700_8$  for 24K words; or  $77700_8$  for 32K words.
- C. Press PRESET (INTERNAL and EXTERNAL); then press RUN. After a successful load, the computer will halt with  $102077_8$  in the display register.

### HP 21MX

The HP 21MX processor is equipped with a paper tape loader ROM, the contents of which are equivalent to the Basic Binary Loader portion of the BMDL used on HP 2100A/S computers. The contents of the ROM must be loaded into memory before the drivers or DSGEN (or any program on paper tape) can be placed into main memory. Use the following procedure to accomplish paper tape ROM loading.

- A. Press PRESET.
- B. Select the S-register for display.
- C. Press the CLEAR DISPLAY.
- D. Bits 15 and 14 of the Display Register must be 00 to select the paper tape loader ROM.
- E. Change bits 11 through 6 of the Display Register to the octal select code of the tape reader.

Since bits 13, 12, and 5 through 0 are not used in conjunction with the paper tape loader, they are ignored.

- F. Press STORE to store the contents of the Display Register in the S-register.

- G. Press IBL to load the contents of the paper tape loader ROM into the uppermost 64 locations in memory. The computer halts with  $102077_8$  in the T-register.
- H. Place the DSGEN paper tape in the paper tape reader, press READ to ready the reader, and press RUN at the main processor. After a successful load, the computer halts with  $102077_8$  in the T-register.

To configure DSGEN (using either an HP 2100A/S or HP 21MX computer), proceed as follows:

1. Specific SIO drivers must be configured before DSGEN can be executed. To configure a driver:
  - a. Load the driver program into memory via the paper tape reader using the proper set of procedures from those described above (*HP 2100A/S Steps A through C* or *HP 21MX Steps A through H*).
  - b. Set the I/O channel select code of the device (lower numbered select code if there are two I/O channels) in bits 5-0 of the switch register.
  - c. Start the driver program by setting the P-register to address  $2_8$ ; then press RUN. Upon successful completion of the driver configuration, the computer will halt with  $102077_8$  in the display register.
2. Configure the SIO console driver (HP part no. 24127-60001) using Steps 1-a through 1-c. (If the console device is an HP 2754B teleprinter, switch register bit 15 must be set to one at Step 1-b.)
3. If program input is to be from the paper tape reader, configure the SIO paper tape reader driver (HP part no. 20319-60001) using Steps 1-a through 1-c.
4. If a high-speed paper tape punch is included in the system, configure the SIO punch driver (HP part no. 20320-60001) using Steps 1-a through 1-c.
5. Load DSGEN via the paper tape reader using the appropriate procedure described above (*HP 2100A/S Steps A through C* or *HP 21MX Steps A through H*).
6. If program input is to be from magnetic tape, configure the SIO magnetic tape driver (HP part no. 13022-60001) using Steps 1-a through 1-c.
7. If the system includes a high-speed or console punch, a configured DSGEN can be punched on paper tape using the following procedure:
  - a. Load the SIO System Dump program (HP part no. 20335-60001) via the paper tape reader using the procedure described in *HP 2100A/S Steps A through C* or the procedure described in *HP 21MX Steps A through H*.
  - b. Set switch register bit 15 to one.
  - c. Start the SIO System Dump program by setting the P-register to address  $2_8$ ; then press RUN. After tape punching is successfully completed, the computer will halt with  $102077_8$  in the display register. For an additional copy of the configured DSGEN, press RUN.

8. If the disc or discs to be used by DOS-III have been formatted, DOS-III system generation can begin immediately. Proceed as follows:
  - a. Set switch register bit 15 to zero.
  - b. Set the P-register to DSGEN starting address  $100_8$ .
  - c. Press RUN. DOS-III system generation dialog begins (see "Using DSGEN to generate DOS-III").
9. To format discs before executing system generation:
  - a. Set switch register bit 15 to one.
  - b. Set the P-register to DSGEN starting address  $100_8$ .
  - c. Press RUN. The disc formatting dialog begins (see "Using DSGEN to Format Discs").

#### DSGEN Start-up

To start either disc formatting or DOS-III system generation from a configured DSGEN program (on paper tape) perform a standard paper-tape load. These procedures are described in *HP 2100A/S Steps A through C* or in *HP 21MX Steps A through H*. Then proceed as follows:

- For disc formatting:
  - a. Set switch register bit 15 to one.
  - b. Set the P-register to the DSGEN starting address  $100_8$ .
  - c. Press RUN. The disc formatting dialog begins (see "Using DSGEN to Format Discs").
- For DOS-III system generation:
  - a. Set switch register bit 15 to zero.
  - b. Set the P-register to the DSGEN starting address  $100_8$ .
  - c. Press RUN. DOS-III system generation begins at the initialization phase (see "Using DSGEN to generate DOS-III").

## **USING DSGEN TO FORMAT DISCS**

Before a fresh disc can be used in DOS-III, it must be formatted by DSGEN. System discs (including a possible User Area) are formatted during system generation, but dedicated user discs must be formatted by running DSGEN again in a special mode. Formatting a disc involves assigning it a system generation code, reading every sector, clearing any existing user or system directory, and so forth. The result is an unlabeled user disc ready for use in DOS-III. The following operator responses are only examples, actual responses should be appropriate to the particular system being generated.

### **Operating Instructions**

1. Turn on all equipment.
2. Unprotect the disc (enable Disc Protect Override).
3. Load a configured DSGEN using the main-memory resident BMDL or the paper tape loader ROM. (See "DSGEN Configuration and Start-up" in this section.)
4. Set up a starting address at location  $100_8$ .
5. Set switch register bit 15 equal to 1.
6. Start the computer executing (press RUN).
7. DSGEN asks for a decimal number to be written on the disc label. This number is used for identification . . . . . *SYS GEN CODE?*  
Operator responds with a 1- to 4-digit decimal number . . . . . 79
8. DSGEN requests the octal channel number (select code) of the disc controller . . . . . *SYS DISC CHANNEL?*  
Operator responds with the appropriate octal number . . . . . 10
9. DSGEN requests the type of disc storage . . . . . *DISC TYPE?*  
Operator responds with 7900, 7901, 2883, or 2883B  
(A response of 2883 implies four subchannels per disc drive; 2883B implies two subchannels per disc drive.) . . . . . 7900
10. DSGEN requests the subchannel number (0 to 7) of the user disc to be formatted . . . . . *USER DISC SUBCHANNEL?*  
Operator responds with a number between 0 and 7 inclusive . . . . . 3

11. DSGEN requests that the disc be unprotected (if it is still protected) . . . . . *TURN ON DISC PROTECT OVERRIDE — PRESS RUN*

Operator unprotects the disc and starts the computer executing.

12. DSGEN carries out formatting on the specified subchannel and halts with a code of  $102007_8$ .

13. This procedure should be repeated for each proposed user disc.

Operator can start the computer (press RUN) to format a new disc of the same type (switch bit 15 must still be equal to 1).

DSGEN repeats from . . . . . *USER DISC SUBCHANNEL?*

Operator can set switch bit 15 equal to 0 and start the computer (press RUN) to proceed to system generation.

## **USING DSGEN TO GENERATE DOS-III**

The operation of DSGEN involves four phases:

1. INITIALIZATION PHASE. DSGEN requests specifications for DOS-III, including description of available disc space, memory, Time-base Generator channel, system generation code, system and user disc subchannels, and program input devices.
2. PROGRAM INPUT PHASE. DSGEN reads the relocatable programs to be included in the system. The relocatable program modules can be input via paper tape, disc, or magnetic tape (the magnetic tape must be prepared off-line using the Prepare Tape System).
3. PARAMETER INPUT PHASE. Parameters to change EXEC modules or drivers from disc- to main-memory resident may be entered. The programs' NAM records are already set for a minimum main-memory system except that two console drivers have been included. DISCM, \$EX30 (if EFMP is used), moving-head driver DVR31, and *one* console driver must be main-memory resident.
4. DISC LOADING PHASE. DSGEN requests a specification of the base page linkage, and begins loading programs onto the disc in absolute format. Systems programs (i.e., the modules of DOS-III) are loaded first, after which DSGEN requests information for the equipment table, device reference table (logical unit table), and interrupt table and proceeds to load the rest of the programs onto the disc.

### **Restart**

If an error occurs during execution of any phase, the operator can restart that phase by restarting DSGEN at location 100<sub>8</sub>.

## Initialization Phase

During the initialization phase, DSGEN requests information necessary to begin generating the DOS-III. After each output on the system console, the operator responds by entering the required information terminated by a *return linefeed*. The following responses are typical. (The operator responses are only examples, actual responses should be appropriate to the particular system being generated.)

1. DSGEN requests a decimal system generation code. This code is written in the label field of the system disc for identification . . . . . **SYS GEN CODE?**  
Operator responds with a 1- to 4-digit decimal integer . . . . . 79
2. DSGEN requests the octal channel number (select code) of the disc controller . . . . . **SYS DISC CHNL?**  
Operator responds with the high priority (low number) channel . . . . . 14  
*Note: BMDL requires that the SYS DISC CHNL? response must be the same value as the EQT entry for the system.*
3. DSGEN requests the type of disc storage . . . . . **DISC TYPE?**  
Operator responds with 7900, 7901, 2883, or 2883B. A response of 2883 implies four subchannels per disc drive; 2883B implies two subchannels per disc drive. . . . . 7900
4. DSGEN requests the number of tracks (decimal) on the system disc . . . . . **SYS DISC SIZE?**  
Operator responds with a decimal number less than or equal to 200. (A response of 200 leaves three tracks as spares. A response less than 200 leaves extra tracks as spares.) . . . . . 200
5. DSGEN requests the number of drives on the system . . . . . **# DRIVES?**  
If response to Step 3 was 2883, the operator responds with 1 or 2; if response to Step 3 was 2883B, 7900, or 7901, the operator responds with a number between 1 and 4 inclusive. . . . . 3
6. DSGEN requests the decimal number of the first track on the system disc which is available to DOS-III . . . . . **FIRST SYSTEM TRACK?**  
Operator responds . . . . . 0
7. DSGEN requests the decimal number of the first sector available to DOS-III . . . . . **FIRST SYSTEM SECTOR?**  
Operator responds. (The system area cannot begin before track 0, sector 3) . . . . . 3

8. DSGEN requests the subchannel number of the system disc . . . . . *SYS DISC SUBCHNL?*  
 Operator responds with a number between 0 and 7 . . . . . 0
- Note: On a 7901 disc, only odd numbered subchannels are available.*
9. DSGEN requests the subchannel number of the user disc.  
 (This may be the same as the system disc.) . . . . . *USER DISC SUBCHNL?*  
 Operator responds with a number between 0 and 7.  
 (System efficiency increases if the user disc is on a  
 different drive from the system disc.) . . . . . 2
10. DSGEN requests the octal channel number (select code) of  
 the Time-base Generator . . . . . *TIME BASE GEN CHNL?*  
 Operator responds with the proper select code or 0  
 if the Time-base Generator is not present . . . . . 0  
 DSGEN now requests the select code of the privileged-  
 interrupt card . . . . . *PRIV INT CARD CHNL?*  
 Operator responds with the channel (octal) of the privileged  
 interrupt fence if privileged interrupt is desired; otherwise,  
 type 0. . . . . 0
11. DSGEN requests the number of DMA channels in the  
 system . . . . . # *DMA CHANNELS?*  
 Operator responds with the number of DMA  
 channels available . . . . . 2
12. DSGEN requests the last word of available main memory  
 in octal . . . . . *LWA MEM?*  
 Operator responds . . . . . 27677
13. DSGEN asks whether SS directives are to be allowed in the  
 system . . . . . *ALLOW :SS?*  
 Operator responds either YES or NO . . . . . YES
14. DSGEN requests the type of primary input unit for relocatable  
 program modules . . . . . *PRGM INPT?*  
 Operator responds with PT (for paper tape), TY (for  
 teleprinter), DF (for disc file), or MT (for magnetic  
 tape; see *PREPARE TAPE SYSTEM (02116-91751)*) . . . . . DF

15. If the previous answer is DF, DSGEN requests the subchannel number of the disc containing the relocatable program modules . . . . . *INPUT DISC SUBCHNL?*

Operator responds with the appropriate subchannel number. The subchannel must contain a disc (prepared by a pre-existing DOS-III) whose user area contains only relocatable modules of DOS-III. By specifying PT to the next question (LIBR INPT?) the operator can include programs from the paper tape reader in addition to those on the disc file . . . . . 3

16. DSGEN requests the type of optional input unit for relocatable program modules . . . . . *LIBR INPT?*

Operator responds with PT, TY, DF, or MT . . . . . *PT*

*Note: Any type of relocatable program can be entered through the Program Input Unit or the Library Input Unit.*

17. DSGEN requests the type of input unit for the parameter input phase . . . . . *PRAM INPT?*

Operator responds with PT or TY . . . . . *TY*

When DSGEN finishes the initialization phase, the computer halts.

## Program Input Phase

During the program input phase, DSGEN accepts relocatable programs from the Program Input Unit and Library Input Unit specified during the initialization phase. The operator selects the input device by setting switch register bits 0-1 ( $00_2$  for the Program Input Unit, or  $10_2$  for the Library Input Unit), and places the programs in the input device. Main programs must be entered prior to their segments. DISCM should be the first module loaded.

The suggested order of module input is

DOS-III MAIN-MEMORY RESIDENT SYSTEM (DISCM)  
DOS-III I/O DRIVERS (DVR05, DVR01, DVR71, . . . ETC)  
DOS-III EXEC MODULES (\$EX01 . . .)  
EFMP EXEC MODULES (IF DESIRED-\$EX30 . . .)  
DOS-III JOB PROCESSOR/FILE MANAGER (JOBPR)  
DOS-III RELOCATING LOADER (LOADR)  
DOS-III ASSEMBLER (MAIN CONTROL, SEGMENTD, SEGMENT1, . . .)  
DOS-III FORTRAN (MAIN CONTROL, PASS1, . . .)  
DOS-III EFMP UTIL (IF \$EX30 . . . AND FORTRAN IV LIBRARY ARE INCLUDED)  
RTE/DOS ALGOL  
RTE/DOS FORTRAN IV LIBRARY OR RTE/DOS BASIC FORMATTER  
RTE/DOS RELOCATABLE PROGRAM LIBRARY (EAU OR FLOATING POINT) — See Note 1  
RTE/DOS FAST FORTRAN PROCESSOR (FFP) SUBROUTINE LIBRARY AND \$SETP  
SYSTEM SUBROUTINE — See Note 2

Any relocatable user programs to be made a permanent part of DOS-III

- Notes:*
- 1) *For systems based on an HP 21MX series processor only, the HP 21MX RTE/DOS DEBUG subroutine should be loaded immediately following the Relocatable Program Library (see “Special Considerations” under “DEBUG Library Subroutine” in Section V).*
  - 2) *When the FFP and \$SETP tapes are loaded, ERR08 and ERR05 will occur and messages will be printed on the console because the entry point names used by these subroutines replace the FORTRAN and library subroutine entry point names.*

Load the first input module and start the computer executing. When entering paper tape, the message “\*EOT” is output whenever an end-of-tape occurs. The computer halts. Program input can be switched back and forth between the input units by varying the switch register bits between  $00_2$  and  $10_2$  before starting the computer.

To terminate the program input phase, the operator must set switch register bits to  $01_2$ , and start the computer. If there are no undefined externals, this message is printed on the system console:

*NO UNDEF EXTS*

If there are undefined externals, the following message is output:

*UNDEF EXTS*

The externals are listed one per line and the computer halts. External references are satisfied by loading more programs. The operator must set switch register bits to  $00_2$  (for Program Input Unit) or  $10_2$  (for the Library Input Unit) and start the computer executing. If the externals are to be left unsatisfied, set the switch register bits to  $01_2$  and start the computer executing.

*Note: \$EX30 through \$EX33 (the EFMP EXEC modules) and \$EX36 and \$EX37 (user EXEC modules) are not listed when missing.*

### Parameter Input Phase

During the parameter input phase, the operator can change selected I/O drivers and EXEC modules from disc-memory to main-memory resident or vice versa. In addition, an optional parameter allows the operator to change the linking mode for each module. Either current page or base page linking can be selected.

The console driver must always be main-memory resident. Console drivers DVR00 and DVR05 are distributed as main-memory resident while terminal printer driver DVR26 is distributed as disc-resident. The console model to be used in the configured system determines which driver must be main-memory resident. Any unnecessary I/O drivers *must* be eliminated at this time. If the memory management capability is not desired, delete modules \$EX22 and \$\$MGT from the system by specifying them as type 8 (see below).

DVR31, DISCM, and \$EX30 are distributed as main-memory resident modules; they must not be changed to disc-resident.

Each parameter record has the form:

*name, type[, link mode]*

where *name* is the name of the program to be changed.

*type* is the program type code:

- 0 — System main-memory resident
- 1 — System disc-resident EXEC modules
- 3 — User disc resident main
- 4 — Disc resident I/O driver
- 5 — User segment
- 6,7 — Library
- >7 — Program is deleted from the system

*link mode* is the mode of linking to be performed:

- 0 — current page linking (default)
- non-zero — base page linking

When changing the linking mode, the program *type* must be specified. An error in either the *type* or *link mode* parameter results in an error message (ERR10).

The following modules are designed to execute with base page linking and must not be changed to current page linking mode:

Program	Module Name
HP ALGOL	ALGOL
HP Assembler	ASMB
HP FORTRAN	FTN
HP FORTRAN IV	.FTN4 (4K area) FTN4 (10K area)
HP DOS-III Job Processor	JOBPR

For programs changed to current page linking mode, the programs should be structured into subroutines of less than 2048 words (two pages of memory) in length. Current page links are generated only at the beginning and end of a program. They cannot be inserted into the program area because the boundary between program code and current page links might occur within a skip or jump sequence. If a program spans more than two pages, there is no area available for current page links in the middle pages, so base page links will be used; thus, the potential for greater efficiency is lost.

Parameter input is terminated by entering the slash character followed by the letter E (/E). This ends the parameter input phase.

EXEC modules and drivers that are often used may be changed from disc- to main-memory resident. The functions of the EXEC modules are

Module Name	Request Codes	Function
\$EX01	16	Disc work tracks status
\$EX02	17	Disc work tracks limits
\$EX03	6	Program completion
\$EX04	7	Program suspension and associated messages
\$EX05	8,10	Program main or segment search <i>(Note: \$EX05 calls \$EX10)</i>
\$EX06	18	User file name search
\$EX07	11	Current time processor
\$EX08	4 (RT)	Real-time disc allocation
\$EX09		:EQ processor
\$EX10	8,10	Load and execute main program or segment <i>(Note: see also \$EX05)</i>
\$EX11	14,15	System file name search <i>(Note: used for file read/write)</i>
\$EX12		System startup

Module Name	Request Codes	Function
\$EX13		Error message processor
\$EX14		:UP, :DN, :LU processor
\$EX15		Abort and post-mortem dump
\$EX16		:GO parameter processor
\$EX17	23	:UD processor
\$EX18	1,2,3, 14,15	I/O initiation processor <i>(Note: See also \$EX11)</i>
\$EX19		:IN processor
\$EX20		Disc parity processor
\$EX21	32,33,34	Programmatic file control
\$EX22	35,36,38,41	Memory management
\$EX36	27	User written module
\$EX37	28	User written module

#### Functions of EFMP EXEC Modules

\$EX30	—	Always main-memory resident (common routines and values).
\$EX31	—	DEFINE, CREATE, DESTROY, OPEN, CLOSE
\$EX32	—	READ, WRITE, RESET, STATUS, CHANGE
\$EX33	—	COPY, REPACK

When changing program types, it is not necessary to explicitly specify all subroutines called by an EXEC module which is made main-memory resident. The generator automatically makes the proper linkages. In addition to making the subroutine main memory resident, the generator places it in the system library, thus making it available to user programs.

## Disc Loading Phase

1. DSGEN asks for the number of base page links . . . . . # LINKS?

The operator responds with the decimal number of links. If the operator responds with a blank character, DSGEN allocates the maximum number of links (800) . . . . . 540

Loading of the absolute, resident supervisor begins after the establishment of the user and system linkage areas. As each program is loaded, DSGEN prints a memory map giving the starting and ending locations of both main memory and base page portions of the program. In addition, if bit 15 is set (ON), the entry points for main programs and subroutines are printed. (Subroutines are indented two spaces, and entry point addresses are preceded by an asterisk.)

2. DSGEN requests memory management subsystem names . . ENTER SUBSYSTEM NAMES

The operator responds with a series of one line entries which specify the subsystem name (1-4 characters) of each subsystem that utilizes memory management (see :MMGT directive). Terminate the input list with the characters "/E" . . . . . SUB3  
SUB7  
/E

*Note: Next, DSGEN generates the three I/O tables; equipment table, device reference table (logical unit table) and the interrupt table.*

3. DSGEN requests the equipment table entries . . . . \* EQUIPMENT TABLE ENTRY

Operator responds with a series of one-line EQT entries, which are assigned EQT numbers sequentially from one as they are entered. The EQT entry relates the EQT number to an I/O channel and driver, in this format . . . . . nn,DVRnn[,D] [,u]

where *nn* is the octal channel number (lower number if multi-board, maximum is 37<sub>8</sub>)

*DVRnn* is the driver name (*nn* is the equipment type code)

*D*, if present, means DMA channel required

*u* is the physical subchannel (unit) number (valid responses; 0-31)

Operator terminates the equipment table entries by typing . . . . . /E

Here is a sample Equipment Table:

\* EQUIPMENT TABLE ENTRY  
10,DVR31,D (EQT entry #1 = disc)  
12,DVR23,D (EQT entry #2 = magnetic tape)  
14,DVR05 (EQT entry #3 = system console)  
15,DVR01 (EQT entry #4 = photoreader)  
16,DVR02 (EQT entry #5 = tape punch)  
17,DVR12 (EQT entry #6 = line printer)  
/E (End of table)

Here is a sample Device Reference Table:

<b>* DEVICE REFERENCE TABLE</b>	
1	= EQT #? <i>(System console on channel 14, EQT #3)</i>
3	
2	= EQT #? <i>(Disc on channel 10, EQT #1)</i>
1	
3	= EQT #? <i>(Disc on channel 10, EQT #1—reserved for system use)</i>
1	
4	= EQT #? <i>(Standard punch unit on channel 16, EQT #5)</i>
5	
5	= EQT #? <i>(Standard input unit on channel 15, EQT #4)</i>
4	
6	= EQT #? <i>(Standard list unit on channel 17, EQT #6)</i>
6	
7	= EQT #? <i>(Standard unit definable by user)</i>
2	
8	= EQT #? <i>(End of table)</i>
/E	

**Note:** The number of responses given here determines the number of logical units allowed in the system. To allow unassigned logical units for the user, respond with a 0 to as many questions as units are desired.

5. DSGEN requests the interrupt table entries . . . . . \* **INTERRUPT TABLE**

Operator responds with an entry for each I/O channel which may interrupt, in ascending order and in the format . . . . .  $n_1, option$

where  $n_1$  is the octal channel number (high number if multi-board) between  $10_8$  and  $37_8$  inclusive (must be entered in ascending order)

*option* directs the system in handling the interrupt:

$\text{EQT},n_2$  relates the channel to EQT entry number  $n_2$ ,

**ABS**, *value* places an absolute octal value in the interrupt location. *value* is an octal integer.

`ENT,entry` transfers control to the entry point of a user-written system program upon interrupt (typically the `P.xx` entry of a privileged I/O driver).

If 2883B was specified as the disc type (see "Initialization Phase," step 3) and a second controller is added, the octal channel number of both controllers must be specified.

The operator terminates entry by typing . /E

Here is a sample Interrupt Table:

<b>*INTERRUPT TABLE</b>	
10,ENT,P.73	(Channel 10 linked to privileged interrupt routine P.73)
12,EQT,1	(Channel 12 linked to EQT #1)
13,ABS,102077	(Channel 13 interrupt location filled with an octal halt instruction)
14,EQT,4	(Channel 14 linked to EQT #4)
15,EQT,5	(Channel 15 linked to EQT #5)
16,ABS,0	(Channel 16 interrupt location filled with a NOP; all zeros)
/E	(End of table)

*Note: The EQT numbers need not appear in numerical order. This order is determined by referring back to the Equipment Table. The octal channel numbers, however, must be in ascending sequence.*

Following the completion of the I/O tables, DSGEN loads the disc-resident executive modules (if any), and the disc-resident I/O drivers (if any).

6. DSGEN reports the last octal address plus 1 of the system base page link area . . . . . LWA LINKS yyyy
7. DSGEN requests the first word base page octal address of the user link area . . . . . FWA USER LINKS?  
Operator responds with an octal address greater than or equal to yyyy and less than 2000<sub>8</sub> . . . . . mmmm
8. DSGEN reports the last octal address plus 1 of the main-memory resident system . . . . . LWA PROG xxxx
9. DSGEN requests the octal address of the first word of the user program area . . . . . FWA USER?  
Operator responds with an octal address greater than or equal to xxxx. (This option is provided so that user programs can start on a page boundary, if desired) . . . . . nnnn

*Note: Some system programs must be base page linked, i.e., the FORTRAN compiler. For this reason it is recommended that the User Area always be started on a page boundary. Since pages contain 2000<sub>8</sub> words, the octal number specified should be some multiple of 2000<sub>8</sub>.*

DSGEN proceeds to load all user main programs and segments onto the disc with memory map listings as described for system programs.

10. When system generation is complete, DSGEN reports . . . \* SYSTEM STORED ON DISC
11. Protect the disc (enable Disc Protect) to prevent access to the system portion of the disc.
12. The DOS-III system which has just been generated (in this case, on Subchannel 0) must be loaded into main memory. This is accomplished by using BMDL or the disc loader ROM. (See Section XI).

*Note: If a configured DOS-III system resides on a disc starting at head 0, track 0, simply press RUN. The system will execute and halt with 102077<sub>8</sub> in the Memory Data register. Then, set the switch register to the subchannel of the newly generated system (in this case, Subchannel 0), press PRESET (INTERNAL and EXTERNAL) and press RUN. The newly generated DOS-III system will be automatically loaded into memory.*

## Sample System Generation

```
SYS GEN CODE?  
0103  
  
SYS DISC CHNL?  
15  
  
DISC TYPE?  
7900  
  
SYS DISC SIZE?  
200  
  
# DRIVES?  
2  
  
FIRST SYSTEM TRACK?  
0  
FIRST SYSTEM SECTOR?  
3  
  
SYS DISC SUBCHNL?  
3  
  
USER DISC SUBCHNL?  
3  
  
TIME BASE GEN CHNL?  
14  
  
PRIV INT CARD CHNL?  
11  
  
# DMA CHANNELS?  
2  
  
LWA MEM?  
77677  
  
ALLOW :SS?  
YES  
  
PRGM INPT?  
DF  
INPUT DISC SUBCHNL?  
1  
  
LIBR INPT?  
PT
```

PRAM INPT?  
TY

\*EOT

NO UNDEF EXTS

ENTER PROG PARAMETERS

\$EX18,0  
/E

# LINKS?  
800

SYSTEM

NAME	PROG BOUNDS	BP BOUNDS
DISCM		
\$TIME	05231	00574
\$SETP	05362	00574
\$PFAL	05403	00574
(BOUNDS)	02000 05406	00337 00574

DVR31

(BOUNDS)	05406 06127	00574 00635
----------	-------------	-------------

F4D.C

(BOUNDS)	06127 06127	00635 00635
----------	-------------	-------------

F2F.B

(BOUNDS)	06127 06127	00635 00635
----------	-------------	-------------

DVR00

(BOUNDS) 06127 06600 00635 00637

DVR70

(BOUNDS) 06600 07022 00637 00642

\$EX18

(BOUNDS) 07022 07712 00642 00642

\$\$MGT

(BOUNDS) 07712 10523 00642 00667

ENTER SUBSYSTEM NAMES

/E

\* EQUIPMENT TABLE ENTRY

10, DVR70

12, DVR00

13, DVR01

15, DVR31, D

17, DVR12

20, DVR11, D

21, DVR23, D

23, DVR02

/E

\* DEVICE REFERENCE TABLE

```
1 = EQT #?
2
2 = EQT #?
4
3 = EQT #?
4
4 = EQT #?
8
5 = EQT #?
3
6 = EQT #?
5
7 = EQT #?
6
8 = EQT #?
7
9 = EQT #?
/E
```

\* INTERRUPT TABLE

```
10, ENT, P.70
12, EQT, 2
13, EQT, 3
16, EQT, 4
17, EQT, 5
20, EQT, 6
22, EQT, 7
23, EQT, 8
/E
```

EXEC SUPERVISOR MODULES

NAME	PROG BOUNDS	BP BOUNDS
\$EX21		
\$SRCH	11734	00670
(BOUNDS)	11034 12375	00667 00713

**\$EX01**  
\$ADDR 11121 00670  
(BOUNDS) 11034 11136 00667 00670

**\$EX02**  
\$ADDR 11124 00670  
(BOUNDS) 11034 11141 00667 00670

**\$EX03**  
(BOUNDS) 11034 11105 00667 00667

**\$EX04**  
ASCII 11426 00671  
(BOUNDS) 11034 11550 00667 00671

**\$EX05**  
\$SRCH 11117 00670  
(BOUNDS) 11034 11560 00667 00670

**\$EX06**  
\$SRCH 11136 00671  
\$ADDR 11577 00671  
(BOUNDS) 11034 11614 00667 00671

**\$EX07**  
\$ADDR 11221 00670  
(BOUNDS) 11034 11236 00667 00670

**\$EX08**  
\$ADDR 11207 00670  
(BOUNDS) 11034 11224 00667 00670

**\$EX09**  
ASCII      11433      00671  
(BOUNDS)  11034 11555      00667 00671

**\$EX10**  
(BOUNDS)  11034 11372      00667 00667

**\$EX11**  
\$SRCH      11057      00670  
(BOUNDS)  11034 11520      00667 00670

**\$EX12**  
(BOUNDS)  11034 11320      00667 00667

**\$EX13**  
ASCII      11411      00671  
(BOUNDS)  11034 11533      00667 00671

**\$EX14**  
ASCII      11557      00670  
(BOUNDS)  11034 11701      00667 00671

**\$EX15**  
ASCII      11403      00670  
(BOUNDS)  11034 11525      00667 00671

**\$EX16**  
(BOUNDS)  11034 11165      00667 00667

**\$EX17**  
\$LBL 11424 00672  
(BOUNDS) 11034 11532 00667 00674

**\$EX19**  
\$LBL 11427 00674  
(BOUNDS) 11034 11535 00667 00674

**\$EX20**  
(BOUNDS) 11034 11520 00667 00667

**\$EX22**  
(BOUNDS) 11034 13134 00667 00705

I/O DRIVER MODULES

NAME	PROG BOUNDS	BP BOUNDS
DVR01		
(BOUNDS)	13134 13525	00713 00715

DVR02		
(BOUNDS)	13134 13361	00713 00715

DVR11		
(BOUNDS)	13134 14053	00713 00724

DVR12		
(BOUNDS)	13134 13521	00713 00715

DVR23

(BOUNDS) 13134 13752 00713 00715

LWA LINKS 00724

FWA USER LINKS?  
724

LWA PROG 14053

FWA USER?  
16000

USER SYSTEM PROGRAMS

NAME	PROG BOUNDS	BP BOUNDS
------	-------------	-----------

LOADR

.EAU.	27501	01422
DUMRX	27551	01426

(BOUNDS) 16000 27631 00724 01426

ASMB

(BOUNDS) 16000 23131 00724 01303

ASMBD

(BOUNDS) 23131 23741 01303 01304

ASMB1

(BOUNDS) 23131 24553 01303 01347

ASMB2

(BOUNDS) 23131 24570 01303 01331

ASMB3

(BOUNDS) 23131 24002 01303 01307

ASMB4

(BOUNDS) 23131 24040 01303 01311

ASMB5

(BOUNDS) 23131 24445 01303 01326

XREF

• OPSY	21230	01013
DUMRX	21270	01015

(BOUNDS) 16000 21350 00724 01015

FTN4

(BOUNDS) 16000 31170 00724 01272

F4.0

(BOUNDS) 31170 37041 01272 01354

F4.1

(BOUNDS) 31170 34732 01272 01406

F4.2

(BOUNDS) 31170 36260 01272 01370

XDISC

•SWCH	20620	01041
FMTIO	20637	01041
INDEX	22070	01101
•PRAM	22246	01101
EXECX	22356	01101
INITX	22402	01101
FLIB	22441	01101
•FLUN	22544	01107
•XFER	22565	01107
DBLE	22631	01110
SNGL	22666	01112
FRMTR	22734	01113
•OPSY	25474	01360
•EAU.	25534	01360
DUMRX	25604	01361
•ZRLB	25664	01361
•XPAK	25725	01361
•ENTR	26122	01373
•PACK	26212	01374
•XCOM	26326	01374

(BOUNDS) 16000 26377 00724 01374

JOBPR

(BOUNDS) 16000 30422 00724 01401

\*SYSTEM STORED ON DISC

# **DSGEN DISC CARTRIDGE SYSTEM GENERATION**

Each HP 24307B DOS-III Disc Operating System with an HP 7900 Disc device included in the system hardware is delivered with a disc cartridge labeled DSGEN (HP part number 24307-13001). The DSGEN cartridge contains a DOS-III software system together with a set of modules with which to generate a DOS-III software system in the computer's memory.

Care must be taken to protect the contents of this disc from modification or destruction. The DSGEN cartridge can be copied to another disc and set aside. Modification can now be made to the copy without affecting the original disc.

If modules not included on the DSGEN cartridge are required, they must be loaded into the system from another type of input unit during the system generation procedure.

The I/O PCA boards must be arranged according to the select codes specified by the label on the DSGEN cartridge. For example:

## Select Codes

11 7900 DISC  
10 SYSTEM CONSOLE

The example indicates that the HP 7900 disc device resides in select codes 11 and 12, and the system console device resides in select code 10.

Initial generation steps differ for an HP 21MX computer (with an optional disc loader ROM installed) and an HP 2100A/S computer. For an HP 21MX not equipped with a disc loader ROM, use HP 2100A/S procedures.

## **HP 21MX**

1. Insert the DSGEN cartridge in the HP 7900 disc device. Press PRESET.
2. Select the S-register for display. Press CLEAR DISPLAY.
3. Set the select code of the disc in bits 11 through 6. Set bit 14 to select the disc loader ROM to be loaded.
4. Press STORE to store the contents of the Display Register in the S-register. Press IBL to load the contents of the disc loader ROM into the uppermost 64 locations of memory.

The computer halts with octal 102077 in the T-register. Press RUN and dialogue with the system begins. Go to step 5.

## **HP 2100A/S**

1. Load and configure the Stand-alone Paper Tape Bootstrap Loader to the system hardware.
2. Insert the DSGEN cartridge in the HP 7900 Disc device.
3. Load DOS-III from Subchannel 1 and initiate it using the Stand-alone Paper Tape Bootstrap Loader. Go to step 5.

Once DOS-III is initiated, a dialogue between the system and the operator begins on the system console. In the following example, information typed by the operator is underlined, and the information printed by the system is not underlined. These underlines will not appear on the terminal under actual operating conditions.

5. The DOS-III system begins the dialog by requesting the DATE directive:

INPUT :DATE,XXXXXXXXXX

<u>@:DATE,,</u>	DATE directive entered
<u>SUBCHAN=1</u>	
<u>LBL=DSGEN</u>	
<u>@</u>	
<u>:JOB</u>	JOB directive entered
<u>JOB</u>	
<u>@</u>	
<u>:UD,*,0</u>	Change user disc to Subchannel 0, no label
<u>@</u>	
<u>:IN,*</u>	Initialize user disc, no label
<u>@</u>	
<u>:UD,DSGEN,1</u>	Change user disc to Subchannel 1, label is DSGEN
<u>@</u>	
<u>:UD</u>	Verify correct subchannel and label
<u>SUBCHAN=1</u>	
<u>LBL=DSGEN</u>	
<u>@</u>	
<u>:DD</u>	Disc-to-disc dump of disc on Subchannel 1
<u>@</u>	
<u>:UD,*,0</u>	Destination disc for dump operation.

6. Wait for the system to respond with @ to indicate that the entire contents of Subchannel 1 have been copied to Subchannel 0.
7. Press HALT.
8. Remove the DSGEN cartridge from the HP 7900 Disc device.
9. Insert a disc cartridge to be used for subsequent DOS-III system generation.
10. Load DOS-III from Subchannel 0 and initiate it using the Stand-alone Paper Tape Bootstrap Loader.
11. System dialog begins:

INPUT :DATE,XXXXXXXXXX

<u>@:DATE,,</u>	DATE directive entered
<u>SUBCHAN=0</u>	
<u>LBL=DSGEN</u>	
<u>@</u>	
<u>:JOB</u>	JOB directive entered
<u>JOB</u>	,
<u>@</u>	
<u>:LIST,S,1,INDEX</u>	List user source file, INDEX on the console (the following list is an example)

0001 DOS III B (24307B) REV 1419  
 0002 THIS INDEX RELATES THE NAMES OF THE RELOCATABLE MODULES  
 0003 TO THE PART NUMBERS OF THE EQUIVALENT PAPER TAPES AND  
 0004 INDICATES THE PURPOSE OF THE MODULES IN THE SYSTEM.  
 0005 NAME PART NUMBER REV DESCRIPTION  
 0006 DISCM 24307-16002 1419 DISC MONITOR  
 0007 \$EXMD 24307-16003 1419 EXEC MODULES  
 0008 DVR00 20985-60001 1419 TTY-LIKE CONSOLE/TERMINAL  
 0009 DVR01 20987-60001 1419 PAPER TAPE READER  
 0010 DVR02 20989-60001 1419 PAPER TAPE PUNCH  
 0011 DVR05 24157-60001 1419 TTY-LIKE CONSOLE  
 0012 D2892 24272-60001 1419 2892B CARD READER (DVR11)  
 0013 D2767 24168-60001 1419 2767A LINE PRINTER (DVR12)  
 0014 D2610 24271-60001 1419 2610A/2614A LINE PRINTER (DVR12)  
 0015 D2607 24349-60001 1419 2607A LINE PRINTER (DVR12)  
 0016 DVR23 13024-60001 1419 7970B/E MAG TAPE  
 0017 DVR26 24333-60001 1419 2762A CONSOLE PRINTER  
 0018 DVR31 24156-60001 1419 7900/7901/2870 DISC  
 0019 DVR67 24341-16001 1419 12889A HS SERIAL IF  
 0020 DVR72 24350-16001 1419 12587B ASYNC DATA SET IF  
 0021 DVR73 24377-16001 1419 12920A/B MUX  
 0022 EFMP 24309-60002 1419 EXT FILE MGR EXEC MODULES  
 0023 24309-60003 1419 EXT FILE MGR UTILITIES  
 0024 JOBPR 24307-16004 1419 JOB PROCESSOR  
 0025 RLODR 24308-60001 1419 RELOCATING-LINKING LOADER  
 0026 ASMB 24158-60001 B ASSEMBLER  
 0027 24158-60002 B  
 0028 24158-60003 B  
 0029 24158-60004 B  
 0030 24158-60005 B  
 0031 24158-60006 B  
 0032 24158-60007 B  
 0033 .FTN4 24170-60001 C FORTRAN IV COMPILER  
 0034 24170-60002 C  
 0035 24170-60003 C  
 0036 FTN4 24177-60001 B FORTRAN IV COMPILER (10K AREA)  
 0037 24177-60002 B  
 0038 ALGOL 24129-60001 C ALGOL COMPILER  
 0039 24129-60002 C  
 0040 XREF 24223-60001 B CROSS REF TABLE GENERATOR  
 0041 F2E.N 24151-60001 D RELO SUBR (EAU) LIBR  
 0042 F2F.N 24248-60001 B RELO SUBR (FP ) LIBR  
 0043 F4D.N 24152-60001 C RELO SUBR (FTN4) LIBR  
 0044 FFP.N 12907-16001 A RELO SUBR (FFP) LIBR  
 0045 ATD01 24381-16001 1419 ASYNC TERMINAL DRIVER #1  
 0046 DVR33 24278-60001 1419 12908 WCS DRIVER  
 0047 MASMB 24332-60001 1419 12908 WCS MICRO ASSEMBLER  
 0048 WCSUT 24333-60001 A 12908 WCS I/O UTILITIES  
 0049 MDBUG 24334-60001 1419 12908 WCS DEBUG EDITOR

\*\*\*\* LIST END \*\*\*\*

@

At this point, use the list printed to select those modules which are to be included in the system to be generated. The PURGE directive is used to flag modules and drivers for deletion. Some guidelines for building a DOS-III system follow.

- a. These modules must be included in every system:

DISCM	Disc Monitor
\$EXMD	EXEC Modules
DVR01	Paper Tape Reader Driver
DVR00	
DVR05	Choose One, System Console Driver
DVR26	
DVR31	Disc Device Driver
JOBPR	Job Processor
EFMP	Include if EFMP or IMAGE is desired
F2E.N	Choose One, EAU
F2F.N	Floating-point Arithmetic

- b. These driver modules are required if the associated peripheral device is included in the system to be generated:

D2767	DVR12 — HP 2767 Line Printer Driver
D2610	DVR12 — HP 2610/2614 Line Printer Driver
D2607	DVR12 — HP 2607 Line Printer Driver
DVR23	HP 7970A/B/E Magnetic Tape Driver
DVR02	HP 2895/2753 Paper Tape Punch Driver
D2892	DVR11 — HP 2892 Card Reader Driver
DVR67	HP 12889A Interface Driver
DVR72	HP 12587B Interface Driver
DVR73	HP 12920A/B MUX Driver
DVR33	HP 12908A WCS Driver

- c. These modules are normally included during system generation, but may be run from the user area instead:

RLODR	Relocating/Linking Loader
ASMB	Assembler
ALGOL	ALGOL Compiler
FTN4	FORTRAN IV Compiler
F4D.N	FORTRAN IV Library — Required in addition to the library selected under point a above if FORTRAN IV or EFMP is included in the system to be generated.
FFP.N	FFP Library — Required if the FFP option is present (this module must appear in the directory <i>after</i> F4D.N).
XREF	Cross Reference Table Generator

- d. These modules should be included if WCS is present:

MASMB	HP 12908 WCS Micro-assembler
WCSUT	HP 12908 WCS I/O Utilities

e. These modules must be deleted from the cartridge on Subchannel 0 under specific conditions:

FFP.N	If FFP hardware is not present
F2F.N	If Floating Point hardware is not present
RDBUG	If HP 21MX is present

Any drivers not required by the system to be generated.

f. This module must be deleted from the cartridge on Subchannel 0:

INDEX  
MDBUG

In the dialog following, assume that a DOS-III system is to be generated which includes these modules:

DISCM  
\$EXMD  
DVR01  
DVR02  
DVR03  
D2767  
DVR23  
DVR31  
JOBPR  
RLODR  
ASMB  
FTN4  
XREF  
F2F.N  
F4D.N

The dialog continues from the @ symbol at the end of Step 11:

:PURGE,EFMP,DVR00,DVR26,F2E.N,D2892,D2610,D2607  
EFMP  
DVR00  
DVR26  
F2E.N  
D2892  
D2610  
D2607  
@

```

:PURGE,DVR67,DVR72,DVR73,ALGOL,FFP.N,ATD01,DVR33
DVR67
DVR72
DVR73
ALGOL
FFP.N
ATD01
DVR33
@
:PURGE,.FTN4,MASMB,WCSUT,MDBUG
.FTN4
MASMB
WCSUT
MDBUG
@
:PURGE,INDEX
INDEX
@
:LIST,U,1           List the user directory on the console
NAME TYPE   SCTR S DISC ORG   PROG LIMITS   B.P. LIMITS   ENTRY FWAM   PB
SUBCHAN=Ø
DISCM RB    ØØØØØ   TØØØ ØØØ
$EXMD RB    ØØØØØ   TØØØ ØØØ
DVRØ1 RB    ØØØØØ   TØØØ ØØØ
DVRØ2 RB    ØØØØØ   TØØØ ØØØ
DVRØ5 RB    ØØØØØ   TØØØ ØØØ
D2767 RB    ØØØØØ   TØØØ ØØØ
DVR23 RB    ØØØØØ   TØØØ ØØØ
DVR31 RB    ØØØØØ   TØØØ ØØØ
JOBPR RB    ØØØØØ   TØØØ ØØØ
RLODR RB    ØØØØØ   TØØØ ØØØ
ASMB RB     ØØØØØ   TØØØ ØØØ
FTN4 RB     ØØØØØ   TØØØ ØØØ
XREF RB    ØØØØØ   TØØØ ØØØ
F2F.N RB    ØØØØØ   TØØØ ØØØ
F4D.N RB    ØØØØØ   TØØØ ØØØ
@
:EJOB          Terminate current job
END JOB
@

```

The modules residing on Subchannel 0 are ready to be used for DOS-III system generation. Proceed as follows:

1. Load the DSGEN program from paper tape using the Stand-alone Paper Tape Bootstrap Loader or the paper tape loader ROM.
2. If the DSGEN program loaded is not configured, perform the procedure under “DSGEN Configuration” presented earlier in this section.

3. Use DSGEN to format the disc cartridge on Subchannel 1. When this step is completed, the computer will halt with  $102077_8$  in the Memory Data register.
4. Use DSGEN to generate a DOS-III system on Subchannel 1. Proceed as directed under “Using DSGEN to Generate DOS-III” in this section.

After DOS-III system generation is completed, modules to be run from the user area of disc memory can be retrieved from the master DSGEN cartridge. For example, if WCS is present in the system, the modules WDBUG and ATD01 may be loaded into the user area as follows:

1. Insert the master DSGEN disc cartridge in the HP 7900 Disc device.
2. Load DOS-III from Subchannel 0 and initiate it using the Stand-alone Paper Tape Bootstrap Loader or the disc loader ROM.
3. System dialog begins:

INPUT :DATE,XXXXXXXXXX	
<u>@:DATE,,</u>	DATE directive entered
<u>SUBCHAN=0</u>	
<u>LBL=DSGEN</u>	
<u>@</u>	
<u>:UD,DSGEN,1</u>	Change user disc to Subchannel 1, label is DSGEN
<u>@</u>	
<u>:DD,U,MDBUG,ATD01</u>	Disc-to-disc dump of specified files from user area
<u>@</u>	
<u>:UD,*,0</u>	Destination disc for dump operation
<u>@</u>	
<u>:LIST,U,1</u>	List user directory to verify that modules were copied

4. The system will print a list of the user directory on the console.

## Sample DSGEN Cartridge Preparation and System Generation

```
INPUT :DATE,XXXXXXXXXX
```

```
@ :DA,,  
SUBCHAN=1  
LBL=DSGEN  
@
```

```
:JOB  
JOB ,  
@  
:UD,*,@  
LBL=SYSTEM  
DISC GEN CODE 6500 NOT SYS GEN CODE 0529 ERR POSS  
RE-ENTER STATEMENT ON TTY.  
@
```

```
:UD,SYSTEM,@  
DISC GEN CODE 6500 NOT SYS GEN CODE 0529 ERR POSS  
@
```

```
:IN,*  
DOS LABEL SYSTEM  
OK TO PURGE?  
YES  
@
```

```
:UD,DSGEN,1  
@
```

```
:UD  
SUBCHAN=1  
LBL=DSGEN  
@
```

```
:DD  
@
```

```
:UD,*,@  
@
```

```
INPUT :DATE,XXXXXXXXXX
```

```
@ :DATE,,  
SUBCHAN=0  
LBL=DSGEN  
@
```

```
:JOB  
JOB ,  
@
```

:LIST,S,I,INDEX

0001 DOS III B (24307B) REV 1419  
0002 THIS INDEX RELATES THE NAMES OF THE RELOCATABLE MODULES  
0003 TO THE PART NUMBERS OF THE EQUIVALENT PAPER TAPES AND  
0004 INDICATES THE PURPOSE OF THE MODULES IN THE SYSTEM.  
0005 NAME PART NUMBER REV DESCRIPTION  
0006 DISCM 24307-16002 1419 DISC MONITOR.  
0007 \$EXMD 24307-16003 1419 EXEC MODULES  
0008 DVR00 20985-60001 1419 TTY-LIKE CONSOLE/TERMINAL  
0009 DVR01 20987-60001 1419 PAPER TAPE READER  
0010 DVR02 20989-60001 1419 PAPER TAPE PUNCH  
0011 DVR05 24157-60001 1419 TTY-LIKE CONSOLE  
0012 D2892 24272-60001 1419 2892B CARD READER (DVR11)  
0013 D2767 24168-60001 1419 2767A LINE PRINTER (DVR12)  
0014 D2610 24271-60001 1419 2610A/2614A LINE PRINTER (DVR12)  
0015 D2607 24349-60001 1419 2607A LINE PRINTER (DVR12)  
0016 DVR23 13024-60001 1419 7970B/E MAG TAPE  
0017 DVR26 24333-60001 1419 2762A CONSOLE PRINTER  
0018 DVR31 24156-60001 1419 7900/7901/2870 DISC  
0019 DVR67 24341-16001 1419 12889A HS SERIAL IF  
0020 DVR72 24350-16001 1419 12587B ASYNC DATA SET IF  
0021 DVR73 24377-16001 1419 12920A/B MUX  
0022 EFMP 24309-60002 1419 EXT FILE MGR EXEC MODULES  
0023 24309-60003 1419 EXT FILE MGR UTILITIES  
0024 JOBPR 24307-16004 1419 JOB PROCESSOR  
0025 RL0DR 24308-60001 1419 RELOCATING-LINKING LOADER  
0026 ASMB 24158-60001 B ASSEMBLER  
0027 24158-60002 B  
0028 24158-60003 B  
0029 24158-60004 B  
0030 24158-60005 B  
0031 24158-60006 B  
0032 24158-60007 B  
0033 .FTN4 24170-60001 C FORTRAN IV COMPILER  
0034 24170-60002 C  
0035 24170-60003 C  
0036 FTN4 24177-60001 B FORTRAN IV COMPILER (10K AREA)  
0037 24177-60002 B  
0038 ALGOL 24129-60001 C ALGOL COMPILER  
0039 24129-60002 C  
0040 XREF 24223-60001 B CROSS REF TABLE GENERATOR  
0041 F2E.N 24151-60001 D RELO SUBR (EAU) LIBR  
0042 F2F.N 24248-60001 B RELO SUBR (FP ) LIBR  
0043 F4D.N 24152-60001 C RELO SUBR (FTN4) LIBR  
0044 FFP.N 12907-16001 A RELO SUBR (FFP) LIBR  
0045 ATD01 24381-16001 1419 ASYNC TERMINAL DRIVER #1  
0046 DVR33 24278-60001 1419 12908 WCS DRIVER  
0047 MASMB 24332-60001 1419 12908 WCS MICRO ASSEMBLER  
0048 WCSUT 24333-60001 A 12908 WCS I/O UTILITIES  
0049 MDBUG 24334-60001 1419 12908 WCS DEBUG EDITOR  
\*\*\*\* LIST END \*\*\*\*

```

:PU,DVR00,DVR26,F2F.N,EFMP,D2767,D2610,D2892,DVR67,DVR73,DVR72
DVR00
DVR26
F2F.N
EFMP
D2767
D2610
D2892
DVR67
DVR73
DVR72
@
:PU,DVR33,.FTN4,ALGOL,FFP.N,ATD01,MASMB,WCSUT,MDBUG
DVR33
.FTN4
ALGOL
FFP.N
ATD01
MASMB
WCSUT
MDBUG
@
:PU, INDEX
INDEX
@
:LIST,U,1

```

NAME	TYPE	SCTRS	DISC	ORG	PROG LIMITS	B.P. LIMITS	ENTRY FWAM	PB
SUBCHAN=0								
DISCM	RB	00026	T007	000				
\$EXMD	RB	00108	T007	026				
DVR01	RB	00004	T009	043				
DVR02	RB	00003	T009	047				
DVR05	RB	00003	T010	002				
D2607	RB	00006	T010	021				
DVR23	RB	00006	T010	027				
DVR31	RB	00005	T010	037				
JOBPR	RB	00081	T015	000				
RLODR	RB	00059	T016	033				
ASMB	RB	00088	T017	044				
FTN4	RB	00177	T024	028				
XREF	RB	00023	T030	006				
F2E.N	RB	00119	T030	029				
F4D.N	RB	00148	T035	021				
@								
:EJOB								
END JOB								
@								

Preparation of the DSGEN cartridge is completed. Proceed as directed under "Using DSGEN to Generate DOS-III" in this section. Sample generation dialog follows:

```
SYS GEN CODE?  
4000  
  
SYS DISC CHNL?  
11  
  
DISC TYPE?  
7900  
  
SYS DISC SIZE?  
200  
  
# DRIVES?  
1  
  
FIRST SYSTEM TRACK?  
0  
FIRST SYSTEM SECTOR?  
3  
  
SYS DISC SUBCHNL?  
1  
  
USER DISC SUBCHNL?  
1  
  
TIME BASE GEN CHNL?  
17  
  
PRIV INT CARD CHNL?  
0  
  
# DMA CHANNELS?  
2
```

LWA MEM?

37677

ALLOW :SS?

YES

PRGM INPT?

DF

INPUT DISC SUBCHNL?

Ø

LIBR INPT?

PT

PRAM INPT?

TY

\*EOT

NO UNDEF EXTS

ENTER PROG PARAMETERS

\$EX18,0  
/E

# LINKS?

800

SYSTEM

NAME	PROG BOUNDS	BP BOUNDS
------	-------------	-----------

DISCM

\$TIME	05274	00603
\$SETP	05421	00603
\$PFAL	05442	00603

(BOUNDS)	02000 05445	00337 00603
----------	-------------	-------------

\$EX18

(BOUNDS)	05445 06341	00603 00631
----------	-------------	-------------

\$\$MGT

(BOUNDS) 06341 07152 00631 00647

DVR05

(BOUNDS) 07152 07421 00647 00651

DVR31

(BOUNDS) 07421 10145 00651 00713

F2E.D

(BOUNDS) 10145 10145 00713 00713

F4D.C

(BOUNDS) 10145 10145 00713 00713

ENTER SUBSYSTEM NAMES

/E

\* EQUIPMENT TABLE ENTRY

10,DVR00  
ERR 25  
10,DVR05  
11,DVR31,D  
13,DVR01  
14,DVR02  
15,DVR23,D,0  
15,DVR23,D,1  
20,DVR12  
/E

\* DEVICE REFERENCE TABLE

```
1 = EQT #?
1
2 = EQT #?
2
3 = EQT #?
2
4 = EQT #?
4
5 = EQT #?
3
6 = EQT #?
7
7 = EQT #?
0
8 = EQT #?
5
9 = EQT #?
6
10 = EQT #?
/E
```

\* INTERRUPT TABLE

```
10,EQT,1
12,EQT,2
13,EQT,3
14,EQT,4
16,EQT,5
20,EQT,7
/E
```

EXEC SUPERVISOR MODULES

NAME	PROG BOUNDS	BP BOUNDS
\$EX01		
\$ADDR	10520	00714
(BOUNDS)	10433 10535	00713 00714
\$EX02		
\$ADDR	10523	00714
(BOUNDS)	10433 10540	00713 00714

**\$EX03**

(BOUNDS) 10433 10504 00713 00713

**\$EX04**

ASCII 11025 00715

(BOUNDS) 10433 11147 00713 00715

**\$EX05**

\$SRCH 10516 00714

(BOUNDS) 10433 11157 00713 00714

**\$EX06**

\$SRCH 10535 00715

\$ADDR 11176 00715

(BOUNDS) 10433 11213 00713 00715

**\$EX07**

\$ADDR 10620 00714

(BOUNDS) 10433 10635 00713 00714

**\$EX08**

\$ADDR 10606 00714

(BOUNDS) 10433 10623 00713 00714

**\$EX09**

ASCII 11032 00715

(BOUNDS) 10433 11154 00713 00715

**\$EX10**

(BOUNDS) 10433 10771 00713 00713

**\$EX11**  
\$SRCH 10456 00714

(BOUNDS) 10433 11117 00713 00714

**\$EX12**

(BOUNDS) 10433 10717 00713 00713

**\$EX13**  
ASCII 11010 00715

(BOUNDS) 10433 11132 00713 00715

**\$EX14**  
ASCII 11156 00714

(BOUNDS) 10433 11300 00713 00715

**\$EX15**  
ASCII 11002 00714

(BOUNDS) 10433 11124 00713 00715

**\$EX16**

(BOUNDS) 10433 10564 00713 00713

**\$EX17**  
\$LBL 11023 00716

(BOUNDS) 10433 11131 00713 00720

**\$EX19**  
\$LBL 11026 00720

(BOUNDS) 10433 11134 00713 00720

**\$EX20**

(BOUNDS) 10433 11117 00713 00713

\$EX21  
\$SRCH 11472 00714  
(BOUNDS) 10433 12133 00713 00742

\$EX22  
(BOUNDS) 10433 12603 00713 00727

I/O DRIVER MODULES

NAME	PROG BOUNDS	BP BOUNDS
DVR01		
(BOUNDS)	12603 13174	00742 00744

DVR02		
(BOUNDS)	12603 13030	00742 00744

DVR12		
(BOUNDS)	12603 13374	00742 00744

DVR23		
(BOUNDS)	12603 13422	00742 00744

LWA LINKS 00744

FWA USER LINKS?  
744

LWA PROG 13422

FWA USER?  
14000

USER SYSTEM PROGRAMS

NAME	PROG BOUNDS	BP BOUNDS
JOBPR		
(BOUNDS)	14000 26613	00744 01412
LOADR		
.EAU.	25511	01446
DUMRX	25561	01452
(BOUNDS)	14000 25641	00744 01452
ASMB		
(BOUNDS)	14000 21131	00744 01323
ASMBD		
(BOUNDS)	21131 21741	01323 01324
ASMB1		
(BOUNDS)	21131 22553	01323 01367
ASMB2		
(BOUNDS)	21131 22570	01323 01351
ASMB3		
(BOUNDS)	21131 22002	01323 01327
ASMB4		
(BOUNDS)	21131 22040	01323 01331
ASMB5		
(BOUNDS)	21131 22445	01323 01346

**F TN4**

(BOUNDS) 14000 27170 00744 01312

**F 4.0**

(BOUNDS) 27170 35041 01312 01374

**F 4.1**

(BOUNDS) 27170 32732 01312 01426

**F 4.2**

(BOUNDS) 27170 34260 01312 01410

**XREF**

.OPSY	17241	01033
DUMRX	17301	01035

(BOUNDS) 14000 17361 00744 01035

\*SYSTEM STORED ON DISC

# ***SECTION XI***

## ***Loading DOS-III***

This section describes the loaders used to load a generated DOS-III system into main memory.

Loaders for an HP 21MX computer and an HP 2100A/S computer are essentially the same — the only apparent difference being how the loaders are supplied.

### ***HP 21MX LOADERS***

The HP 21MX processor is equipped with a paper tape loader ROM. The contents of this ROM are equivalent to the Basic Binary Loader portion of the BMDL used with HP 2100A/S computers. The ROM contents must be placed in memory before programs can be loaded from paper tape.

The HP 21MX processor can also be equipped with an optional disc loader ROM. This ROM performs the same functions as the BMDL used with HP 2100A/S computers. (If your HP 21MX does not have the disc loader ROM installed, follow steps for loading programs from disc using HP 2100A/S loaders.) The ROM contents must be placed in memory before programs can be loaded from a disc.

To load either of the ROM's into memory, perform the following at the operator panel:

- a. Press PRESET.
- b. Select the S-register for display in the Display Register.
- c. Press CLEAR DISPLAY to clear the contents of the Display Register.
- d. Bits 15 and 14 of the Display Register are used to select the loader ROM to be loaded. The paper tape loader ROM is automatically selected by the clear display operation. Set bit 14 to select the disc loader ROM.
- e. Change bits 11 through 6 of the Display Register to the octal select code of the disc or paper tape reader.
- f. Change bits 5 through 0 of the Display Register to contain the system disc subchannel number.

- g. Press STORE to store the contents of the Display Register in the S-register.
- h. Press IBL to load the contents of the selected loader ROM into the uppermost 64 locations in the first 32K of directly addressable memory. Press RUN.

The computer halts with octal 102077 in the T-register (indicating a successful load of the ROM).

- i. Place the tape or disc (containing the program to be loaded) into the input device and ready that device. Press RUN.

## **HP 2100A/S LOADERS**

To load a generated DOS-III system from the disc into main memory of an HP 2100A/S computer, execute either the BMDL or the Stand-alone Bootstrap Loader. The former resides in the uppermost 64 words of main memory and is hardware protected. The BMDL exists in two versions depending on the type of disc drive included in the system (HP 7900/7901, HP 2883/2884). Operation of these loaders is essentially the same. They consist of two parts: a Basic Binary Loader which loads absolute binary programs into main memory (from paper tape devices), and a disc loader which loads the configured DOS-III system from the disc into main memory.

The BMDL loads the system from any active subchannel, with one major requirement: whether that particular system is loaded or not, a configured DOS-III system must exist on the disc starting at head 0, drive 0 of the disc device. Head 0, drive 0 corresponds to Subchannel 0 on the HP 2883/2884 disc, or to Subchannel 1 on the HP 7900/7901 disc. The BMDL will read that system or any other configured DOS-III system on the disc as long as a configured system resides on head 0, drive 0.

To load a configured DOS-III system when no system exists on head 0, drive 0, the user must load the Stand-alone Bootstrap Loader into main memory (using the paper tape portion of the BMDL) and execute the Stand-alone Bootstrap Loader. This program loads the configured DOS-III system from the specified disc subchannel without the existence of a configured system on head 0, drive 0 of the disc.

## **USING THE BMDL TO LOAD ABSOLUTE BINARY PROGRAMS**

The BMDL loads absolute binary program tapes into main memory of an HP 2100A/S computer. The Loader resides in the last  $64_{10}$  words of main memory.

*Note: When using an HP 21MX computer, the paper tape loader ROM is used to load absolute binary program tapes into memory. Replace steps 2 through 6 (below) with the procedure (described earlier) for loading a paper tape ROM.*

### **Operating Instructions**

1. Halt the computer.
2. Place the tape to be loaded into the paper tape input device and ready that device.
3. Set the Loader starting address according to the memory size of the computer:

Memory Size	Starting Address (octal)
16K	037700
24K	057700
32K	077700

4. Clear the switch register.
5. Enable the Loader
6. Press both PRESET buttons.
7. Press RUN.
8. After all or part of the tape is read, the computer halts with  $1020xx_8$  displayed.

If  $xx = 11$ , a checksum error was detected. Check for torn tape or dust in the reader, check the tape for ragged edges or torn holes, then return to step 2.

If  $xx = 55$ , an address error was detected. A program being loaded attempted to enter a location reserved for the main-memory resident Loader, or a location not available in the computer. Check that an absolute binary tape was used, and that it was placed properly in the reader.

If  $xx = 77$ , the tape was loaded correctly.

## ***INITIATING DOS-III WITH THE BMDL***

When DOS-III has been generated on the disc (by DSGEN), it can be loaded into main memory and initiated by a main-memory resident program called the BMDL. This program resides permanently in the last  $64_{10}$  words of main memory and is hardware protected. Once DOS-III has been loaded and initiated, it is ready to process user tasks.

*Note: When using an HP 21MX computer with a disc loader ROM installed, steps 1 through 6 (below) are replaced by the ROM loading procedures described earlier.*

### **Operating Instructions**

1. Verify that a configured DOS-III system resides on head 0, drive 0 of the disc. (Head 0, drive 0 corresponds to subchannel 1 for the HP 7900/7901, or to subchannel 0 for the HP 2883/2884 disc.) If a configured system does not reside there, then use the Stand-alone Bootstrap Loader program (see *Initiating DOS-III with the Stand-alone Bootstrap Loader*, in this Section).
2. Set a starting address of  $0x7750$ , where  $x = 3$  for 16K;  $x = 5$  for 24K;  $x = 7$  for 32K.
3. Enable (unprotect) the main-memory resident Loader.
4. Press PRESET button(s) and start the computer executing.
5. The computer halts with  $102077_8$  displayed in the Display register. Protect the main-memory resident Loader (if necessary).
6. Set the disc subchannel number of the system to be loaded into the switch register (bits 5 through 0).
7. Start computer execution. The system is loaded into main memory and prints the following message:

*INPUT :DATE, XXXXXXXXXXXX (No Time-base Generator)  
or  
INPUT :DATE, XXXXXXXXXXXX,H,M (Time-base Generator)*

8. All other directives are ignored until a valid DATE directive is entered. Immediately following the DATE directive, the only valid directives are :TRACKS, :BATCH, :TYPE, and :JOB. All other directives are ignored until a JOB directive is entered.

## ***CONFIGURING THE DOS-III STAND-ALONE BOOTSTRAP LOADER***

Once DOS-III has been generated onto a disc, it may be initiated into operating status using the DOS-III Stand-alone Bootstrap. The Bootstrap, however, must be configured before being used.

### **Operating Instructions**

1. Turn on all equipment.
2. Load (using the BMDL or the paper tape loader ROM) and configure the SIO Punch or Teletypewriter Driver.
3. Load the Bootstrap using the BMDL or the paper tape loader ROM.
4. Set up the Bootstrap configuration starting address at location  $2_8$ .
5. Set switch register bits 5 through 0 equal to the octal channel number (select code) of the disc controller (low number, high priority channel).
6. Set switch register bit 15 on to punch a configured Bootstrap tape; off to configure the Bootstrap in main memory only.
7. Start the computer executing.
8. If bit 15 of the switch register is set, the Bootstrap punches out a configured copy of itself and halts. For another copy, simply start the computer executing again.

# **INITIATING DOS-III WITH THE STAND-ALONE BOOTSTRAP LOADER**

When DOS-III has been generated onto the disc, it can be loaded into main memory and initiated by using a small stand-alone program called the Stand-alone Bootstrap Loader. Once DOS-III has been loaded and initiated, it is ready to process user tasks.

*Note: The Stand-alone Bootstrap Loader need be used only if a configured DOS-III system does not reside on head 0, drive 0 of the disc. If a system resides on the disc in the above mentioned area, the BMDL can be used.*

## **Operating Instructions**

1. Turn on all equipment.
2. Configure a Stand-alone Bootstrap Loader (as previously described).
3. Load the configured Bootstrap into main memory using the BMDL or the paper tape loader ROM.
4. Set up the starting address of the Bootstrap at location  $100_8$ .
5. Set switch register bits 5 through 0 equal to the octal subchannel of the system disc. (If this subchannel differs from that established at system generation time, the new subchannel overrides the old.)
6. Set switch register bit 14 equal to one if the disc type is 2883 with two subchannels per drive; to zero if the disc type is 7900, 7901, or 2883 with four subchannels per drive.
7. Start the computer executing.
8. When DOS-III has been loaded into main memory, it prints the following message:

*INPUT :DATE,XXXXXXXXXX (No Time-base Generator)  
or  
INPUT :DATE, XXXXXXXXXX,H,M (Time-base Generator present)*

9. All other directives are ignored until a valid DATE directive is entered. Immediately following the DATE directive, the only valid directives are :TRACK, :BATCH, :TYPE, and :JOB. All others are ignored until one of these directives is entered.

## BMDL

The BMDL resides in the last  $64_{10}$  words of main memory (hardware protected by a button/switch on the computer front panel) and is responsible for loading main-memory resident modules from configured DOS-III systems residing on the disc into main memory. The BMDL also loads absolute binary programs into main memory through the paper tape input device. A separate version of the BMDL exists for each of two classes of disc, depending upon which disc type is used with the system (HP 7900/7901, or HP 2883/2884). Only one version can exist in main memory at any one time. The following two tables show the last  $64_{10}$  word addresses and their octal contents for each version of the BMDL.

*Note: When using the HP 7900/7901 BMDL with a newly-inserted 7900 or 7901 disc cartridge, it is necessary to execute the bootstrap twice. After executing the bootstrap the first time, the system loops; it must be halted and the bootstrap executed a second time. This procedure does not apply to the Stand-alone Bootstrap.*

Table 11-1. HP 7900/7901 BMDL

Address	Contents	Address	Contents	
x7700	002701	x7740	1023kk	Paper tape loader starting address = $x7700_8$ ; Moving-head
x7701	063722	x7741	027740	disc loader starting address =
x7702	002307	x7742	1064kk	$x7750_8$ (PRESET must be
x7703	102077	x7743	002041	pressed).
x7704	017735	x7744	127735	
x7705	007307	x7745	005767	
x7706	027702	x7746	027737	
x7707	077733	x7747	030000*	x = 3 for 16k, 4 for 20k,
x7710	017735	x7750	002400	5 for 24k, 6 for 28k,
x7711	017735	x7751	1026cc	7 for 32k
x7712	074000	x7752	1037cc	
x7713	077734	x7753	067747	
x7714	067734	x7754	1066dd	kk = tape input device
x7715	047777	x7755	1037dd	select code
x7716	002040	x7756	1066cc	
x7717	102055	x7757	063776	dd = low priority (higher
x7720	017735	x7760	102606	numbered) disc
x7721	040001	x7761	067732	select code
x7722	177734	x7762	106602	
x7723	037734	x7763	1037cc	cc = high priority (lower
x7724	000040	x7764	102702	numbered) disc
x7725	037733	x7765	106602	select code
x7726	027714	x7766	013741	
x7727	017735	x7767	1026dd	n = 4 for 16k, 3 for 20k,
x7730	054000	x7770	1037cc	2 for 24k, 1 for 28k,
x7731	027701	x7771	103706	0 for 32k
x7732	102011	x7772	1037dd	
x7733	000000	x7773	1023dd	
x7734	000000	x7774	027773	*The HP 7900/7901 BMDL can
x7735	000000	x7775	127717	be altered to boot a DOS-III sys-
x7736	006600	x7776	1200cc	tem from subchannel 0 instead
x7737	1037kk	x7777	1n0100	of subchannel 1 by changing the
				contents of address x7747 from
				$30000_8$ to $31000_8$ .

Table 11-2. HP 2883/2884 BMDL

Address	Contents	Address	Contents	
x7700	002701	x7740	1023kk	Paper tape loader starting address = $x7700_8$ ; Moving-head
x7701	063722	x7741	027740	disc loader starting address =
x7702	002307	x7742	1064kk	$x7750_8$ (PRESET must be
x7703	102077	x7743	002041	pressed).
x7704	017735	x7744	127735	
x7705	007307	x7745	005767	
x7706	027702	x7746	027737	
x7707	077733	x7747	177600	$x = 3$ for 16k, 4 for 20k,
x7710	017735	x7750	063775	5 for 24k, 6 for 28k,
x7711	017735	x7751	1026dd	7 for 32k
x7712	074000	x7752	1037dd	
x7713	077734	x7753	1023dd	
x7714	067734	x7754	027753	kk = tape input device
x7715	047777	x7755	067776	select code
x7716	002040	x7756	106606	
x7717	102055	x7757	067732	dd = low priority (higher
x7720	017735	x7760	106602	numbered) disc
x7721	040001	x7761	102702	select code
x7722	177734	x7762	067747	
x7723	037734	x7763	106602	cc = high priority (lower
x7724	000040	x7764	001000	numbered) disc
x7725	037733	x7765	1067dd	select code
x7726	027714	x7766	1026dd	
x7727	017735	x7767	1037cc	$n = 4$ for 16k, 3 for 20k,
x7730	054000	x7770	103706	2 for 24k, 1 for 28k,
x7731	027701	x7771	1037dd	0 for 32k
x7732	102011	x7772	1023dd	
x7733	000000	x7773	027772	
x7734	000000	x7774	127717	
x7735	000000	x7775	020000	
x7736	006600	x7776	1200cc	
x7737	1037kk	x7777	1n0100	

## **PART 4**

### ***DOS-III Systems Programming***



## ***SECTION XII***

### ***User-written EXEC Modules***

DOS-III is capable of accepting user-written EXEC modules. Up to two EXEC modules may be written; these must be loaded with all the DOS-III EXEC modules during DOS-III Generation. (See Section X, "Generating DOS-III" for details.)

This section presents the user-written EXEC call directives and calling sequences, along with a brief description of internal design and a sample EXEC module.

For example, DOS-III halts on power failure. The user may write a power fail recovery routine. Because of system requirements, the routine must be called \$PFAL.

## ***USER EXEC MODULES: DIRECTIVES***

### **Purpose**

To execute user EXEC modules.

### **Format**

<i>:EA[<i>p1</i>, . . . ,<i>p5</i>]</i>	(Calls EXEC module \$EX36)
<i>:EB[<i>p1</i>, . . . ,<i>p5</i>]</i>	(Calls EXEC module \$EX37)

where all parameters are non-negative decimal integers.

### **Comments**

Number and meaning of the parameters varies depending upon user definition of the EXEC module.

## ***USER EXEC MODULES: EXEC CALLS***

### **Purpose**

To execute either user-created EXEC module \$EX36 or \$EX37. The number of parameters in the EXEC call are defined by the user. The general format of the call is

### **Assembly Language**

```
EXT    EXEC
      .
      .
JSB    EXEC      (Transfer control to DOS-III)
DEF    *+2 (to 7) (Determine number of parameters—from 1 to 5)
DEF    RCODE     (Define request code)
DEF    PRAM1    (Define the first optional parameter)
      .
      .
DEF    PRAM5    (Define the fifth optional parameter)
      .
      .
RCODE   DEF  27 (or 28) (RCODE for $EX36 = 27; RCODE for $EX37 = 28)
PRAM1   ---      (Up to five words of parameter information)
      .
      .
PRAM5   ---
```

### **FORTRAN**

```
IRCDE = 27 (or 28)
CALL EXEC (IRCDE[,P1, . . . . . P5])
```

## **USER EXEC MODULES: INTERNAL DESIGN**

EXEC modules are typically type-1 Assembly-language routines which are incorporated at generation time as part of the operating system. As "system" modules, they execute with the interrupt system and memory protect off. They may directly access entry points and subroutines within the system, but must not issue any EXEC calls (EXEC processing is not re-entrant). Also, user-written EXEC modules should be defined as disc-resident supervisory modules; the NAM pseudo-instruction for these modules should indicate that the routine is a type-1 program.

Special programming considerations are required upon initiation and completion.

### **Initiation**

Upon entry, information used in processing the EXEC function can be found in the following base page locations.

<b>Location</b>	<b>Name</b>	<b>Definition</b>
224 <sub>8</sub>	RQCNT	# of parameters in the calling sequence
225 <sub>8</sub>	RQRTN	return address upon completion
226 <sub>8</sub>	RQP1	address of request code
227-233 <sub>8</sub>	RQP2-RQP6	address(es) of specified parameters

### **Completion**

Prior to returning to the system, the EXEC module must

1. release itself from the EXEC module overlay area if it is disc-resident. This code handles EXEC module release:

```
LDA EXMOD      (Get current module in overlay area)
CPA NUMB       (Is it this one?)
CMA,INA        (Yes—set value positive)
STA EXMOD      (No—leave value alone)
.
.
EXMOD          EQU 245B
NUMB           DEC -36 (or -37)
```

2. place the desired transfer address in XIRT (location  $137_8$ ) and jump to the label \$IRT (defined as an EXternal), for example,

```
EXT  $IRT
.
.
LDA  RQRTN    (Set the return address)
STA  XIRT
JMP  $IRT     (Transfer to system)
RQRTN EQU 225B
XIRT  EQU 137B
```

SAMPLE EXEC MODULE

PAGE 0001

0001 ASMB,L,C,X,N,R,B DISC WORK LIMITS MODULE (SEX02)  
\*\* NO ERRORS\*

PAGE 0002 #01

0001 ASMB,L,C,X,N,R,B DISC WORK LIMITS MODULE (SEX02)  
0002 00000 NAM SEX02,1  
0003 ENT SEX02  
0004 EXT SRQER,SADDR  
0005 EXT SIRT  
0006\* SEX02 ROUTINE PROVIDES THE USER WITH DISC WORK AREA TRACK  
0007\* ADDRESS LIMITS AND THE # OF SECTORS PER DISC TRACK.  
0008\*  
0009\* CALLING SEQUENCE:  
0010\*  
0011\* JSB EXEC  
0012\* DEF \*+5(OR 6)  
0013\* DEF RCODE RCODE = 17  
0014\* DEF FTRAK FTRAK = ADDR OF WORD TO STORE 1ST WORK TRK  
0015\* DEF LTRAK LTRAK = ADDR OF WORD TO STORE LAST WORK TRK  
0016\* DEF SIZE SIZE = # SECTOR/TRACK WORD ADDR.  
0017\* DEF DISC(OPTIONAL) DISC = 0 FOR SYSTEM DISC, NON-0 FOR US  
0018\* DEFAULT IS SYSTEM.  
0019\*  
0020 00000 060224 SEX02 LDA RQCNT CHECK PARAMETER COUNT  
0021 00001 050057 CPA ..+4 4 PARAMETERS?  
0022 00002 026010R JMP CHK YES, OK.  
0023 00003 050060 CPA ..+5 5 PARAMETERS?  
0024 00004 002001 RSS YES, OK  
0025 00005 026065R JMP RQER TOO FEW OR TOO MANY PARAMETERS.  
0026 00006 060232 LDA RQP5 CHECK ADDR OF 5TH PARAM  
0027 00007 016002X JSB SADDR  
0028 00010 060227 CHK LDA RQP2  
0029 00011 016002X JSB SADDR PARAMETERS  
0030 00012 060230 LDA RQP3  
0031 00013 016002X JSB SADDR  
0032 00014 060231 LDA RQP4  
0033 00015 016002X JSB SADDR  
0034 00016 064224 LDB RQCNT  
0035 00017 054057 CPB ..+4 DEFAULT AS SYSTEM DISC?  
0036 00020 026024R JMP SYS YES.  
0037 00021 160232 LDA RQP5,I NO, CHECK 5TH PARAM  
0038 00022 002002 SZA 0 MEANS SYSTEM DISC  
0039 00023 026057R JMP USER  
0040 00024 060160 SYS LDA SYNTS GET START OF WORK AREA TRACK  
0041 00025 040074 ADA .377  
0042 00026 001727 ALF,ALF  
0043 00027 010074 AND .377  
0044 00030 170227 STA RQP2,I  
0045 00031 060102 LDA JBINC  
0046 00032 002003 SZA,RSS  
0047 00033 026043R JMP EX010  
0048 00034 010074 AND .377  
0049 00035 070001 STA B  
0050 00036 020102 XOR JBINC  
0051 00037 001727 ALF,ALF  
0052 00040 010074 AND .377

PAGE 0003 #01

0053	00041	040052	ADA N1	
0054	00042	026045R	JMP EX020	
0055	00043	060154	EX010 LDA DISCO	STORE END OF WORK AREA TRACK #
0056	00044	010074	AND .377	
0057	00045	170230	EX020 STA RQP3,I	
0058	00046	060116	LDA SECTR	STORE # OF SECTORS PER TRACK
0059	00047	170231	STA RQP4,I	
0060	00050	060245	LDA EXMOD	
0061	00051	050051	CPA ..-2	
0062	00052	003004	CMA,INA	
0063	00053	070245	STA EXMOD	
0064	00054	060225	LDA RQRTN	
0065	00055	070137	STA XIRT	
0066	00056	026003X	JMP SIRT	
0067	00057	060157	USER LDA UDNTS	
0068	00060	040074	ADA .377	
0069	00061	001727	ALF,ALF	
0070	00062	010074	AND .377	
0071	00063	170227	STA RQP2,I	
0072	00064	026043R	JMP EX010	
0073	00065	002400	RQER CLA	FREE MODULE AREA
0074	00066	070245	STA EXMOD	
0075	00067	026001X	JMP SRQER	
0076*				
0077	00000		A EQU 0	
0078	00001		B EQU 1	
0079	00053		. EQU 53B	
0080	00052		N1 EQU ..-1	
0081	00074		.377 EQU ..+17	
0082	00100		. EQU 100B	
0083	00102		JBINC EQU ..+2	
0084	00116		SECTR EQU ..+14	
0085	00126		RONBF EQU ..+26B	
0086	00137		XIRT EQU RONBF+9	
0087	00154		DISCO EQU ..+44	
0088	00157		UDNTS EQU ..+47	
0089	00160		SYNTS EQU ..+48	
0090	00224		RQCNT EQU ..+84	
0091	00225		RQRTN EQU ..+85	
0092	00227		RQP2 EQU ..+87	
0093	00230		RQP3 EQU ..+88	
0094	00231		RQP4 EQU ..+89	
0095	00232		RQP5 EQU ..+90	
0096	00245		EXMOD EQU ..+101	
0097			END	

\*\* NO ERRORS\*

<b>SEX02</b>	<b>CROSS-REFERENCE SYMBOL TABLE</b>				<b>PAGE 0001</b>		
<b>SADDR</b> 00004	00027	00029	00031	00033			
<b>SEX02</b> 00020	00003						
<b>SIRT</b> 00005	00066						
<b>SRQER</b> 00004	00075						
.	00082	00083	00084	00085	00087	00088	00089
	00090	00091	00092	00093	00094	00095	00096
..	00079	00021	00023	00035	00061	00080	00081
.377	00081	00041	00043	00048	00052	00056	00068
00070							
<b>PA</b>	00077						
<b>B</b>	00078	00049					
<b>CHK</b>	00028	00022					
<b>DISCO</b>	00087	00055					
<b>EX010</b>	00055	00047	00072				
<b>EX020</b>	00057	00054					
<b>EXMOD</b>	00096	00060	00063	00074			
<b>JBINC</b>	00083	00045	00050				
<b>N1</b>	00080	00053					
<b>RONBF</b>	00085	00086					
<b>RQCNT</b>	00090	00020	00034				
<b>RQER</b>	00073	00025					
<b>RQP2</b>	00092	00028	00044	00071			
<b>RQP3</b>	00093	00030	00057				
<b>RQP4</b>	00094	00032	00059				
<b>RQP5</b>	00095	00026	00037				
<b>RQRTN</b>	00091	00064					
<b>SECTR</b>	00084	00058					
<b>SYNTS</b>	00089	00040					
<b>SYS</b>	00040	00036					

**SEX02**

**CROSS-REFERENCE SYMBOL TABLE**

**PAGE 0002**

**UDNTS 00088 00067**

**USER 00067 00039**

**XIRT 00086 00065**

# ***SECTION XIII***

## ***Planning I/O Drivers***

### **STANDARD I/O DRIVERS**

*Note: Before attempting to program an I/O driver, the programmer should be thoroughly familiar with Hewlett-Packard computer hardware I/O organization, interface kits, computer I/O instructions, and Direct Memory Access (DMA).*

An I/O driver, operating under control of the Input/Output Control (\$EX18) and Central Interrupt Control (\$CIC) modules of DOS-III, is responsible for all data transfer between an I/O device and the computer. During its execution, the driver may refer to the base page communication area for information from the system: the device equipment table (EQT) entry, which contains the parameters of the transfer, and the current DMA value (CHAN), which contains the number of the allocated DMA channel (if required).

An I/O driver includes two relocatable, closed subroutines: the Initiation Section and the Completion Section. If *nn* is the octal equipment type code of the device, *I.nn* and *C.nn* are the entry point names of the two sections and *DVRnn* is the driver name.

#### **Initiation Section**

The I/O control module (\$EX18) calls the initiation section directly when an I/O transfer is initiated. Locations EQT1 through EQT17 of the base page communication area contain the addresses of the appropriate EQT entry. CHAN in the base page contains the number of the DMA channel assigned to the device, if needed. This section is entered by a jump subroutine (JSB) to the entry point *I.nn*. On entry, the A register contains the select code (channel number) of the device (bits 0 through 5 of EQT entry word 3). The driver returns to \$EX18 by an indirect jump through *I.nn*.

Before transferring to *I.nn*, DOS-III places the request parameters from the user program's EXEC call into words 7 through 13 of the EQT entry. Word 9, CONWD, is modified to contain the request code in bits 0 through 5 in place of the logical unit. (See Figure A-4 and Section III, I/O READ/WRITE EXEC Call (RCODE = 1 or 2), for details of the parameters.)

Once initiated, the drive can use words 5, 6, and 11 through 14 of the EQT entry in any way, but words 1, 2, 3, 7, 8, 9, 10, 15, 16, and 17 must not be altered. The driver updates the status field in word 4, if appropriate, but the rest of word 4 must not be altered.

**FUNCTIONS OF THE INITIATION SECTION:** The initiation section is responsible for these functions (as flowcharted in Figure 13-1):

1. Rejects the request and proceeds to step 5 if:
  - the device is inoperable, or
  - the request code, or other of the parameters, is illegal.

*Note: All drivers must accept a clear request. (Request code = 3, function code = 0.)*

2. Configures all I/O instructions in the driver to include the select code of the device (or DMA channel). (Does not apply to DVR05 and 7900/7901 DVR31.)
3. Initializes DMA, if appropriate.

*Note: The initiation section must save the DMA channel number (found in CHAN) in the EQT entry, since it is not set on entry to the continuation section.*

4. Initializes software flags and activates the device. All variable information pertinent to the transmission must be saved in the EQT entry because the driver may be called for another device before the first operation is complete.
5. Returns to \$EX18 with the A register set to indicate initiation or rejection and the cause of the reject:

If A = 0, then the operation was initiated.

If A ≠ 0, then the operation was rejected with A set as:

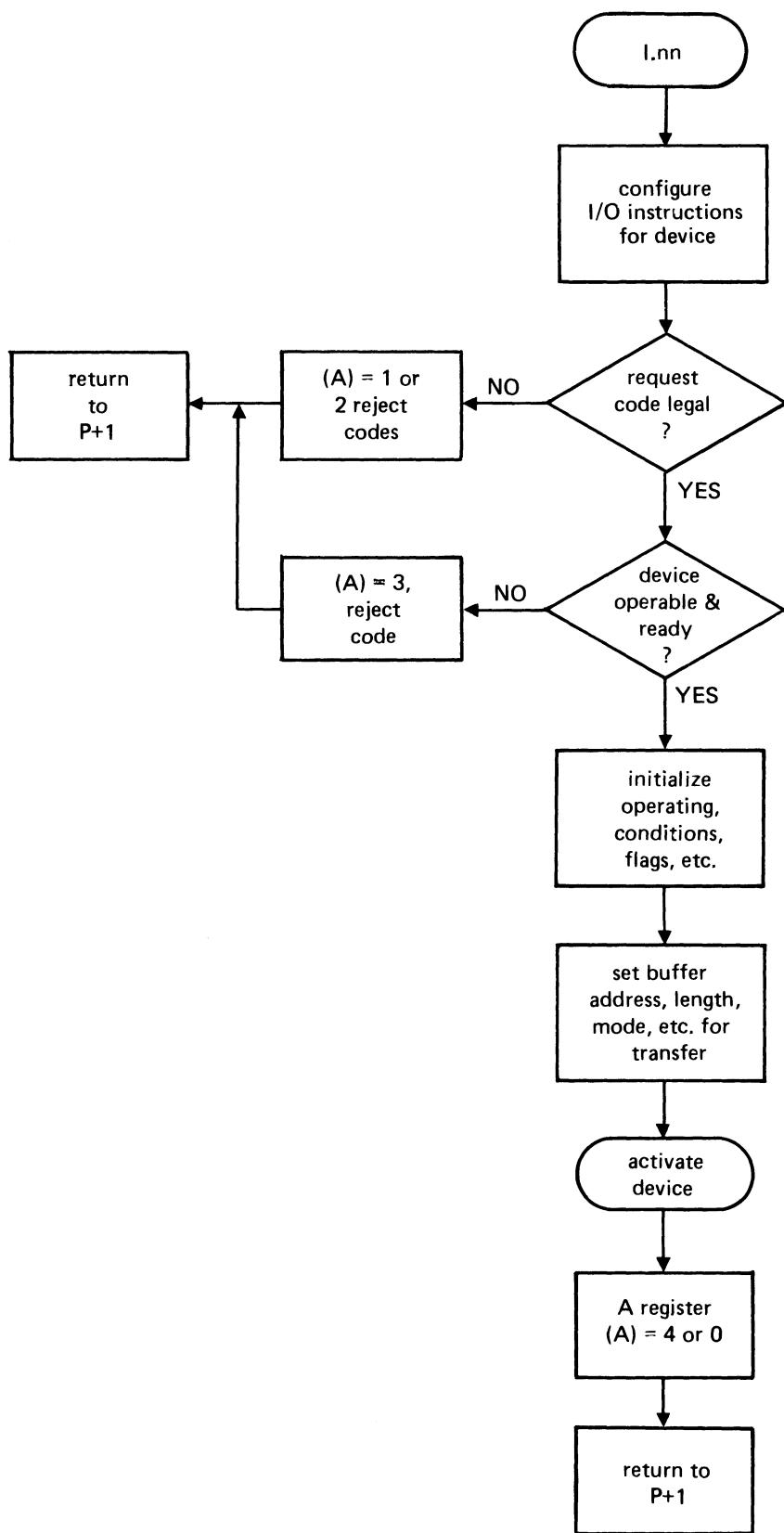
1 = read or write illegal for device

2 = control request illegal or undefined

3 = equipment malfunction or not ready

4 = immediate completion (for control requests)

6 = driver cannot handle a control request; the system is instructed to wait



**Figure 13-1. I/O Driver Initiation Section**

## Completion Section

DOS-III calls the completion section of the driver whenever an interrupt is recognized on a device associated with the driver. Before calling the driver, \$CIC sets the EQT entry addresses in base page, sets the interrupt source code (select code) in the A register, and clears the I/O interface or DMA flag. The calling sequence for the completion section is

Location	Action
	Set A register equal to interrupt source code
P	JSB C.nn
P+1	Completion return from C.nn
P+2	Continuation return from C.nn

The point of return from C.nn to \$CIC indicates whether the transfer is continuing or has been completed (in which case, end-of-operation status is returned also).

**FUNCTIONS OF THE COMPLETION SECTION:** The completion section of the driver is responsible for the functions below (as flowcharted in Figure 13-2):

1. The driver configures all I/O instructions in the completion section to reference the interrupting device.
2. If both DMA and device completion interrupts are expected and the device interrupt is significant, the DMA interrupt is ignored by returning to \$CIC in a continuation return.
3. Performs the input or output of the next data item if the device is driven under program control. If the transfer is not completed, the driver proceeds to step 6.
4. If the driver detects a transmission error, it can re-initiate the transfer and attempt a retransmission. A counter for the number of retry attempts can be kept in the Equipment Table. The return to \$CIC must be (P+2) as in step 6.
5. At the end of a successful transfer or after completing the retry procedure, the following information must be set before returning to \$CIC at (P+1):
  - a. Set the actual or simulated device status into bits 0 through 7 of EQT word 4.
  - b. Set the number of transmitted words or characters (depending on which the user requested) in the B register.
  - c. Set the A register to indicate successful or unsuccessful completion.
    - 0 = successful completion
    - 1 = device malfunction or not ready
    - 2 = end-of-tape (information)
    - 3 = transmission parity error

6. Clear the device and DMA control on end-of-operation, or set the device and DMA for the next transfer or retry. Return to \$CIC at

(P+1) completion, with the A and B registers set as in step 5

(P+2) continuation; the registers are not significant.

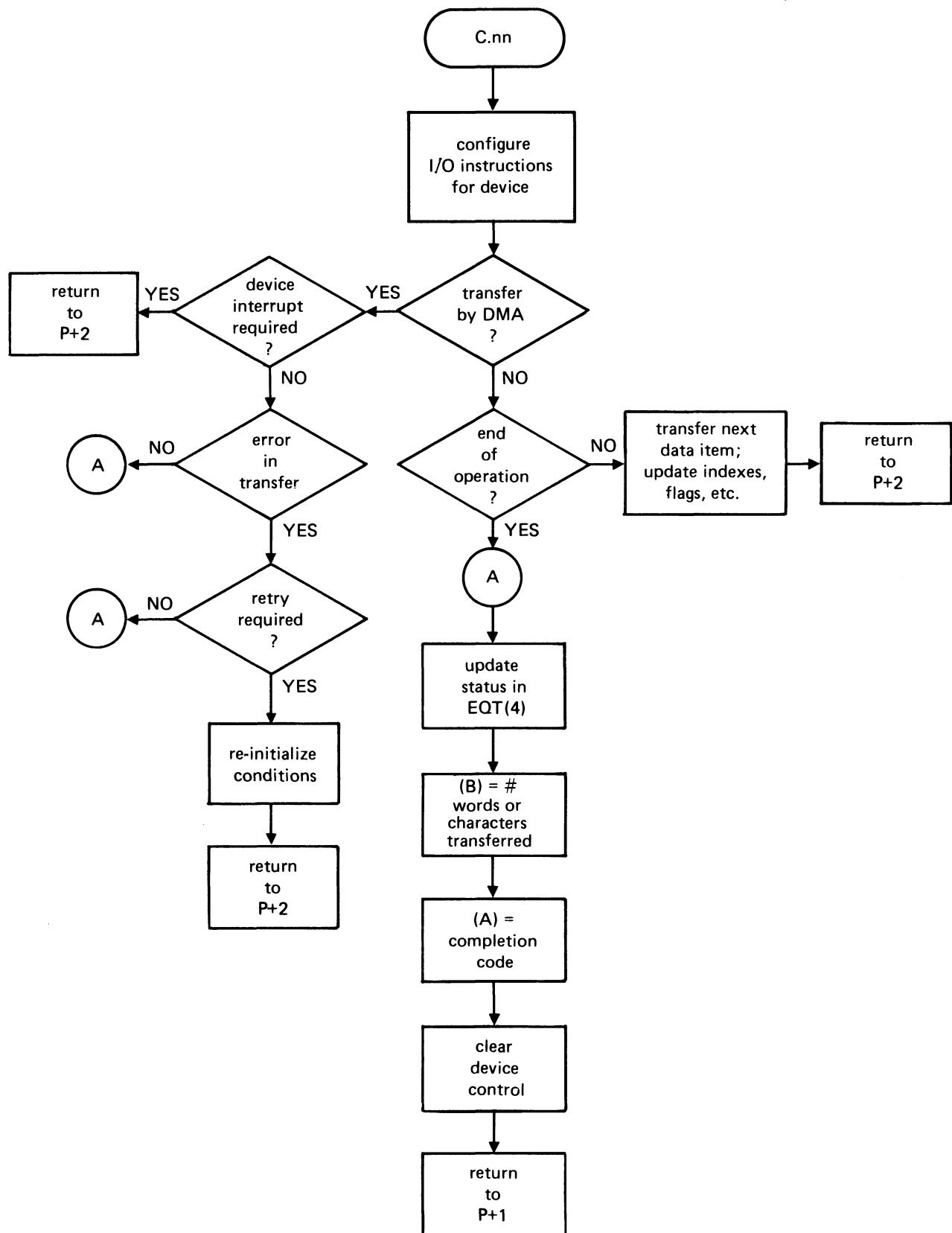


Figure 13-2. I/O Driver Completion Section

## **SAMPLE I/O DRIVER**

The following pages provide an assembly listing and cross-reference symbol table for a sample I/O driver.

PAGE 0001

0001 ASMB,R,B,L,C  
\*\* NO ERRORS\*

0001 ASMB,R,B,L,C  
0003 00000 NAM DVR02,4  
0004\*  
0005\*\*\*\*\* VERSION 8/24/72  
0006\*  
0007\*  
0008 ENT I.02,C.02  
0009\*  
0010\*\*\*\*\* PROGRAM DESCRIPTION \*\*\*\*\*  
0011\*  
0012\* DRIVER 02 OPERATES UNDER THE CONTROL OF THE  
0013\* I/O CONTROL MODULE OF THE D.O.S. EXECUTIVE  
0014\* THIS DRIVER IS RESPONSIBLE FOR CONTROLLING  
0015\* OUTPUT DATA TRANSMISSION WITH A 2753A TAPE PUNCH.  
0016\* <02> IS THE EQUIPMENT TYPE CODE ASSIGNED TO THIS  
0017\* TYPE OF DEVICE. I.02 IS THE ENTRY POINT FOR THE  
0018\* \*INITIATION\* SECTION AND C.02 FOR THE \*COMPLETION\*  
0019\* SECTION.  
0020\*  
0021\* - THE INITIATION SECTION IS CALLED FROM I/O  
0022\* CONTROL TO INITIALIZE A DEVICE AND INITIATE  
0023\* AN OUTPUT OR CONTROL OPERATION.  
0024\*  
0025\* CALLING SEQUENCE:  
0026\*  
0027\* - ADDRESSES OF DEVICE EQT ENTRY  
0028\* SET IN "EQT1-EQT17" -  
0029\*  
0030\* (A) = I/O ADDRESS OF DEVICE  
0031\*  
0032\* (P) JSB I.02  
0033\* (P+1) - RETURN -  
0034\*  
0035\* (A) = 0, OPERATION INITIATED, OR  
0036\* (A) = REJECT CODE:  
0037\*  
0038\* 1, ILLEGAL READ REQUEST  
0039\* 2, ILLEGAL CONTROL FUNCTION  
0040\*  
0041\*  
0042\* - THE COMPLETION SECTION IS CALLED BY CENTRAL  
0043\* INTERRUPT CONTROL TO CONTINUE OR COMPLETE  
0044\* AN OPERATION.  
0045\*  
0046\* CALLING SEQUENCE:  
0047\*  
0048\* - ADDRESSES OF DEVICE EQT ENTRY  
0049\* SET IN "EQT1-EQT17" -  
0050\*  
0051\* (A) = I/O ADDRESS OF DEVICE  
0052\*  
0053\* (P) JSB C.02  
0054\* (P+1) -- COMPLETION RETURN --  
0055\* (P+2) -- CONTINUATION RETURN --  
0056\*  
0057\* - COMPLETION RETURN:

PAGE 0003 #01 \*\* D.O.S. DRIVER <02> PAPER TAPE PUNCH \*\*

0058\* (A) = 0, SUCCESSFUL COMPLETION WITH  
0059\* (B) = # WORDS OR CHARACTERS  
0060\* TRANSFERRED.  
0061\* (A) = 2 IF \*TAPE-SUPPLY-LOW\* CONDITION  
0062\* DETECTED AFTER RECORD IS  
0063\* FINISHED.  
0064\* (B), SAME AS FOR (A) = 0  
0065\*  
0066\* - CONTINUATION RETURN: REGISTERS  
0067\* MEANINGLESS  
0068\*  
0069\*  
0070\* - RECORD FORMATS:  
0071\*  
0072\* ASCII: A STRING OF CHARACTERS, THE NUMBER  
0073\* ----- DESIGNATED BY THE BUFFER LENGTH IN  
0074\* THE REQUEST, TERMINATED BY A RETURN  
0075\* AND LINE-FEED (SUPPLIED BY THE DRIVER).  
0076\*  
0077\* SPECIAL CHARACTER PROCESSING:  
0078\*  
0079\* LEFT-ARROW: IF A LEFT-ARROW IS THE LAST  
0080\* CHARACTER IN THE USER BUFFER,  
0081\* THE RETURN/LINE-FEED AND LEFT  
0082\* ARROW CODES ARE NOT OUTPUT.  
0083\*  
0084\* A ZERO BUFFER LENGTH CAUSES ONLY A RETURN/  
0085\* LINE-FEED TO BE OUTPUT.  
0086\*  
0087\* BINARY: A STRING OF CHARACTERS SPECIFIED  
0088\* ----- BY THE "BUFFER LENGTH" IN THE REQUEST.  
0089\*  
0090\*  
0091\* - CONTROL FUNCTIONS ACCEPTED:  
0092\*  
0093\* 10 - TEN INCHES OF ZEROS (FEED-FRAMES) ARE  
0094\* OUTPUT FOR LEADER/TRAILER.  
0095\*  
0096\* 11 - LINE SPACING: THE PARAMETER WORD OF THE  
0097\* CONTROL REQUEST DETERMINES THE NUMBER  
0098\* OF LINE-FEEDS TO BE OUTPUT.  
0099\*

PAGE 0004 #01 < DRIVER 02 \*INITIATION\* SECTION >

```

0101*
0102***** INITIATION SECTION *****
0103*
0104*
0105 00000 000000 I.02 NOP
0106*
0107 00001 016201R JSB SETIO SET I/O INSTRUCTIONS FOR UNIT,
0108*
0109 00002 160213 LDA EQT9,I GET CONTROL WORD OF REQUEST,
0110 00003 010056 AND .3 ISOLATE.
0111*
0112 00004 050054 CPA .1 ERROR IF REQUEST IS
0113 00005 126000R JMP I.02,I FOR INPUT, REJECT CALL,
0114 00006 050055 CPA .2 PROCESS FOR
0115 00007 026043R JMP D04 WRITE REQUEST.
0116*
0117* CONTROL FUNCTION REQUEST
0118*
0119 00010 160213 LDA EQT9,I GET CONTROL WORD
0120 00011 001727 ALF,ALF FROM REQUEST, POSITION AND
0121 00012 001222 RAL,RAL ISOLATE FUNCTION FIELD.
0122 00013 010073 AND MASK1
0123 00014 002003 SZA,RSS IS IT A CLEAR?
0124 00015 026024R JMP CLEAR YES,
0125 00016 050063 CPA .10B FIELD = <10> TO GENERATE
0126 00017 026026R JMP D01 LEADER (10 INCHES OF BLANK TAPE)
0127 00020 050064 CPA .11B FIELD = <11> FOR LINE
0128 00021 026032R JMP D02 SPACING,
0129*
0130* REQUEST ERROR - CAUSE REJECT RETURN TO I/O CONTROL
0131*
0132 00022 060055 LDA .2
0133 00023 126000R JMP I.02,I
0134 00024 106700 CLEAR CLC 0 TURN DEVICE OFF
0135 00025 026066R JMP I.A.6
0136*
0137* LEADER/TRAILER GENERATOR
0138*
0139 00026 062224R D01 LDA N100 SET INDEX COUNTER FOR FEED FRAMES
0140 00027 170216 STA EQT12,I = -100.
0141 00030 002400 CLA (A) = 0 FOR
0142 00031 026041R JMP D03 FEED FRAME.
0143*
0144* LINE SPACING
0145*
0146 00032 160214 D02 LDA EQT10,I GET LINE COUNTER WORD.
0147 00033 002021 SSA,RSS INSURE VALUE
0148 00034 003004 CMA,INA IS NEGATIVE.
0149 00035 002003 SZA,RSS PROTECT AGAINST
0150 00036 003400 CCA A ZERO VALUE.
0151 00037 170216 STA EQT12,I
0152 00040 060065 LDA LINF (A) = LINE FEED CODE.
0153*
0154 00041 170217 D03 STA EQT13,I SET ACTION CODE.
0155 00042 026056R JMP D05
0156*

```

PAGE 0005 #01 < DRIVER 02 \*INITIATION\* SECTION >

0157\* WRITE REQUEST PROCESSING

0158\*

0159 00043 160214 D04 LDA EQT10,I CONVERT BUFFER ADDRESS TO EVEN  
0160 00044 001200 RAL CHARACTER ADDRESS AND SET  
0161 00045 170216 STA EQT12,I AS CURRENT BUFFER ADDRESS.  
0162 00046 160215 LDA EQT11,I GET BUFFER LENGTH.  
0163 00047 002020 SSA IF CHARACTER SPECIFIED,  
0164 00050 026053R JMP ++3 USE VALUE.  
0165 00051 001000 ALS CONVERT WORDS TO NEGATIVE  
0166 00052 003004 CMA,INA CHARACTERS.  
0167 00053 170217 STA EQT13,I SET CURRENT BUFFER LENGTH.  
0168\*

0169 00054 002400 CLA  
0170 00055 170220 STA EQT14,I FOR BINARY WRITE.

0171\*

0172\* CALL \*COMPLETION\* SECTION TO WRITE FIRST CHAR.

0173\*

0174 00056 062223R D05 LDA IEXTA ADJUST RETURN  
0175 00057 072070R STA C.02 TO \*INITIATOR\* SECTION.  
0176 00060 026075R JMP D10

0177\*

0178 00061 026064R JMP I.A.4 BINARY READ WITH 0 BUFFER LEN.  
0179 00062 002400 IEXIT CLA RETURN TO I/O CONTROL WITH  
0180 00063 126000R JMP I.02,I OPERATION INITIATED.

0181\*

0182 00064 006400 I.A.4 CLB  
0183 00065 174220 STB EQT14,I CLEAR TLOG.  
0184 00066 060057 I.A.6 LDA ,4 SET A=4 FOR IMMED.COMPL RETURN  
0185 00067 126000R JMP I.02,I RETURN

0187\*

0188\*\*\*\*\* COMPLETION SECTION \*\*\*\*\*

0189\*

0190\*

0191 00070 000000 C.02 NOP

0192\*

0193 00071 016201R JSB SETIO SET I/O INSTRUCTIONS FOR UNIT.  
 0194 00072 160207 LDA EQT5,I GET "CLEAR" FLAG,  
 0195 00073 002020 SSA CLEAR?  
 0196 00074 026155R JMP IO3 YES, TERMINATE.

0197\*

0198 00075 160213 D10 LDA EQT9,I GET CONTROL WORD  
 0199 00076 070001 STA B SAVE FOR CODE TEST.  
 0200 00077 001727 ALF,ALF ROTATE MODE BIT  
 0201 00100 001200 RAL TO BIT 15  
 0202 00101 072222R STA TEMP1 AND SAVE.

0203\*

0204 00102 002400 CLA IF CURRENT BUFFER ADDRESS OR  
 0205 00103 150216 CPA EQT12,I FUNCTION INDEX = 0, THEN  
 0206 00104 026155R JMP IO3 OPERATION COMPLETED.

0207\*

0208 00105 004010 SLB  
 0209 00106 026133R JMP D11 - CONTROL FUNCTION -

0210\*

0211 00107 150217 CPA EQT13,I IF CURRENT CHARACTER INDEX =  
 0212 00110 026137R JMP D12 0, THEN OUTPUT END OF RECORD.

0213\*

0214 00111 164216 LDB EQT12,I GET CURRENT CHAR. BUFFER ADDRESS.  
 0215 00112 134216 ISZ EQT12,I ADD 1 FOR NEXT CHARACTER.  
 0216 00113 004065 CLE,ERB CONVERT TO WORD ADDRESS.  
 0217 00114 160001 LDA B,I GET WORD AND  
 0218 00115 002041 SEZ,RSS POSITION PROPER  
 0219 00116 001727 ALF,ALF CHARACTER IN A(07-00).  
 0220 00117 010074 AND MASK3 REMOVE UPPER POSITION DATA.

0221\*

0222 00120 066222R LDB TEMP1 PUT MODE IN B(15).  
 0223 00121 134217 ISZ EQT13,I INDEX CHARACTER COUNTER.  
 0224 00122 026127R JMP IO1 - NOT LAST CHARACTER.

0225\*

0226 00123 006020 SSB IF BINARY MODE,  
 0227 00124 026127R JMP IO1 WRITE LAST CHARACTER.

0228\*

0229 00125 052220R CPA ARROW IF CHAR = < >, THEN OMIT IT  
 0230 00126 026155R JMP IO3 AND R/LF ON ASCII RECORD.

0231\*

0232\* OUTPUT CHARACTER TO PUNCH UNIT.

0233\*

0234 00127 102600 IO1 OTA 0 OUTPUT CHARACTER TO INTERFACE  
 0235 00130 102700 IO2 STC 0 TURN DEVICE ON.  
 0236 00131 036070R ISZ C.02 ADJUST RETURN TO (P+2).  
 0237 00132 126070R JMP C.02,I -EXIT-.

0238\*

0239\* CONTROL FUNCTION OUTPUT

0240\*

0241 00133 160217 D11 LDA EQT13,I (A) = LINE-FEED OR FEED FRAME.  
 0242 00134 134216 ISZ EQT12,I INDEX OUTPUT COUNT FOR LEADER/

PAGE 0007 #01 < DRIVER 02 \*COMPLETION SECTION\* >

0243	00135	000000	NOP	TRAILER OR LINE SPACING.	
0244	00136	026127R	JMP I01	GO TO OUTPUT CHARACTER.	
0245*					
0246*	END OF RECORD PROCESSING				
0247*					
0248	00137	062222R	D12	LDA TEMP1	CHECK MODE OF TRANSFER.
0249	00140	002020		SSA	
0250	00141	026155R		JMP I03	- BINARY -
0251*					
0252	00142	164220		LDB EQT14,I	*ASCII* RECORD
0253	00143	062217R		LDA RETN	OUTPUT FIRST A
0254	00144	056217R		CPB RETN	RETURN AND THEN A
0255	00145	060065		LDA LINF	LINE-FEED.
0256	00146	170220		STA EQT14,I	SET EQT11 FOR LINE-FEED CHECK.
0257	00147	056217R		CPB RETN	IF LINE-FEED IS BEING OUTPUT,
0258	00150	026152R		JMP D14	GO TO SET COMPLETION FLAG.
0259	00151	026127R		JMP I01	- OUTPUT RETURN -
0260*					
0261*					
0262	00152	006400	D14	CLB	SET BUFFER ADDRESS = 0
0263	00153	174216		STB EQT12,I	TO INDICATE LAST CHARACTER.
0264	00154	026127R		JMP I01	

```

0266*
0267* STATUS AND TRANSMISSION COMPLETION SECTION
0268*
0269 00155 102500 I03 LIA 0      GET DEVICE STATUS.
0270 00156 070001 STA B
0271 00157 160206 LDA EQT4,I    REMOVE PREVIOUS
0272 00160 010075 AND MASK2    STATUS.
0273 00161 030001 IOR B        SET NEW
0274 00162 170206 STA EQT4,I    STATUS WORD.
0275 00163 002400 CLA          IF LOW TAPE
0276 00164 006002 SZB          SUPPLY, SET
0277 00165 060055 LDA .2      A * 2 FOR *EOT*.
0278 00166 164207 LDB EQT5,I    GET "CLEAR" FLAG.
0279 00167 006020 SSB          CLEAR?
0280 00170 026176R JMP I05     YES.

0281*
0282 00171 164215 LDB EQT11,I   SET (B) = TRANSMISSION
0283 00172 006020 SSB          LOG AS POSITIVE # OF WORDS
0284 00173 007004 CMB,INB      OR CHARACTERS.

0285*
0286 00174 106700 I04 CLC 0      TURN DEVICE OFF.
0287*
0288 00175 126070R JMP C.02,I    AND EXIT FOR COMPLETION.

0289*
0290 00176 006400 I05 CLB
0291 00177 174207 STB EQT5,I    RESET "CLEAR" FLAG.
0292 00200 126070R JMP C.02,I    RETURN

0293*
0294* SUBROUTINE: <SETIO>
0295*
0296* PURPOSE: TO CONFIGURE THE I/O INSTRUCTIONS
0297*           IN THE DRIVER TO REFERENCE THE
0298*           SUBJECT PAPER TAPE PUNCH.
0299*
0300* CALL:      (A)05-00 CONTAINS I/O ADDRESS
0301*           (P)   JSB SETIO
0302*           (P+1) -RETURN- (REGISTERS MEANINGLESS)
0303*
0304 00201 000000 SETIO NOP
0305 00202 032221R IOR LIA      COMBINE <LIA> WITH I/O ADDRESS
0306 00203 072155R STA I03     AND SET.
0307*
0308 00204 040067 ADA .100     CONSTRUCT <OTA> INSTRUCTION
0309 00205 072127R STA I01
0310*
0311 00206 042215R ADA .1100    CONSTRUCT <STC,C> INSTRUCTION
0312 00207 072130R STA I02
0313*
0314 00210 032216R IOR .4000    CONSTRUCT <CLC> INSTRUCTION
0315 00211 072174R STA I04
0316 00212 072024R STA CLEAR
0317*
0318 00213 126201R JMP SETIO,I

```

PAGE 0001 #01 < DRIVER 02 \*COMPLETION SECTION\* >

0320\*  
0321\* CONSTANT AND VARIABLE STORAGE AREA  
0322\*  
0323 00000 A EQU 0 DEFINE SYMBOLIC REFERENCE FOR  
0324 00001 B EQU 1 A AND B REGISTERS.  
0325\*  
0326 00F14 000040 ,40 OCT 40  
0327 00215 001100 ,1100 OCT 1100  
0328 00216 004000 ,4000 OCT 4000  
0329\*  
0330\*  
0331 00217 000015 RETN OCT 15  
0332 00220 000137 ARROW OCT 137  
0333\*  
0334 00221 102500 LIA LIA 0  
0335\*  
0336 00222 000000 TEMP1 NOP  
0337\*  
0338 00223 000061R IEXTA DEF IEXIT=1  
0339 00224 177610 N100 DEC -120  
0340\*

PAGE 0010 #01 \*\* SYSTEM BASE PAGE COMMUNICATION AREA \*\*

0342\*  
0343\*\*\* SYSTEM BASE PAGE COMMUNICATION AREA \*\*\*  
0344\*  
0345 00053 .. EQU 53B  
0346 00047 N4 EQU ..-4  
0347 00054 .1 EQU ..+1  
0348 00055 .2 EQU ..+2  
0349 00056 .3 EQU ..+3  
0350 00057 .4 EQU ..+4  
0351 00061 .6 EQU ..+6  
0352 00063 .10B EQU ..+8  
0353 00064 .11B EQU ..+9  
0354 00065 LINF EQU ..+10  
0355 00067 .100 EQU ..+12  
0356 00073 MASK1 EQU ..+16  
0357 00074 MASK3 EQU ..+17  
0358 00075 MASK2 EQU ..+18  
0359 00100 . EQU 100B ESTABLISH ORIGIN OF AREA  
0360\*  
0361\*  
0362\* I/O MODULE/DRIVER COMMUNICATION  
0363\*  
0364 00203 EQT1 EQU ..+67  
0365 00204 EQT2 EQU ..+68  
0366 00205 EQT3 EQU ..+69  
0367 00206 EQT4 EQU ..+70  
0368 00207 EQT5 EQU ..+71  
0369 00210 EQT6 EQU ..+72  
0370 00211 EQT7 EQU ..+73  
0371 00212 EQT8 EQU ..+74  
0372 00213 EQT9 EQU ..+75  
0373 00214 EQT10 EQU ..+76  
0374 00215 EQT11 EQU ..+77  
0375 00216 EQT12 EQU ..+78  
0376 00217 EQT13 EQU ..+79  
0377 00220 EQT14 EQU ..+80  
0378 00221 EQT15 EQU ..+81  
0379 00222 EQT16 EQU ..+82  
0380 00223 EQT17 EQU ..+83  
0381 END  
\*\* NO ERRORS\*

,	00359	00364	00365	00366	00367	00368	00369
	00370	00371	00372	00373	00374	00375	00376
	00377	00378	00379	00380			
..	00345	00346	00347	00348	00349	00350	00351
	00352	00353	00354	00355	00356	00357	00358
,1	00347	00112					
,100	00355	00308					
,10B	00352	00125					
,1100	00327	00311					
,11B	00353	00127					
,2	00348	00114	00132	00277			
,3	00349	00110					
,4	00350	00184					
,40	00326						
,4000	00328	00314					
,6	00351						
PA	00323						
ARROW	00332	00229					
B	00324	00199	00217	00270	00273		
C,02	00191	00008	00175	00236	00237	00288	00292
CLEAR	00134	00124	00316				
D01	00139	00126					
D02	00146	00128					
D03	00154	00142					
D04	00159	00115					
D05	00174	00155					
D10	00198	00176					
D11	00241	00209					
D12	00248	00212					

D14	00262	00258					
EQT1	00364						
EQT10	00373	00146	00159				
EQT11	00374	00162	00282				
EQT12	00375 00242	00140 00263	00151	00161	00205	00214	00215
EQT13	00376	00154	00167	00211	00223	00241	
EQT14	00377	00170	00183	00252	00256		
EQT15	00378						
EQT16	00379						
EQT17	00380						
EQT2	00365						
EQT3	00366						
EQT4	00367	00271	00274				
EQT5	00368	00194	00278	00291			
EQT6	00369						
EQT7	00370						
EQT8	00371						
EQT9	00372	00109	00119	00198			
I.02	00105	00008	00113	00133	00180	00185	
I.A.4	00182	00178					
I.A.6	00184	00135					
IEXIT	00179	00338					
IEXTA	00338	00174					
I01	00234	00224	00227	00244	00259	00264	00309
I02	00235	00312					
I03	00269	00196	00206	00230	00250	00306	
I04	00286	00315					
I05	00290	00280					

LIA	00334	00305		
LINF	00354	00152	00255	
MASK1	00356	00122		
MASK2	00358	00272		
MASK3	00357	00220		
N100	00339	00139		
•N4	00346			
RETN	00331	00253	00254	00257
SETIO	00304	00107	00193	00318
TEMP1	00336	00202	00222	00248

## PRIVILEGED INTERRUPT I/O DRIVERS

Privileged interrupt I/O drivers include a third relocatable, closed subroutine in addition to the Initiation Section and the Completion Section. This subroutine is the Privileged Interrupt Section. P.*nn* is the entry point name. The Initiation Section is identical to those written for the standard I/O drivers except that the EQT entry should be saved for subsequent use by the Privileged Interrupt Section. Figure 13-3 is a flowchart of the privileged interrupt driver Initiation Section.

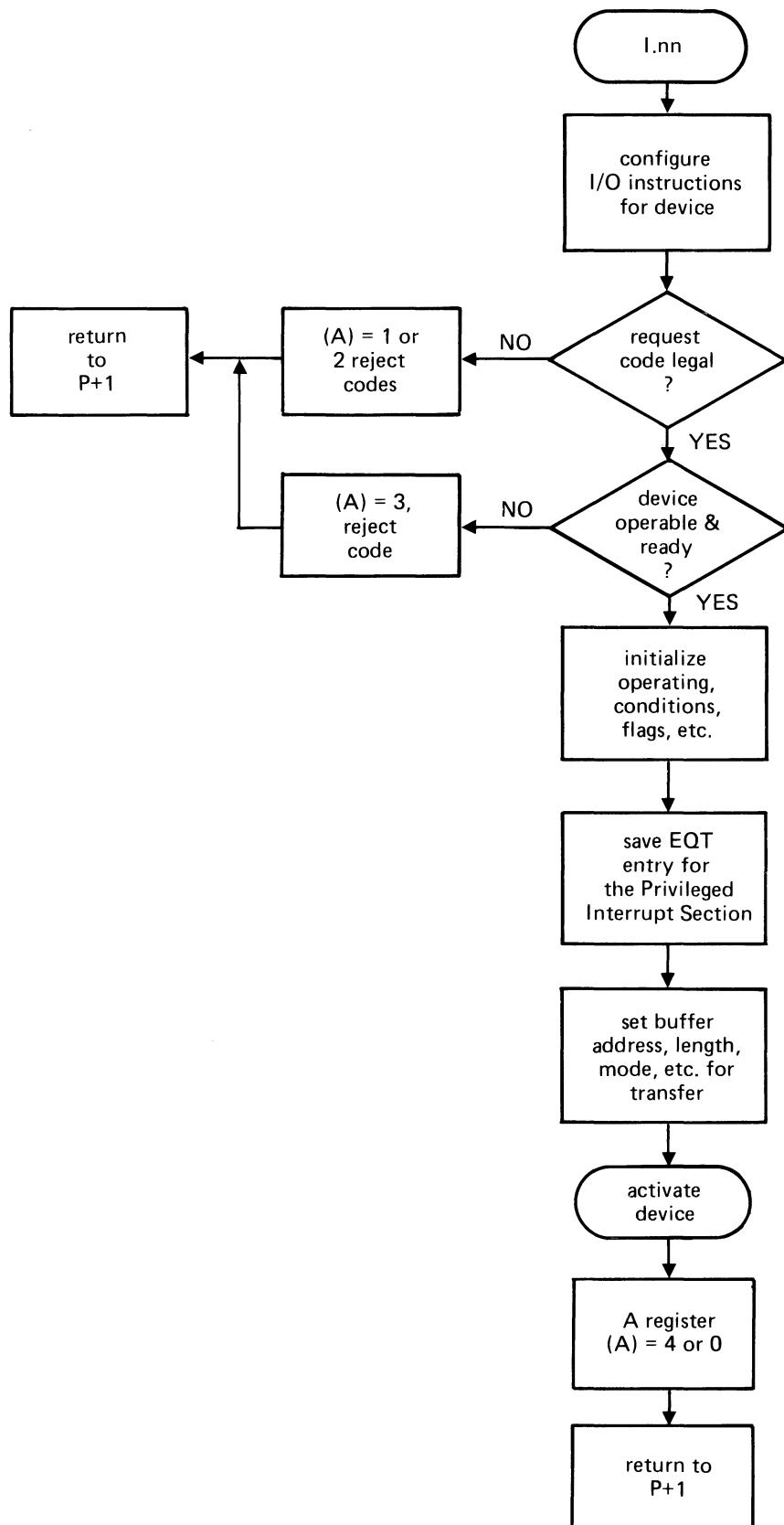


Figure 13-3. Privileged Interrupt I/O Driver Initiation Section

## Privileged Interrupt Section

Control passes directly to the Privileged Interrupt Section of the driver ( $P.nn$ ) whenever an interrupt occurs from a device associated with the driver. The address specifying where control is to be passed (that is, the  $P.nn$  entry point) must be included at generation time while building the interrupt table entries (the ENT option should be used; see Section 10). Since control does not pass through the system's central interrupt routine before entering the Privileged Interrupt Section, the following standard interrupt processing is not performed:

1. The I/O interface flag for the device is not cleared.
2. The A register does not contain the interrupt source code.
3. The EQT entry addresses are not set in the base page.

*Note: To allow access to the EQT entry, the Initiation Section should save the EQT address, then the Privileged Interrupt Section can use the saved address to reference the EQT entry.*

**FUNCTIONS OF THE PRIVILEGED INTERRUPT SECTION:** The Privileged Interrupt Section is responsible for the following functions (flowcharted in Figure 13-4):

1. Upon entry to  $P.nn$ , the driver must save the contents of the A, B, E, and O registers.
2. The driver services the current data item and determines whether or not the transfer is complete.
3. If the transfer is not complete, the Privileged Interrupt Section should set the device for the next transfer and proceed to step 5.
4. If the transfer is complete, the Privileged Interrupt Section should make the following system completion call:

```
EXT  $PCOM
LDA  EQT1      (saved EQT entry)
JSB  $PCOM
```

This call directs the system to pass control to the standard Completion Section ( $C.nn$  entry point) as soon as it is possible for a "system" device to interrupt.

5. Prior to returning control to the point of suspension, the Privileged Interrupt Section must restore the A, B, E, and O registers. In addition, since memory protect is automatically disabled whenever an interrupt occurs, the Privileged Interrupt Section is responsible for restoring memory protect to its original state. A memory protect flag exists on the base page ( $MPTFL = 271_8$ ) to provide the driver with information concerning the state of memory protect. If  $MPTFL$  is zero, memory protect was on and an STC 5 instruction should be executed immediately prior to returning to the point of suspension. If  $MPTFL$  is one, memory protect was off and an STC 5 instruction should not be issued.

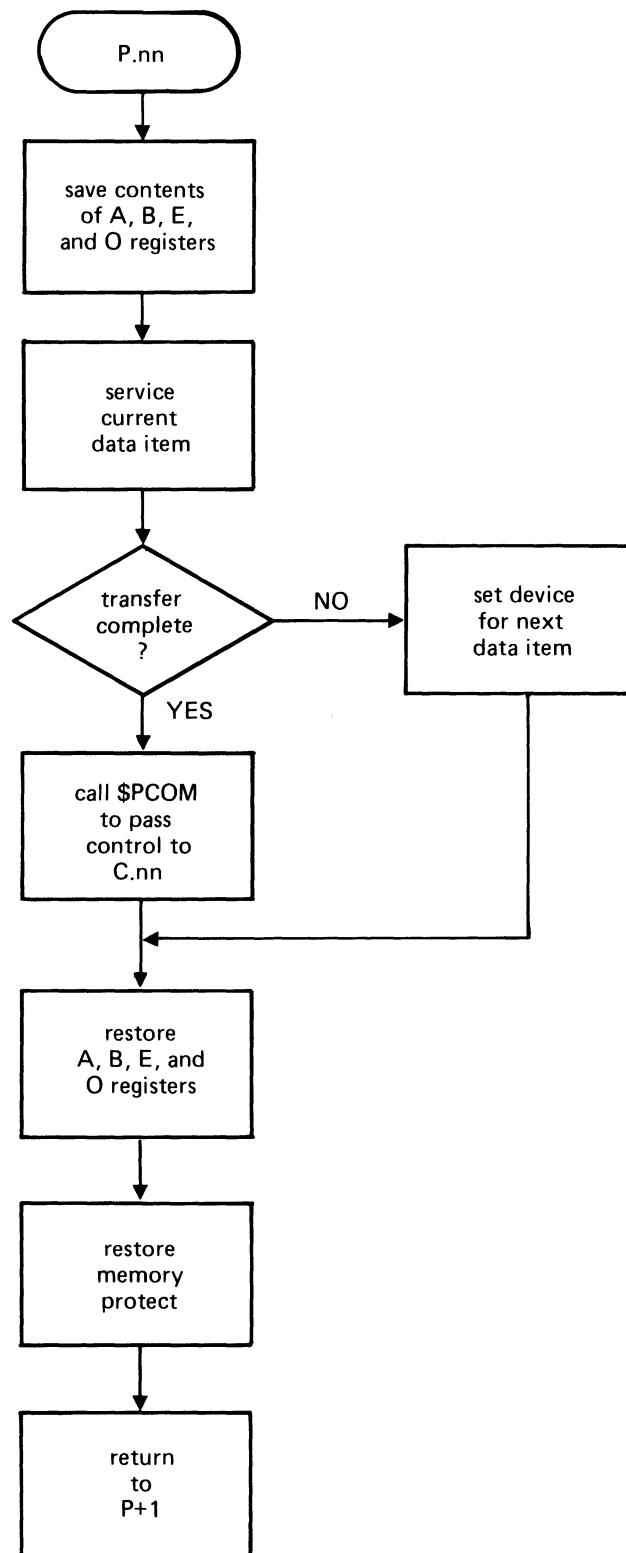


Figure 13-4. Privileged Interrupt I/O Driver Privileged Interrupt Section

## Privileged Interrupt Completion Section

The completion section in a privileged interrupt driver is used to perform the following functions (flowcharted in Figure 13-5):

1. Set the actual or simulated device status into bits 0 through 7 of EQT word 4.
2. Set the number of transmitted words or characters (depending on which the user requested) in the B register.
3. Set the A register to indicate successful or unsuccessful completion.

0 = successful completion  
1 = device malfunction or not ready  
2 = end-of-tape (information)  
3 = transmission parity error

4. Clear the device control on end-of-operation, or set device for next transfer.  
Return to \$CIC at P+1.

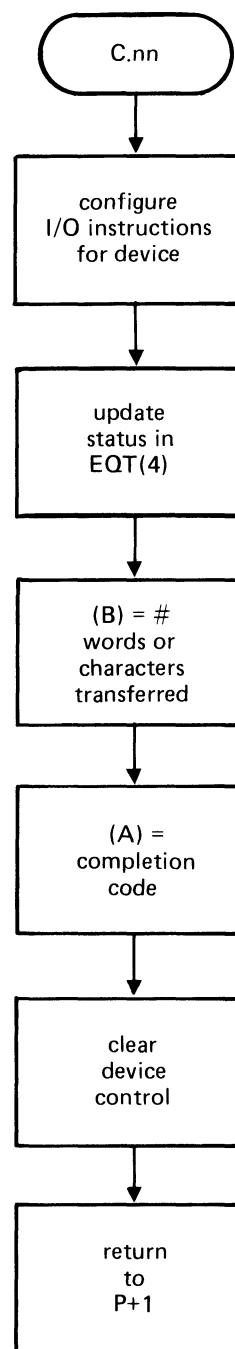


Figure 13-5. Privileged Interrupt I/O Driver Completion Section

## SAMPLE PRIVILEGED INTERRUPT I/O DRIVER

The following pages provide an assembly listing and cross-reference symbol table for a sample privileged interrupt I/O driver.

PAGE 0001

0001 ASMB,R,B,L,C PRIVILEGED DRIVER FOR PUNCH  
\*\* NO ERRORS\*

0001 ASMB,R,B,L,C PRIVILEGED DRIVER FOR PUNCH  
 0003 00000 NAM DVR02,0  
 0004\*  
 0005 ENT I.02,P.02,C.02  
 0006\*  
 0007 EXT \$PCOM,\$MOVE  
 0008\*  
 0009\*\*\*\*\* PROGRAM DESCRIPTION \*\*\*\*\*  
 0010\*  
 0011\* DRIVER 02 IS A SIMPLIFIED VERSION OF THE GENERAL PURPOSE  
 0012\* PUNCH DRIVER TO ILLUSTRATE THE USE OF PRIVILEGED INTERRUPT  
 0013\* FENCE REGISTER.  
 0014\*  
 0015\* DRIVER 02 OPERATES UNDER THE I/O CONTROL MODULE OF THE DOS  
 0016\* EXECUTIVE FOR INITIATION AND COMPLETION AND DIRECTLY FROM THE  
 0017\* TRAP CELL FOR PRIVILEGED INTERRUPTS.  
 0018\*  
 0019\* I.02 IS THE ENTRY POINT TO THE \*INITIATION\* SECTION  
 0020\* P.02 IS THE ENTRY POINT TO THE \*PRIVILEGED\* SECTION  
 0021\* C.02 IS THE ENTRY POINT TO THE \*COMPLETION\* SECTION  
 0022\* - THE INITIATION SECTION IS CALLED FROM I/O CONTROL TO  
 0023\* INITIALIZE A DEVICE AND INITIATE AN OUTPUT  
 0024\*  
 0025\* CALLING SEQUENCE:  
 0026\*  
 0027\* - ADDRESSES OF DEVICE EQT ENTRY SET IN "EQT1-EQT17"  
 0028\*  
 0029\* (A) = I/O ADDRESS OF DEVICE  
 0030\*  
 0031\* (P) JSB I.02  
 0032\* (P+1) -RETURN-  
 0033\* (A) = 0, OPERATION INITIATED  
 0034\* = 4, OPERATION REJECTED=IMMEDIATE COMPLETIO  
 0035\*  
 0036\* - THE PRIVILEGED SECTION IS CALLED DIRECTLY FROM THE I/O TRAP  
 0037\* CELL WHOSE ADDRESS HAS BEEN SET AT SYSTEM GENERATION.  
 0038\*  
 0039\* CALLING SEQUENCE:  
 0040\*  
 0041\* (P) JSB P.02  
 0042\* (P+1) -RETURN-  
 0043\*  
 0044\* - THE COMPLETION SECTION IS CALLED BY CENTRAL INTERRUPT  
 0045\* CONTROL TO COMPLETE AN OPERATION.  
 0046\*  
 0047\* CALLING SEQUENCE:  
 0048\*  
 0049\* - ADDRESSES OF DEVICE EQT ENTRY SET IN "EQT1-EQT17"  
 0050\*  
 0051\* (A) = I/O ADDRESS OF DEVICE  
 0052\*  
 0053\* (P) JSB C.02  
 0054\* (P+1) -RETURN-  
 0055\* (A) = 0, SUCCESSFUL COMPLETION  
 0056\*  
 0057\* - RECORD FORMAT MUST BE A STRING OF ASCII CHARACTERS

PAGE 0003 #01 INITIATOR SECTION

0059\*  
 0060\* THE FUNCTIONS OF THE INITIATION SECTION ARE:  
 0061\*  
 0062\* 1. CONFIGURE I/O INSTRUCTIONS  
 0063\* 2. SAVE SYSTEM EQT ENTRY ADDRESSES USED IN PRIVILEGED  
 0064\* SECTION FROM EQT1-EQT17.  
 0065\* 3. CHECK FOR LEGITIMATE REQUEST CODE  
 0066\* 4. FORM CHARACTER BUFFER ADDRESS  
 0067\* 5. FORM NEGATIVE CHARACTER COUNT  
 0068\* 6. OUTPUT FIRST CHARACTER  
 0069\* 7. ENABLE DEVICE  
 0070\* 8. RETURN  
 0071\*  
 0072\* NOTE: FUNCTION 2 IS THE MAIN DIFFERENCE FROM  
 0073\* STANDARD DRIVERS  
 0074\*  
 0075 00000 000000 I.02 NOP INITIATOR SECTION ENTRY  
 0076 00001 016140R JSB CONFIG CONFIGURE I/O INSTRUCITONS  
 0077 00002 062160R LDA DEQT1 MOVE SYSTEM EQT1-EQT17 INTO  
 0078 00003 066161R LDB N17 PRIVILEGED DRIVER EQT AREA  
 0079 00004 016002X JSB \$MOVE  
 0080 00005 000166R DEF TEQ1  
 0081 00006 162175R LDA TEQ8,I GET REQUEST CODE  
 0082 00007 002020 SSA  
 0083 00010 003004 CMA,INA MAKE + IF NEGATIVE  
 0084 00011 050055 CPA .2  
 0085 00012 002001 RSS  
 0086 00013 026042R JMP ERTN IGNORE REQUEST CODE RETURN  
 0087 00014 162177R LDA TEQ10,I FORM CHARACTER BUFFER ADDRESS  
 0088 00015 001200 RAL  
 0089 00016 172201R STA TEQ12,I -BUF ADDR USED BY DRIVER-  
 0090 00017 162200R LDA TEQ11,I FORM NEGATIVE CHARACTERS COUNTER  
 0091 00020 002003 SZA,RSS  
 0092 00021 026042R JMP ERTN  
 0093 00022 002020 SSA ERROR IF ZERO CHARACTER  
 0094 00023 026026R JMP \*+3  
 0095 00024 001000 ALS  
 0096 00025 003004 CMA,INA  
 0097 00026 172202R STA TEQ13,I -CHAR COUNT USED BY DRIVER-  
 0098 00027 166177R LDB TEQ10,I  
 0099 00030 136201R ISZ TEQ12,I  
 0100 00031 160001 LDA B,I FORM FIRST CHAARACTER  
 0101 00032 001727 ALF,ALF  
 0102 00033 010074 AND .377  
 0103 00034 102600 I.02A OTA 0 OUTPUT FIRST CHARACTER  
 0104 00035 136202R ISZ TEQ13,I INCR FOR FIRST CHARACTER  
 0105 00036 000000 NOP  
 0106 00037 102700 I.02B STC 0 ENABLE DEVICE  
 0107 00040 002400 CLA INDICATE NORMAL RETURN  
 0108 00041 126000R JMP I.02,I RETURN TO SYSTEM  
 0109 00042 060057 ERTN LDA .4 IMMEDIATE COMPLETION RETURN  
 0110 00043 126000R JMP I.02,I RETURN TO SYSTEM

0112\*  
 0113\*       PRIVILEGED PROCESSOR SECTION  
 0114\*  
 0115\*  
 0116\*       THE FUNCTIONS OF THE PRIVILEGED SECTION ARE:  
 0117\*  
 0118\*       1. TURN OFF INTERRUPTS  
 0119\*       2. SAVE COMPUTER REGISTERS AT INTERRUPT  
 0120\*       3. IF ALL CHARACTERS OUTPUT, GO TO FUNCTION 10  
 0121\*       4. OUTPUT NEXT CHARACTER  
 0122\*       5. ENABLE DEVICE  
 0123\*       6. RESTORE REGISTERS  
 0124\*       7. SET MEMORY PROTECT TO ORIGINAL STATE AT TIME OF INTERRUPT  
 0125\*       8. TURN ON INTERRUPTS  
 0126\*       9. RETURN TO POINT TO INTERRUPT  
 0127\*  
 0128\*       10. CALL \$PCOM TO ENTER DEVICE INTO PRIVILEGED INTERRUPT  
 0129\*           COMPLETION QUEUE  
 0130\*       11. DISABLE DEVICE  
 0131\*       12. RETURN TO POINT OF INTERRUPT  
 0132\*  
 0133 00044 000000 P.02 NOP  
 0134 00045 103100 CLF 0       TURN OFF INTERRUPT SYSTEM  
 0135 00046 016120R JSB SEOAB   SAVE REGISTERS  
 0136 00047 162202R LDA TEQ13,I   CHECK IF LAST CHARACTER SENT OUT  
 0137 00050 002003 SZA,RSS  
 0138 00051 026077R JMP P.02D   YES, SO INITIATE COMPLETION PROC  
 0139 00052 166201R LDB TEQ12,I  
 0140 00053 136201R ISZ TEQ12,I   INCREMENT BUFFER ADDRESS  
 0141 00054 004065 CLE,ERB  
 0142 00055 160001 LDA B,I       PUT DATA IN A REGISTER  
 0143 00056 002041 SEZ,RSS      CHECK IF UPPER OR LOWER CHARACTER  
 0144 00057 001727 ALF,ALF      UPPER SO MOVE INTO LOW  
 0145 00060 010074 AND .377     MASK OFF OTHER CHARACTER  
 0146 00061 102600 P.02A OTA 0   OUTPUT A CHARACTER  
 0147 00062 103700 P.02B STC 0,C   ENABLE DEVICE  
 0148 00063 136202R ISZ TEQ13,I   INCREMENT CHARACTER COUNT  
 0149 00064 000000 NOP  
 0150 00065 064271 P.MPT LDB MPTFL   CHECK IF MEM PROTECT TO BE ENABL  
 0151 00066 006002 SZB            YES  
 0152 00067 026074R JMP MPOFF     NO  
 0153 00070 016130R JSB REOAB    RESTORE REGISTERS  
 0154 00071 102100 STF 0        TURN ON INTERRUPTS  
 0155 00072 102705 STC 5        ENABLE MEMORY PROTECT  
 0156 00073 126044R JMP P.02,I   RETURN TO POINT OF INTERRUPT  
 0157 00074 016130R MPOFF JSB REOAB   RESTORE REGISTERS  
 0158 00075 102100 STF 0        TURN ON INTERRUPTS  
 0159 00076 126044R JMP P.02,I   RETURN TO POINT OF INTERRUPT  
 0160 00077 062166R P.02D LDA TEQ1   CAUSE COMPLETION INTERRUPT  
 0161 00100 016001X JSB \$PCOM   ENTER DEVICE INTO PRIV INT COMPLETIO  
 0162 00101 106700 P.02E CLC 0    CLEAR DEVICE  
 0163 00102 026065R JMP P.MPT    GO TO RETURN PROCESSOR

PAGE 0005 #01 COMPLETION SECTION

0165\*  
0166\* COMPLETION PROCESSOR SECTION  
0167\*  
0168\*  
0169\* THE FUNCTIONS OF THE COMPLETION SECTION ARE:  
0170\*  
0171\* 1. UPDATE STATUS IN EQT4  
0172\* 2. SET TRANSMISSION LOG IN B  
0173\* 3. CLEAR A TO INDICATE OKAY COMPLETION  
0174\* 4. RETURN TO CENTRAL INTERRUPT PROCESSOR  
0175\*  
0176 00103 000000 C.02 NOP  
0177 00104 102500 C.02A LIA 0 UPDATE STATUS  
0178 00105 010071 AND .37  
0179 00106 070001 STA B  
0180 00107 162171R LDA TEQ4,I  
0181 00110 010075 AND MASK2  
0182 00111 030001 IOR B  
0183 00112 172171R STA TEQ4,I STATUS IN EQT4  
0184 00113 166200R LDB TEQ11,I TRANSMISSION LOG IN B  
0185 00114 006020 SSB  
0186 00115 007004 CMB,INB  
0187 00116 002400 CLA CLEAR A TO INDICATE OKAY STATUS  
0188 00117 126103R JMP C.02,I RETURN TO SYSTEM

PAGE 0006 #01 SUBROUTINES

```

0190*
0191*      SAVE A,B,E,O
0192*
0193  00120 000000  SEOAB NOP
0194  00121 072207R  STA XA      A
0195  00122 076210R  STB XB      B
0196  00123 001520   ERA,ALS
0197  00124 102201   SOC
0198  00125 002004   INA
0199  00126 072211R  STA XEO    E AND O
0200  00127 126120R  JMP SEOAB,I

0201*
0202*      RESTORE A,B,E,O
0203*
0204  00130 000000  REOAB NOP
0205  00131 062211R  LDA XEO    E AND O
0206  00132 103101   CLO
0207  00133 000036   SLA,ELA
0208  00134 102101   STF 1
0209  00135 062207R  LDA XA     A
0210  00136 066210R  LDB XB     B
0211  00137 126130R  JMP REOAB,I

0212*
0213*      CONFIGURE I/O INSTRUCTIONS
0214*
0215  00140 000000  CONFG NOP
0216  00141 070001   STA B       SAVE SELECT CODE
0217  00142 032162R  IOR OTAC
0218  00143 072034R  STA I.02A  CONFIGURE OTA SC
0219  00144 072061R  STA P.02A
0220  00145 062163R  LDA STCC
0221  00146 030001   IOR B
0222  00147 072037R  STA I.02B  CONFIGURE STC SC,C
0223  00150 072062R  STA P.02B
0224  00151 062164R  LDA CLCC
0225  00152 030001   IOR B
0226  00153 072101R  STA P.02E  CONFIGURE CLC SC
0227  00154 062165R  LDA LIAC
0228  00155 030001   IOR B
0229  00156 072104R  STA C.02A  CONFIGURE LIA SC
0230  00157 126140R  JMP CONFG,I  RETURN

```

PAGE 0007 #01 BUFFERS, POINTERS, CONSTANTS, AND MASKS

0232*				
0233	00001	B	EQU 1	
0234*				
0235	00053	..	EQU 53B	
0236	00055	.2	EQU ..+2	DEC 2
0237	00057	.4	EQU ..+4	DEC 4
0238	00071	.37	EQU ..+14	OCT 37
0239	00074	.377	EQU ..+17	OCT 377
0240	00075	MASK2	EQU ..+18	OCT 177400
0241*				
0242	00100	.	EQU 100B	
0243	00203	EQT1	EQU .+67	EQUIPMENT TABLE ADDRESS
0244	00271	MPTFL	EQU .+121	MEMORY PROTECT FLAG
0245*				
0246	00160 000203	DEQT1	DEF EQT1	
0247*				
0248	00161 177757	N17	DEC -17	
0249	00162 102600	OTAC	OTA 0	
0250	00163 103700	STCC	STC 0,C	
0251	00164 106700	CLCC	CLC 0	
0252	00165 102500	LIAC	LIA 0	
0253*				
0254	00166 000000	TEQ1	NOP	INITIATION ADDRESS
0255	00167 000000	TEQ2	NOP	COMPLETION ADDRESS
0256	00170 000000	TEQ3	NOP	D,R,UNIT,CHANNEL
0257	00171 000000	TEQ4	NOP	AV,TYPE,STATUS
0258	00172 000000	TEQ5	NOP	-
0259	00173 000000	TEQ6	NOP	-
0260	00174 000000	TEQ7	NOP	REQUEST RETURN
0261	00175 000000	TEQ8	NOP	REQUEST CODE
0262	00176 000000	TEQ9	NOP	I/O REQUEST CONTROL WORD
0263	00177 000000	TEQ10	NOP	REQUEST BUFFER ADDRESS
0264	00200 000000	TEQ11	NOP	REQUEST BUFFER LENGTH
0265	00201 000000	TEQ12	NOP	-
0266	00202 000000	TEQ13	NOP	-
0267	00203 000000	TEQ14	NOP	-
0268	00204 000000	TEQ15	NOP	-
0269	00205 000000	TEQ16	NOP	-
0270	00206 000000	TEQ17	NOP	-
0271*				
0272	00207 000000	XA	NOP	A REGISTER TEMPORARY
0273	00210 000000	XB	NOP	B REGISTER TEMPORARY
0274	00211 000000	XEO	NOP	E AND O REGISTER TEMPORARY
0275			END	

\*\* NO ERRORS\*

\$MOVE	00007	00079					
\$PCOM	00007	00161					
.	00242	00243	00244				
..	00235	00236	00237	00238	00239	00240	
.2	00236	00084					
.37	00238	00178					
.377	00239	00102	00145				
.4	00237	00109					
B	00233 00225	00100 00228	00142	00179	00182	00216	00221
C,02	00176	00005	00188				
C,02A	00177	00229					
CLCC	00251	00224					
CONFG	00215	00076	00230				
DEQT1	00246	00077					
EQT1	00243	00246					
ERTN	00109	00086	00092				
I,02	00075	00005	00108	00110			
I,02A	00103	00218					
I,02B	00106	00222					
LIAC	00252	00227					
MASK2	00240	00181					
MPOFF	00157	00152					
MPTFL	00244	00150					
N17	00248	00078					
OTAC	00249	00217					
P,02	00133	00005	00156	00159			
P,02A	00146	00219					

DVR02

## CROSS-REFERENCE SYMBOL TABLE

PAGE 0002

P,028	00147	00223			
P,02D	00160	00138			
P,02E	00162	00226			
P,MPT	00150	00163			
REOAB	00204	00153	00157	00211	
SEOAB	00193	00135	00200		
STCC	00250	00220			
TEQ1	00254	00080	00160		
TEQ10	00263	00087	00098		
TEQ11	00264	00090	00184		
TEQ12	00265	00089	00099	00139	00140
TEQ13	00266	00097	00104	00136	00148
•TEQ14	00267				
•TEQ15	00268				
•TEQ16	00269				
•TEQ17	00270				
•TEQ2	00255				
•TEQ3	00256				
TEQ4	00257	00180	00183		
•TEQ5	00258				
•TEQ6	00259				
•TEQ7	00260				
TEQ8	00261	00081			
•TEQ9	00262				
XA	00272	00194	00209		
XB	00273	00195	00210		
XEO	00274	00199	00205		

## ***SECTION XIV***

# ***Privileged Mode***

Certain situations may arise where a user wishes to process his own errors instead of having the operating system handle them for him. In addition, there may be cases where he wishes to determine when an I/O operation (initiated without wait) is complete.

Both of these options are available with use of the system's privileged mode flag (MDFLG = location  $133_8$ ). In order to operate in this privileged mode (i.e., user processing of I/O errors and/or determining I/O completions) the user

- must be programming in Assembly language
- is responsible for setting MDFLG properly

    Bit 0 set - user error processing

    Bit 15 set - I/O completion processing

DOS-III uses MDFLG as follows:

1. After an I/O initiation (performed by an EXEC call) MDFLG bit 0 is checked, and if it is equal to one, control returns to the user program with the A register set as follows:

Contents (decimal)	Meaning
0	Operation initiated
1	Read or write illegal
2	Control request ignored
3	Device down
4	Immediate completion
5	DMA busy
6	Driver busy
7	Driver overlay area busy
8	EXEC overlay area busy
9	Operation rejected
10	Memory protect error
11	Request code error
12	Execution time exceeded
13	Spare

Contents (decimal)	Meaning
14	Illegal logical unit
15	Unassigned logical unit
16	Illegal buffer address
17	Memory wrap around
18	Illegal track address
19	File cannot be found

2. After an I/O completion, MDFLG bit 15 is checked, and if it is equal to one, control is passed to a user subroutine which must immediately follow the EXEC call. Upon entry to the routine, the B register contains the driver transmission log and the A register contains the device status as follows:

A register Contents	Meaning
0	I/O completed without errors
-1	Device was not ready
-2	End-of-tape
-3	Parity error
-4	Batch input detected a colon (:)

If the I/O completion resulted from an I/O error (not ready, parity, or end-of-tape) and the device is not the system console or the disc, bit 14 of EQT4 (the fourth word of the current Equipment Table entry) is set to indicate that the device is down.

MDFLG bit 0 is then checked, and if it is equal to one, control returns to user (thus bypassing system processing of the error).

3. During a FILE NAME SEARCH EXEC call (RCODE = 18) where the search is requested without wait, no subsequent EXEC calls are allowed. If a second EXEC call is requested during execution of a file search, the system will wait for the search to complete before processing the second EXEC call. If the user does not want the system to wait, he should set Bit 1 of MDFLG. If Bit 1 of MDFLG is set and the above condition is encountered, control will be returned to the user following the second EXEC call with the A register = 8 (EXEC busy).
4. The system clears all bits of MDFLG following any program completion.

5. An I/O calling sequence operating in privileged mode might look something like this:

<i>JSB</i>	<i>EXEC</i>		
<i>DEF</i>	<i>END</i>		
<i>DEF</i>	<i>RCODE</i>		
<i>DEF</i>	<i>CONWD</i> ( <i>must be an I/O without wait</i> )		
.			
<i>END</i>	<i>JMP INIT</i>		
<i>COMP</i>	<i>NOP</i>		
.		{	<i>If present, the completion routine must be located here. Executed following I/O completion, and should include a check for completion errors. This routine must not use any routine that is not re-entrant.</i>
<i>JMP</i>	<i>COMP,I</i>		
.		{	<i>Executed following an I/O initiation, and should include a check for initiation errors.</i>
.			
.		}	
.			



**PART 5**

***Error Codes and Messages***



# **SECTION XV**

## ***Halt Codes and Error Messages***

This section describes the error conditions which can occur while DOS-III is being generated, loaded and operated. Error conditions are reported to the user by one of the following:

- a computer halt; the halt code is displayed in the DISPLAY register
- an error message; the message is displayed on the system console
- an error message (displayed on the system console) followed by a computer halt (halt code displayed in the DISPLAY register)
- an error code returned to a user program (by EFMP); the error code is also returned in the A register

This section contains halt code and error message tables, including corrective action (when applicable) for the following:

- DSGEN ERROR CONDITIONS
  - DSGEN Error Halts
  - DSGEN Error Messages
- DOS-III BOOTSTRAP ERROR HALTS
- DOS-III ERROR CONDITIONS
  - DOS-III Error Halts
  - DOS-III Error Messages
- EFMP ERROR CODES

*Note: The ALGOL, FORTRAN and Assembler subsystems also print error messages. These subsystem error messages are documented in the SOFTWARE OPERATING PROCEDURE module "Assembler, FORTRAN and ALGOL Error Messages" (5951-1377). FORTRAN IV error messages are described in HP FORTRAN IV (5951-1321).*

**Table 15-1. DSGEN Error Conditions**

---

### DSGEN ERROR HALTS

Halt Code	Cause	Recovery Action
102000	Follows an irrecoverable error message. Generator unable to find \$STRT in DISCM. DISCM is probably missing.	Irrecoverable Irrecoverable
102002	Follows ERR02.	See ERR02 in error messages.
102003	Follows ERR03.	See ERR03 in error messages.
102004	Follows ERR04.	See ERR04 in error messages.
102007	Normal halt. Disc initialization of sub-channel has completed.	Start the computer executing to initialize another subchannel or to generate a system.
102022	Disc error after ten attempts. Disc address in A, disc status in B.	Start execution to retry ten more times. When preceded by ERR12 continues to next track.
102032	Disc not ready or disc should be unprotected. Disc address in A and disc status in B.	Ready or unprotect the disc. Start the computer executing.
102077	Normal halt. Ready to receive another program tape.	Continue generation. Enter next tape and start the computer executing.
102000	If DSGEN is above $10000_8$ an impossible condition has occurred.	Either a hardware/software failure has occurred or DSGEN has overflowed its work area because the system was too large.

### DSGEN ERROR MESSAGES

#### Messages During Initialization and Input Phases

Message	Meaning	Action
ERR01	Invalid response to initialization request.	Request is repeated. Enter valid reply.
ERR02	Checksum error on program input.	Computer halts; to try again, reposition tape to beginning of program and start the computer.
ERR03	Record out of sequence.	Same as ERR02.

**Table 15-1. DSGEN Error Conditions (continued)**

Message	Meaning	Action
ERR04	Illegal record type.	Same as ERR02. If input is from disc, error is irrecoverable; remove non-relocatable files from disc.
ERR05 name	Duplicate entry point.	The current entry point replaces the previous entry point.
ERR06	Invalid base page length in BCS-produced relocatable tape (must be zero).	Base page area is ignored, but memory protect error will occur if program is executed.
ERR07	Program name or entry point table overflow of available memory.	Irrecoverable error. Revise or delete programs.
ERR08 name	Duplicate program name.	The current program replaces the previous program.

#### **Messages During the Parameter Phase**

ERR09	Parameter name error (no such program).	Enter valid parameter statement.
ERR10	Parameter type error.	Same as ERR09.

#### **General Messages**

ERR11	System directory track overflow.	Irrecoverable. Regenerate system and reduce the value of the response to the "FIRST SYSTEM SECTOR?" message.
ERR12	Disc error during disc initialization.	Start the computer executing to bypass the faulty tracks.
ERR13	User segment precedes user main program.	Irrecoverable.
ERR14	Absolute code overlays relocatable code in the disc scratch area.	Irrecoverable. Regenerate the system and select one of the following two options: 1. Reduce number of programs being loaded 2. Load the library after all other programs are loaded. If this is not successful, increase the size of the system disc and/or lower the starting track/sector of the system.
ERR15	More than 63 subprograms called by a main program.	Revise main program (subsequent calls to subprograms are ignored).

**Table 15-1. DSGEN Error Conditions (continued)**

Message	Meaning	Action
ERR16	Base page linkage overflow.	Diagnostic printed once when overflow occurs. Bounds field indicates the number of words overflowed. Revise order and composition of program loading to reduce linkage requirements.
ERR17	Current disc address exceeds number of available tracks.	Irrecoverable error.
ERR18	Memory overflow (absolute code exceeds LWA memory).	Diagnostic printed once when overflow occurs. Bounds field indicates the number of words overflowed. (Absolute code is generated beyond LWA). Revise program.
ERR19	Program overlay (current word of absolute code has identical location to previous word).	Current word is ignored (the address is printed).
ERR20	Binary DBL record overflow of internal table.	Records overlay previous DBL records (diagnostic printed for each overflow record). Revise program.
ERR21	Module containing entry point \$CIC not loaded.	Irrecoverable error. Regenerate the system; include DISCM.
ERR22	Read parity/decode disc error. A register bits 8-14 show track number; bits 0-7 show sector number.	After ten attempts to read or write the disc sector, the computer halts. To try ten more times, start the computer executing.
ERR23	EQT not entered for disc-resident I/O module.	Restart at $100_8$ .

#### Messages During I/O Table Entry

ERR24	Invalid channel number.	Enter valid EQT statement.
ERR25	Invalid driver name or no driver entry points.	Same as ERR24.
ERR26	Invalid or duplicate D,R,U operands.	Same as ERR24.
ERR27	Invalid logical unit number.	Enter valid DRT statement.
ERR28	Invalid channel number.	Enter valid INT statement.
ERR29	Channel number decreasing.	Same as ERR28.
ERR30	Invalid INT mnemonic.	Same as ERR28.
ERR31	Invalid EQT number.	Same as ERR28.
ERR33	Invalid entry point.	Same as ERR28.
ERR34	Invalid absolute value.	Same as ERR28.
ERR35	Base page interrupt locations overflow into linkage area.	Restart Disc Loading Phase.
ERR36	Invalid number of characters in final operand.	Same as ERR28.

**Table 15-2. DOS-III Bootstrap Error Halts**

Halt Code	Cause	Recovery Action
102011	Disc error status is in the A register. If A register contains 0, the subchannel did not contain a system.	Check that the device is ready and the proper disc cartridge is being used; then call maintenance.
102031	Same as above.	Occurs during execution of disc-resident part of Bootstrap. Check that the disc is ready; then call maintenance.

**Table 15-3. DOS-III Error Conditions**

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### DOS-III ERROR HALTS

Halt Code	Location	Cause	Recovery Action
102002	location 2 <sub>8</sub>	Possible memory wrap-around when	
102003	location 3 <sub>8</sub>	memory protect is not present.	Program error. Bootstrap DOS-III from the disc and correct the program.
102004	DISCM	Power has gone up or down with powerfail option present.	Bootstrap DOS-III from disc and restart.
102005	DISCM	Memory parity error occurred.	A-register contains address of word containing the parity error. Run the memory diagnostic programs, then bootstrap DOS-III from disc and restart.
102011	\$EX20	Disc parity error. Halt occurs after a message is printed giving location of error.	Unprotect the disc and start the computer executing. DOS-III assigns next spare track.
102031	DVR31	Trying to write on disc cylinder that is flagged "protected" without first unprotecting the disc.	Start the computer executing to exit DVR31 with no action taken.
102077	\$EX20	Follows message telling operator to protect the disc after spare track assignment.	Protect the disc and start the computer executing. DOS-III aborts the job that was running.

### DOS-III ERROR MESSAGES

During the operation of DOS-III certain messages may be output on the system console. These messages may be error reports or simply informative; they are generated by various parts of DOS-III. The messages are listed alphabetically including where they originated, what they mean, and what response if any, the operator must make. Messages that begin with a variable name or a non-alphabetic character are listed by the first non-variable, alphabetic character.

Message	Source	Description
BAD CONTROL STATE	JOBPR	Directive just entered is not acceptable in DOS III. Enter correct directive on system console. <sup>1</sup>
BEGIN 'DEBUG' OPERATION	DEBUG	Any legal DEBUG operations may now be entered. Enter any legal DEBUG operations.
BP BND [L,U] ?	LOADR	Specify the base page bounds desired for the program being loaded by the Loader. The bounds should be entered as two octal constants separated by a comma.
CHECKSUM ERROR	JOBPR	Checksum error in input to ST,R,file or ST,X,file directive. Correct tape. <sup>1</sup>

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<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
CW nnnnn	DISCM	In an I/O READ/WRITE EXEC call at nnnnn, buffer extends beyond memory bounds. Correct program.
DEVICE #nn DOWN	JOBPR	EQT #nn is unavailable (down). Use the UP,nn directive to make the device available. (Then use the GO directive if needed.)
DICTIONARY OVERFLOW	JOBPR	No room is left for entries in the user file dictionary. Put file on another disc or remove some of the files.
??? DISC	DISCM	Informs user that disc is not recognizable by DOS-III. Must be labeled or unlabeled with :IN, or formatted with DSGEN, before using in DOS-III.
DISC GEN CODE nnnn NOT SYS GEN CODE mmmm ERR POSS	DISCM	Informs the user that the disc being requested was initialized (labeled) by a system with a different system generation code. Generation code on disc may be updated by labeling or unlabeling using :IN.
DISC NOT ON SYSTEM	DISCM	No disc pack with the currently requested label can be found on the system. Mount disc pack with correct label or ready drive containing disc.
DONE?	JOBPR	Thirty feed frames (paper tape) or an end-of-file (magnetic tape) have occurred during input. Enter YES for end of input; NO for more input.
??? LABEL xxxxxx DOS LABEL xxxxxx TSB LABEL xxxxxx OK TO PURGE?	DISCM	Attempting to label (or unlabel) an already labeled disc pack. Enter YES to relabel the disc pack or NO to drop the request to relabel the disc pack.
DUPLICATE FILE NAME	JOBPR	Doubly defined file name found in a STORE directive (other than STORE,P); an EDIT directive with a new file name; on DD,U; or on a RENAME directive. Remove file or rename file. <sup>1</sup>
\$END ALGOL	ALGOL	End of ALGOL compilation. No response required.
\$END ASMB	ASMB	Assembly has completed. No response required.
\$END ASMB CS	ASMB	Assembly has ended because of an error in the assembler control statement. Correct the control statement.
\$END ASMB NPRG	ASMB	Assembly has terminated because no JFILE was found when required. Define the file using a JFILE directive.

<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
\$END ASMB PASS	ASMB	Another pass of the source program through the input device is required. Printed on the system console after Pass 1. Replace the program in the input device and type :GO.
\$END ASMB XEND	ASMB	Assembly stops. An EOF occurred in the source program before an END statement. Add an END statement to the program.
END FILE	JOBPR	During an EDIT, (1) the master file ended before completion of editing or (2) a triple colon occurred in the first 3 columns of a source statement. Check input to the EDIT program. <sup>1</sup>
\$END,FTN[4]	FTN[4]	Compilation has completed. No response required.
END JOB xxxx [RUN = xxxx MIN. xx.x SEC EXEC = xxxx MIN. xx.x SEC]	JOBPR	End of current job. Total job time and execution time of the job are printed on the system console and standard list device if a Time-base Generator is present.
ENTER FILE NAME(S) OR /E	LOADR	Enter list of relocatable program files. To terminate list of file names type "/E".
ENTRY ERROR	DEBUG	DEBUG operation entered was illegal. Correct entry.
EOF-NO DATA STORED	JOBPR	An attempt was made to read an EOF without first reading data. A file is not created when this message is output.
EQT xx CH xx DVRxx D R Ux Sx	JOBPR	Equipment table entry output by the EQ directive. No action required.
EXTRA PARAMETERS	JOBPR	More than 15 parameters in a directive. Excess parameters are not processed.
FI nnnnn	DISCM	In a FILE READ/WRITE EXEC call (1) the file requested at nnnnn cannot be found. If nnnnn is not present, enter the file. (2) The length of the buffer requested at nnnnn extends beyond the end of the file. Correct the buffer length. Either case causes calling program to abort.
HPAL??	ALGOL	Control statement error. Correct control statement.
IB nnnnn	DISCM	Illegal buffer address in EXEC call at location nnnnn. Program is aborted. Correct buffer program address.
IE nnnnn	DISCM	If a colon occurs in the first column of input entered through the batch device during a program execution, the program is aborted, control is given to the JOBPR and the input is processed as a directive. nnnnn is the memory location of the input request.

<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
IGNORED	DISCM	Input from system console during program execution cannot be processed. Correct input.
*IGNORED	JOBPR	All directives following EJOB and before next JOB except BATCH, TYPE, TRACKS, and OFF are ignored. Enter acceptable directive.
file ILLEGAL	JOBPR	On a source file LIST directive, the requested file was not a source file. Retype LIST directive using source file. <sup>1</sup> A file name begins with a non-alphabetic character. Rename the file. <sup>1</sup>
ILLEGAL DIGIT	JOBPR	In a decimal number, character is other than 0-9. Enter correct decimal number. In an octal number, digit is other than 0-7. Enter correct octal number. <sup>1</sup>
ILLEGAL LUN	JOBPR	Logical unit requested is equal to zero, greater than the number of logical units in the system, not the correct type (i.e., input type for output device), etc. Enter a correct logical unit. <sup>1</sup>
ILLEGAL PROGRAM RUN LIMITS	DISCM	Attempt to run a user main or segment whose user area limits or base page limits will not fit within the limits of the current system. Recreate user mains or segments on current system using LOADR.
ILLEGAL PROGRAM TYPE	JOBPR	Program requested in a RUN or PROG is not legal. Enter correct name. <sup>1</sup>
INPUT ERROR	DISCM	Equipment table entry number or logical unit number in :EQ, :LU, :UP or :DN is illegal. Enter correct equipment table or logical unit entry number.
INPUT :DATE, XXXXXXXXX[,H,M]	DISCM	When system is initiated from the disc, DOS-III requires a DATE directive. The [,H,M] is ignored in DOS-III if a Time-base Generator is not in the system. Enter a DATE directive:
I/O ERR ET EQT #mm	DISCM	End-of-tape on device #mm. EQT #mm is unavailable. To make the device available (up), use the UP,mm directive.
I/O ERR NR EQT #mm	DISCM	The device #mm is not ready. To make the device available (up), use the UP,mm directive.
I/O ERR PE EQT mm	DISCM	Parity error on device #mm returns to program return address with A set to status, B set to 0. Call maintenance.

<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
I/O ERR {PE } NR } USER DISC	DISCM	A parity error or device not ready occurred when attempting to assign a user disc. Disc may not be formatted; format it with DSGEN.
I/O ERR {PE } NR } USER DISK	DISCM	Disc error in completion section of DVR31. Retry previous operation.
IT nnnnn	DISCM	Illegal disc track or sector address in EXEC call from location nnnnn. Program is aborted. Correct the track or sector address in EXEC call.
JBIN OFV	FTN [,4], ASMB, ALGOL	Overflow of Job Binary Area during assembly or compilation. Reduce size of job or purge user files.
JOB ABORTED!	JOBPR	Correct problem and start new job.
JOB xxxxx dddddddddd [TIME = xxxx MIN. xx.x SECS EXEC = xxxx MIN. xx.x SEC.]	JOBPR	Message output at the beginning of each job. The time information is deleted in DOS-III if a Time-base Generator is not included in the system. Start job.
L01	LOADR	Checksum error on tape.
L02	LOADR	Illegal record.
L03	LOADR	Memory overflow.
L04	LOADR	Base page overflow.
L05	LOADR	Symbol table overflow.
L06	LOADR	Duplicate main or segment name (may be caused by attempting to run the Loader twice in one job).
L07	LOADR	Duplicate entry point.
L08	LOADR	No main or segment transfer address.
L09	LOADR	Record out of sequence.
L10	LOADR	Insufficient directory work area or user area space.
L11	LOADR	Program table overflow.
L12	LOADR	User file specified cannot be found.
L13	LOADR	Program name duplication.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
L14	LOADR	Non-zero base page length.
L15	LOADR	Segment occurred before main.
L16	LOADR	Program overlay (illegal ORG).
L17	LOADR	Illegal library record.
L18	LOADR	Illegal octal digit in base page bounds specification; or the lower base page bound is greater than the upper base page bound; or the lower or upper base page bound is greater than $2000_8$ . In keyboard mode, re-enter new base page bounds. In batch mode, Loader aborts.
L19	LOADR	Illegal octal digit in main memory bounds specification; or the lower program bound is greater than the upper program bound. In keyboard mode, re-enter new program bounds. In batch mode, Loader aborts.
LBL = 111111	DISCM	Disc subchannel referenced is labeled 111111. If attempting to change user disc subchannel, enter :UD with correct label.
LIMIT ERROR	JOBPR	In a directive, source statement numbers are out of order (:EDIT), dump limits are incompatible (:PDUMP, :ADUMP), sector numbers are illegal (:DUMP), number of words requested exceeds number of words available (:MMGT), or beginning source statement number is greater than final statement number (:EDIT). Correct directive and re-enter. <sup>1</sup>
xxxx LINES	JOBPR	Total number of statements stored by a STORE,S directive. No response required.
*****LIST END*****	JOBPR	Terminates list of source statements generated by a LIST directive. No response required.
LN nnnn	DISCM	Logical unit requested by an EXEC call at nnnnn is unassigned. Program is aborted. Assign logical unit.
LOADR COMPLETE	LOADR	Loading has completed. No responses required.
LOADR SUSP	LOADR	Loader has suspended (usually at EOT). Type :GO,n to restart the Loader with proper parameter value.
LOADR TERMINATED	LOADR	Loader has terminated because of an error. Correct input.
LOAD TAPE	LOADR	In conjunction with LOADR SUSP, this message requests that next relocatable tape be loaded before :GO. Load the next relocatable tape and enter :GO to read next tape or :GO,1 to indicate that all tapes are read in.

<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
LU nnnnn	DISCM	Illegal logical unit in EXEC call at nnnnn. Program is aborted. Enter correct logical unit number.
LUxx EQTyv	JOBPR	Logical unit table entry; EQT #yy assigned to LU #xx. No response required.
LUN UNASSIGNED	JOBPR	Logical unit requested in a directive is unassigned. Assign logical unit number requested in the directive. <sup>1</sup>
xxxxx MISSING	DISCM	Segment xxxxx requested by an EXEC call is not in system or user directory. Job is aborted. Correct job.
MISSING PARAMETER	JOBPR	A parameter is missing in a directive. Retype the directive correctly. <sup>1</sup>
MP nnnnn	DISCM	Memory protect violation at location nnnnn. Program is aborted. Correct the program.
NAME *IGNORED	JOBPR	Illegal JOB name; numeric first character. Retype correct job name.
NEXT AVAIL TRACK=tt BAD=n	JOBPR	In TRACK directive, tt = first track beyond end of current user area; n = number of bad tracks. "BAD=n" returned only if bad tracks do exist. tt = "NONE" if no tracks are available.
NO BIN END	JOBPR	No END record detected when storing a relocatable binary program. <sup>1</sup>
NO PROGRAMS LOADED	LOADR	No programs were loaded by the Loader. Loading terminates.
NO SOURCE	JOBPR	No source statements following a /R or /I in an EDIT directive. Enter source statements after the /R or /I. <sup>1</sup>
NO SOURCE	ALGOL	Source file from disc not pre-set.
NO SUBSYSTEMS DEFINED	JOBPR	Informs the user that a :MM directive was attempted but no subsystems were defined during system generation.
NUMBER OVERFLO	JOBPR	An integer is too large. <sup>1</sup>
OR nnnnn	DISCM	I/O operation requested by EXEC call at nnnnn is rejected. Program is aborted. Check program.
OVERFLOW JBIN	JOBPR	There is not enough room in the JBIN for storing the relocatable binary output from the Assembler or compilers. <sup>1</sup>
PARAMETER ILLEGAL	JOBPR	A parameter of a directive is illegal. Re-enter directive. <sup>1</sup>
PARITY ERROR SC=m,TRK=ttt,SCTR=sss	JOBPR	Parity error during disc read or write. Call maintenance.

<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
PAUSE xxxx	LIBR (Formatter)	Program has temporarily suspended itself. xxxx is an octal number acting as an identifier. Restart program using the GO directive.
PROG BND [L,U]?	LOADR	Enter the program bounds for the program being loaded by the Loader. The bounds consist of two octal numbers separated by a comma.
RE-ENTER STATEMENT ON TTY	JOBPR	Follows most error messages that do not cause abort. Type in the correct statement.
RQ nnnnn	DISCM	Illegal parameter in EXEC call at nnnnn. Program is aborted. Correct the program.
SPARE TRK OVERFLOW	JOBPR	Defective cylinder detected and no spare tracks available for reassignment.
STOP xxxxx: nnnnn	LIBR	Program xxxxx has terminated at location nnnnn.
SUBCHAN = n	DISCM/ JOBPR	Given in response to :UD information request or when :SS makes new subchannel assignment. No response required.
xxxxx SUSP	DISCM	Program xxxxx suspended by EXEC call or PAUSE directive. Restart program using the GO directive.
TAPE END	JOBPR	EOT flag set on magnetic tape or paper tape device during output via JOBPR directives DUMP and LIST or output of a JOB or EJOB statement. If a magnetic tape, it is rewound with standby; if paper tape, a trailer is punched. The JOBPR will then pause to allow new tape to be set up. Mount a new magnetic tape. Enter :GO to continue the output.
TM nnnnn	DISCM	Maximum execution time exceeded. The program is currently at nnnnn and is aborted. Increase execution time.
#TRACKS UNAVAILABLE	DISCM	There are not enough word tracks for the compiler. Enter :OFF then purge disc of unnecessary files.
TRAC #TOO BIG	JOBPR	Track requested is higher than last available disc track (track may be in JBIN area). Redefine the track request or purge files or use different disc. <sup>1</sup>
TSB DISC	DISCM	Informs user that the user disc was labeled by a non-DOS-III system. May be made DOS-III disc by labeling or unlabeled with :IN.

<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

**Table 15-3. DOS-III Error Conditions (continued)**

Message	Source	Description
TURN { ON } OFF } DISC PROTECT OVERRIDE SWITCH	DISCM	Unprotect [ON] or protect [OFF] the disc.
UD nnnnn	DISCM	Unable to find user disc requested by EXEC call at nnnnn. Mount required disc and type :GO; or terminate program with :ABORT or :OFF.
UNLBL	DISCM	User disc specified in :UD is unlabeled. If trying to change user disc assignment, enter :UD,*[,n].
file name UNDEFINED	JOBPR	Undefined file name as a parameter of a directive. Retype correct file name on the system console. <sup>1</sup>
subsystem name UNDEFINED	JOBPR	Undefined subsystem name as a parameter of :MMGT directive. Subsystem names must be defined at system generation.
UNDEFINED EXTS	LOADR	Undefined external references exist in programs loaded. The external references are listed one per line. To load additional programs from paper tape, type :GO,0[,n].
WRONG INPUT	JOBPR	Relocatable binary input furnished for a source file request or vice-versa. Enter correct input. <sup>1</sup>
name: nn xx	ERR0	Library routine error code, where name is the name of the user's program, nn is the routine identifier and xx is the error type.
@	JOBPR/ DISCM	Directives may be entered. Enter desired directive.
*	DISCM	Operator attention directives may be entered. Enter desired directive.

<sup>1</sup>This error causes a batch abort if the command is entered in batch mode. See "Batch Abort" in Section 1.

## **DOS-III EFMP ERROR CODES**

These error numbers are returned to the user program (in ERRNO) by the EFMP. The error numbers are also returned in the A register.

Error No.	Description
0	No errors.
1	Invalid EFMP function number.
2	Duplicate file name.
3	File name not in directory.
4	File too long for this pack.
5	Invalid record length.
6	Pack number not available (or name not in directory if a search was made on all available pack directories).
7	Invalid security code.
8	A temporary file must be opened with a CREATE function. An OPEN function can only change the Temporary Record Buffer number of the starting record number for a temporary file.
9	Buffer area specified in Exec call is not valid.
10	Invalid Record Number.
11	File not open.
12	DEFINE not previously executed or Opened-File table used in previous DEFINE has been altered. Issue a new DEFINE.
13	Backspaced beyond "start-of-file."
14	No pack space available.
15	Invalid pack number.
16	No pack number entry is available in Opened-File table.
17	Work Area space not sufficient.
18	No Opened-File table space available.
19	Invalid temporary record buffer number.
20	Invalid number of EXEC call parameters.

Error No.	Description
21	End-of-File.
22	COPY terminated.
23	Invalid argument(s).
24	Maximum number of files exceeded.
25	File already OPEN.
26	Record size larger than one-half of a temporary record buffer.
27	Pack number previously initialized.
28	Pack number not initialized.
29	Directory requested is too large.
30	Invalid number of active pack numbers.

**PART 6**

***Appendix and Indexes***

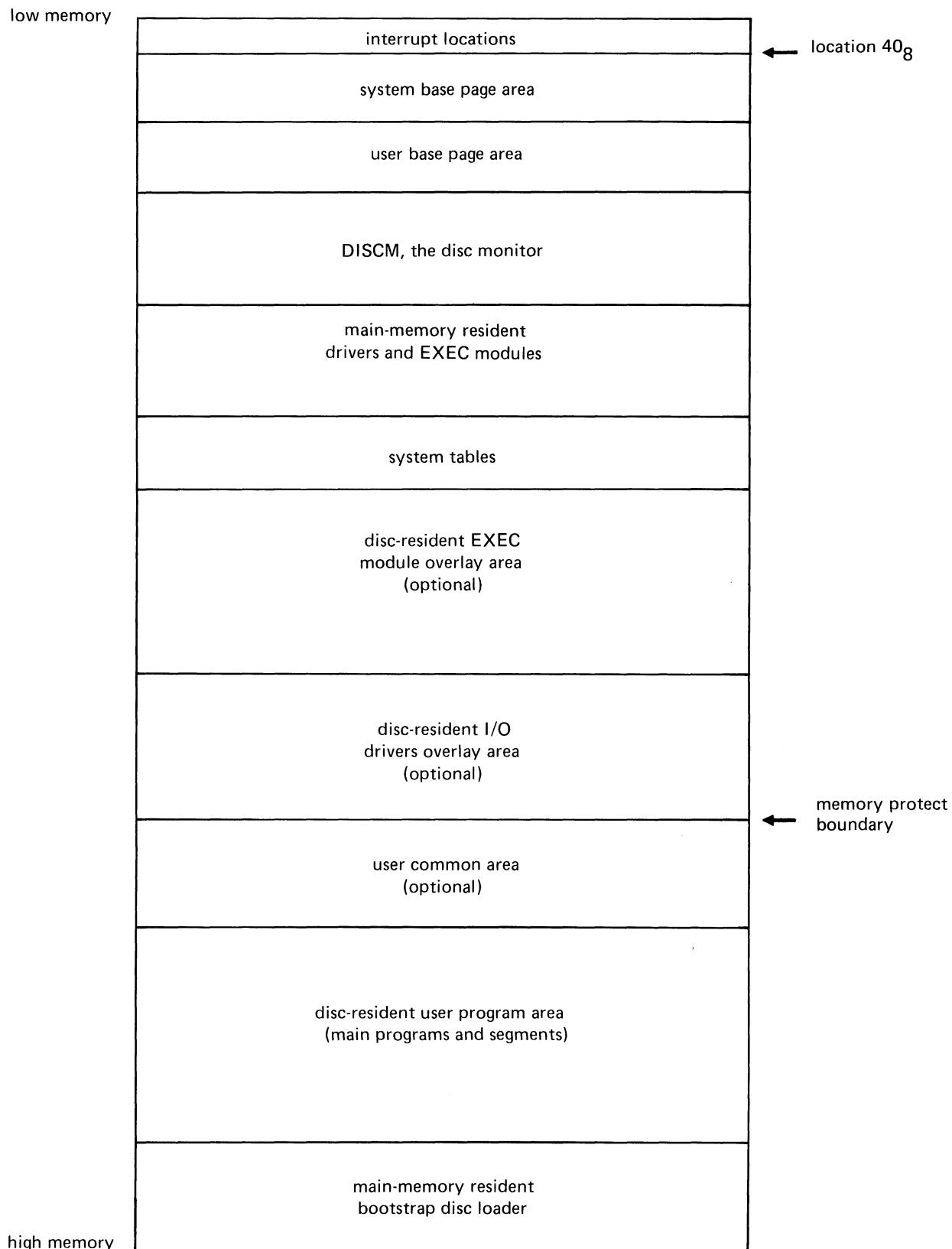


# ***APPENDIX A***

## ***System Tables***

This appendix contains figures and tables which represent the structure of the following

- Main-memory layout, including
  - main memory allocations in DOS-III
  - DOS-III base page constants
  - DOS-III base page communication area
- Disc layout, including
  - disc structure in DOS-III
  - disc directory entry format
  - disc labels
- System I/O tables, including
  - the equipment table
  - the logical unit table
  - the interrupt table



**Figure A-1. Main Memory Allocations in DOS-III**

**Table A-1. DOS-III Base Page Constants**

<b>Location</b>	<b>Type</b>	<b>Value</b>
40	DEC	-64
41	DEC	-10
42	DEC	-9
43	DEC	-8
44	DEC	-7
45	DEC	-6
46	DEC	-5
47	DEC	-4
50	DEC	-3
51	DEC	-2
52	DEC	-1
53	DEC	0
54	DEC	1
55	DEC	2
56	DEC	3
57	DEC	4
60	DEC	5
61	DEC	6
62	DEC	7
63	DEC	8
64	DEC	9
65	DEC	10
66	DEC	17
67	DEC	64
70	OCT	17
71	OCT	37
72	OCT	77
73	OCT	177
74	OCT	377
75	OCT	177400
76	OCT	3777
77	OCT	177700

**Table A-2. DOS-III Base Page Communication Area**

Location	Name	Contents
100	UMLWA	Last word address of user available memory
101	JBINS	Start track/sector of Job Binary Area
102	JBINC	Current track/sector of Job Binary Area
103	TBG	Time-base Generator I/O channel address
104-5	CLOCK	Current system clock time (2 words)
106-7	CLEX	Execution clock time (2 words)
110	CXMX	Maximum allowable execution time
111	BATCH	Logical unit # of batch input device
112	SYSTY	Logical unit # of system console
113	DUMPS	Abort/Post Mortem dump flag
114	SYSDR	System directory track/sector
115	SYSBF	System buffer track/sector
116	SECTR	Number of sectors/disc track
117	EQTAB	First word address of equipment table
120	EQT#	Number of equipment entries
121	LUTAB	First word address of logical unit table
122	LUT#	Number of logical unit entries
123	JBUF	Job input buffer address
124	JFILS	Source file starting track/sector
125	JFILC	Source file current track/sector
126-32	RONBF	Parameter buffer (5 words)
133	MDFLG	Mode flag for privileged I/O
134	DISP	(Reserved for System use)
135	AEPF	Alternate entry point flag
136	SGRTN	Segment return address
137	XIRT	System transfer address for interrupt-completion routine
140	SVEQT	EQT address for I/O operations
141-53	EXPG	Directory entry for current program (11 words)
154	DISCO	Disc I/O channel/last track on disc
155	SYSSC	System subchannel

**Table A-2. DOS-III Base Page Communication Area (continued)**

Location	Name	Contents
156	SCCNT	Number of subchannels on system minus 1
157	UDNTS	Next user disc track/sector
160	SYNTS	Next system disc track/sector
161	CUDSC	Current user disc subchannel
162	CRFLG	Current disc request flag: 0 for system, non-0 for user
163	CUDLA	Current user disc last access
164	FSFLG	File search flag
165	CUMID	Computer identification
166-70	DBUFR	System disc triplet parameter buffer (3 words)
171-73	UBUFR	User disc triplet parameter buffer (3 words)
174	TSONE	Last track/sector referenced +1
175	GUDSC	Default user disc subchannel
176	SYSCD	System generation code
177	JFLSC	Source file subchannel
200	DISCL	User label track/sector
201	INTAB	First word address of interrupt table
202	INT#	Number of interrupt entries
203	EQT1	
204	EQT2	
205	EQT3	
206	EQT4	
207	EQT5	
210	EQT6	
211	EQT7	EQT1-EQT17 are addresses of current equipment table entry
212	EQT8	
213	EQT9	
214	EQT10	
215	EQT11	
216	EQT12	
217	EQT13	

**Table A-2. DOS-III Base Page Communication Area (continued)**

Location	Name	Contents
220	EQT14	
221	EQT15	
222	EQT16	
223	EQT17	
224	RQCNT	Number of request parameters
225	RQRTN	Current request return address
226	RQP1	
227	RQP2	
230	RQP3	
231	RQP4	
232	RQP5	
233	RQP6	
234	RQP7	
235	RQP8	
236	NABRT	Illegal request code abort/no abort option
237	XA	A register contents at time of interrupt
240	XB	B register contents at time of interrupt
241	XEO	E and O register contents at time of interrupt
242	XSUSP	Point of suspension at time of interrupt
243	EXLOC	Address of Exec module doublet table
244	EX#	Number of Exec module doublet table entries
245	EXMOD	Exec module # currently in Exec module overlay area
246-47	EXMAN	Exec module low and high main memory addresses (2 words)
250-51	EXBAS	Exec module low and high base page memory addresses (2 words)
252	IODMN	First word address of I/O driver module main area
253	IODBS	First word address of I/O driver module base page area
254	UMFWA	First word address of user main area
255	UBFWA	First word address of user base page area
256	UBLWA	Last word address of user base page area

**Table A-2. DOS-III Base Page Communication Area (continued)**

Location	Name	Contents
257	CHAN	Current DMA channel number
260	OPATN	Operator/keyboard attention flag
261	OPFLG	Operator communication flag
262	SWAP	Job processor resident flag
263-64	JOBPM	Job processor disc address/number of words in main (2 words)
265	JOBPB	Job processor base page number of words
266	EJOBF	End-job flag
267	RTRK	Real time simulation track number
270	DUMMY	Reserved for system use
271	MPTFL	Memory protect flag
272	\$GOPT	Point of suspension continuation address
273	\$IDCD	Input request code check
274-75	\$MDBF	Exec module data buffer (2 words)
276-304	TEMP	Reserved for data communications (7 word buffer)
305	TEMPO	{}
306	TEMP1	
307	TEMP2	
310	UTMPO	{}
311	UTMP1	
312	UTMP2	
313	MSECT	Negative number of sectors/track
314	VADR	Address of instruction causing memory protect violation
315	IODMD	Current resident I/O driver module flag
316	RCODE	Current request code value
317	SXA	Operator attention restore A register value
320	SXB	Operator attention restore B register value
321	SXEO	Operator attention E and O register value
322	SXSUS	Operator attention return address
323	EFMP	Extended File Management Package flag

**Table A-2. DOS-III Base Page Communication Area (continued)**

<b>Location</b>	<b>Name</b>	<b>Contents</b>
324	DSCLB	Disc track/sector of Relocatable Library
325	DSCL#	Number of Relocatable Library routines
326	LSTCH	Last disc referenced
327	FLFLG/TRAC#	User file table validity flag/#Bad tracks found
330	XFLG	Entry address for disc not ready
331	SSFLG	System search flag
332	CHARC	Batch input character count
333	TYEQT	System console EQT4 address
334	DMFLG	Data Management Flag
335	SSTBL	Address of Subsystem Table
336	TMBEG	Address of Timer List

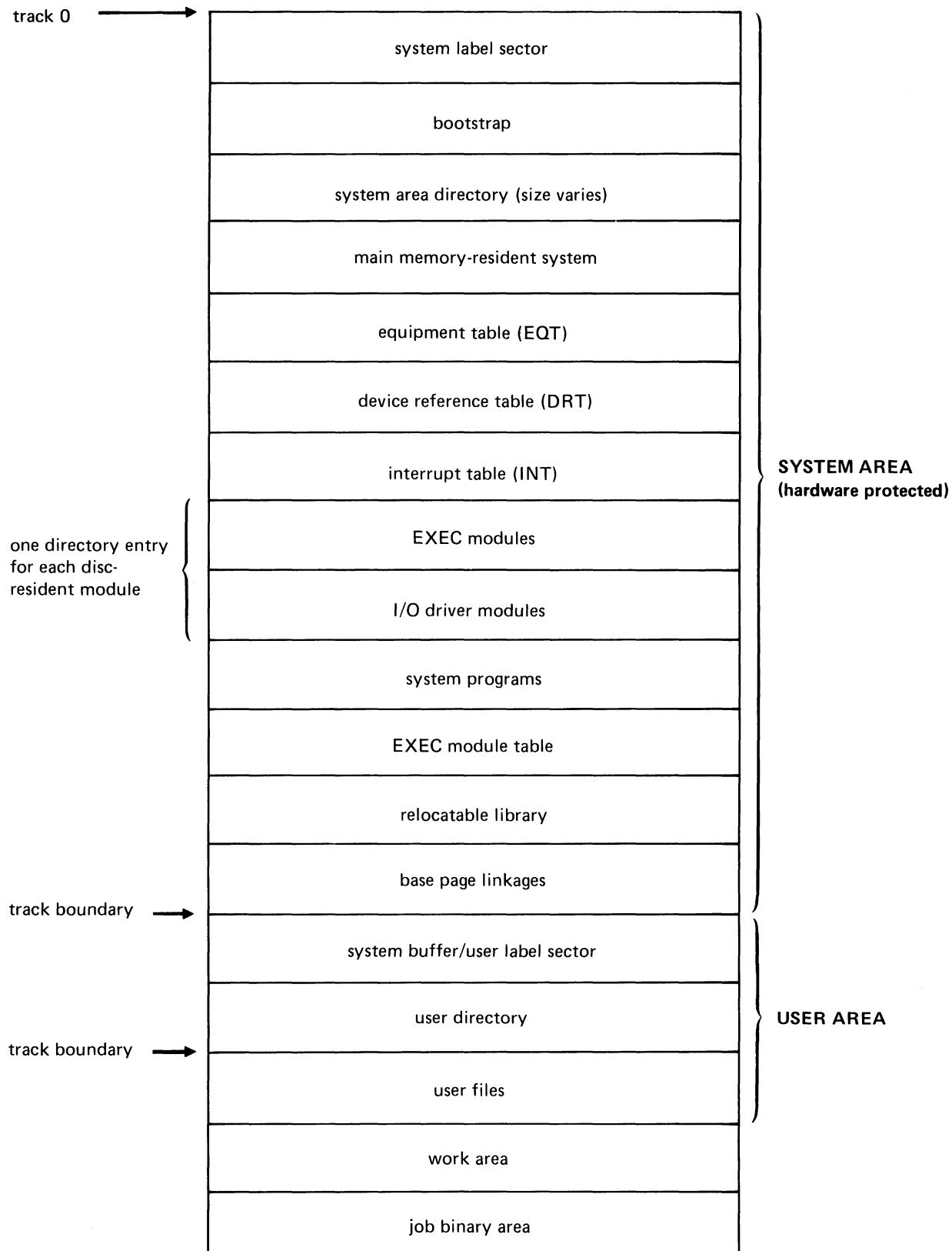


Figure A-2. Disc Structure in DOS-III

WORD	CONTENTS	
1	first character	second character
2	third character	fourth character
3	fifth character	P entry type
4	track	sector
5	file length (in sectors)	
6	FWA program	
7	LWA program	
8	FWA base page linkage area	
9	LWA base page linkage area	
10	program entry point	
11	FWA of memory available for memory management (see Note)	

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0      BITS

(five-character file name)

for system or loader-generated binary programs only

*Note: For overlays, word 11 value is the last word (plus 1) of the overlay. For a main program, word 11 value is the last word (plus 1) of the largest segment.*

**Figure A-3. Disc Directory Entry Format**

## 'P' Bit

0 = Permanent file—no action is taken at end-of-job.

1 = Temporary file—purge this entry at end-of-job.

This bit is set by the Relocating Loader and cleared by a STORE,P directive.

## Entry Type

Type	File
0	System resident
1	Disc-resident executive supervisor module
2	Reserved for system
3	User program, main
4	Disc-resident device driver
5	User program segment
6,7	Library
10 <sub>8</sub>	Relocatable binary
11 <sub>8</sub>	ASCII source statements
12 <sub>8</sub>	Binary data
13 <sub>8</sub>	ASCII data
14 <sub>8</sub>	Absolute binary

*Note: The last directory entry in each sector is followed by a word containing -1.  
The last entry in the directory is followed by a word containing zero (0).*

## DISC LABELS

Sector 0 of track 0 of each disc is used for label information. In addition, if the user area is on the system disc, a label also exists in Sector 0 of the first track after the system area. The first 64 words (words 0-63) are reserved for label information. Word 64 contains the next available track and sector. Words 65 and 66 contain the number of bad tracks and the next available spare track.

The contents of the label include:

Word 0: Label presence code (ASCII "LB" for labeled, zero for unlabeled)

Word 1: System proprietary code:

1. "DO" for DOS-III
2. "TS" for Time-shared BASIC

Word 2: System generation code assigned at system generation time. The code can be any four decimal digits.

Words 3-5: A six-character disc label. If the first character equals \* the disc is unlabeled. This label can only be set using :IN (for user areas) or by DSGEN (set to "SYSTEM" for system discs).

Word 31: Checksum of words 0-30.

## THE EQUIPMENT TABLE

The equipment table (EQT) has an entry for each device recognized by DOS-III (these entries are established by the user when DOS-III is generated). The EQT entries reside in the permanent main-memory resident part of the system and have this format:

D	= 1 if DMA channel required.
R	= 1 if driver type is main-memory resident.
Unit #	May be used for subchannel addressing.
Channel #	I/O select code for device (lower number if multiboard interface).
Av	= 0 Unit not busy and available = 1 Unit disabled (down) = 2 Unit busy

Status—Actual or simulated unit status at end of operation.

Equipment Type Code—Identifies type of device and associated software driver. Assigned equipment type codes in octal are:

00-07	Paper Tape Devices
00	Teleprinter
01	Punched Tape Reader
02	High Speed Punch
04	Display Terminal
05	System Console
10-17	Unit Record Devices
11	Card Reader
12	Line Printer
20-37	Magnetic Tape/Mass Storage and other devices capable of both input and output
23	7970 Magnetic Tape
26	2762A Terminal Printer
31	Moving-Head Disc
33	Writable Control Store

For equipment type codes 01 through 17, odd numbers indicate input devices and even numbers indicate output devices (except 05, which is both input and output).

WORD	CONTENTS
1	driver "initiation section" address
2	driver "continuation section" address
3	D    R    (reserved)    unit #    channel #
4	Av    equipment type code    status
5	(saved for driver use)
6	(saved for driver use)
7	request return address
8	(reserved for system)
9	current I/O request control word
10	request code
11	request buffer address
12	request buffer length
13	temporary or disc track #
14	temporary or starting sector #
15	temporary storage for driver
16	upper memory address: main driver area
17	upper memory address: driver linkage area
	starting track #    starting sector #

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0      BITS

} All zeros if  
main-memory  
resident

Figure A-4. The Equipment Table

## THE LOGICAL UNIT TABLE

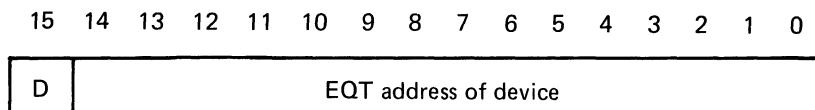
The logical unit table (LUT) has an entry for each logical unit defined at system generation time (maximum number is 63). These entries provide logical addressing of the physical devices defined in the EQT. Logical unit numbers 4-63 may be modified within a job by using the LU directive. At end-of-job, logical unit number 1-9 are restored to their original system generation values. The LUT entries reside in the permanent main-memory resident part of the system and have the following format:

Word	Contents
1	Device EQT number
:	
n	Device EQT number

## THE INTERRUPT TABLE

The interrupt table (INT) contains an entry, established at system generation time, for each I/O channel which can cause an interrupt (beginning with I/O channel 6). The INT entries reside in the main-memory resident portion of the system and have the following format:

The entry is in the following form:



D = 0 no DMA interrupts expected

D = 1 DMA interrupts expected

Bit 15 is set and cleared by calls to \$SDMA and \$CDMA, respectively.



# **INDEX 1**

## ***Summary of Directives***

Directive	Description	Page
<i>:ABORT</i>	Terminate the current job	2-3
<i>:ADUMP[,FWA [,LWA]] [,B] [,S]</i>	Dump a program if it aborts	2-13
<i>:BATCH, logical unit</i>	Switch from keyboard to batch mode, or reassign batch device	2-4
<i>:CLEAR [,logical unit]</i>	Clear the Job Binary Area or issue a clear request to an I/O device	2-5
<i>:COMMENT string</i>	Print a message on the system console	2-6
<i>:DATE, day [,hour,min]</i>	Set the date (and the time, if Time-base Generator is present)	2-7
<i>:DD</i>	Dump the entire current disc onto a disc on another subchannel	2-9
<i>:DD,X</i>	Dump the system area only to another disc	2-9
<i>:DD,U[,file[,,(name)] ,file[,,(name)] . . . ]</i>	Dump all or specified files of the current user disc to another disc, optionally assigning new file names	2-9
<i>:DN,n</i>	Declare an I/O device down	2-8
<i>:DUMP,logical unit,file[,S<sub>1</sub> [,S<sub>2</sub>] ]</i>	Dump all or part of a user file to a peripheral I/O device	2-11
<i>:EA [,P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>,P<sub>5</sub>]</i>	Execute user EXEC module \$EX36	12-2
<i>:EB [,P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>,P<sub>5</sub>]</i>	Execute user EXEC module \$EX37	12-2
<i>:EDIT,file,logical unit[,newfile]</i>	Edit a source statement file stored on disc, optionally creating a new file	2-17
<i>:EF[,logical unit]</i>	Write end-of-file on magnetic tape	2-21

Directive	Description	Page
:EJOB	Terminate the current batch and/or job normally	2-22
:EQ[, <i>n</i> ]	List the complete equipment table, or just one line	2-23
:GO[, <i>P</i> <sub>1</sub> , <i>P</i> <sub>2</sub> , . . . , <i>P</i> <sub>5</sub> ]	Continue processing a suspended program	2-25
:IN, <i>label</i>	Label or unlabel ("*") the current user disc	2-26
:JFILE, <i>file</i>	Specify a source file on the disc for the Assembler or a compiler	2-43
:JOB[, <i>name</i> ]	Initiate a user job	2-28
:LIST, <i>S,logical unit,file[,<i>m</i>[,<i>n</i>]]</i>	List all or part of a source statement file	2-29
:LIST, <i>U,logical unit[,file</i> <sub>1</sub> <i>, . . . ]</i>	List all or part of the user directory	2-29
:LIST, <i>X,logical unit[,file</i> <sub>1</sub> <i>, . . . ]</i>	List all or part of the system directory	2-29
:LU[, <i>n</i> <sub>1</sub> <i>[,<i>n</i><sub>2</sub>]]</i>	Assign or list logical unit assignments	2-33
:MMGT[, <i>subsystem name,wwwwww,. . . , subsystem name,wwwwww</i> ]	Reserve memory address space (in words) for specific subsystems or obtain a list of previously reserved memory space	2-35
:OFF	Abort the currently executing program or operation without terminating the job	2-37
:PAUSE [ <i>comment string</i> ]	Suspend the current job or program (optionally, output a comment on the system console)	2-38
:PDUMP[,FWA[,LWA]] [,B] [,S]	Dump a program after normal completion	2-13
:PROG, <i>name[,<i>P</i><sub>1</sub>,<i>P</i><sub>2</sub>, . . . ,<i>P</i><sub>5</sub>]</i>	Turn on a system or user program	2-39
:PURGE[, <i>file</i> <sub>1</sub> , <i>file</i> <sub>2</sub> . . . ]	Delete all temporary file or specified user file directory entries.	2-40
:RNAME, <i>oldname,newname[,type]</i>	Rename a specified user file and optionally, change its program type	2-42
:RPACK	Repack disc user file area eliminating purged files (see :PURGE directive)	2-44
:RWND[, <i>logical unit</i> ]	Rewind a magnetic tape	2-43
:RUN, <i>name[,time] [,N]</i>	Run a user program	2-45
:SA, <i>track,sector[,number]</i>	Dump disc in ASCII to standard list device	2-15
:SO, <i>track,sector[,number]</i>	Dump disc in octal to standard list device	2-15
:SS	Set up system search for file names over all subchannels	2-52
:SS, <i>n</i> <sub>1</sub> , <i>n</i> <sub>2</sub> . . .	Set up system search for file names over specified subchannels	2-52

Directive	Description	Page
:SS,99	Restrict search for file names to current user disc (plus system directory for RUN and PROG)	2-52
:STORE,A,file,sectors	Reserve space for an ASCII data file	2-47
:STORE,B,file,sectors	Reserve space for a binary data file	2-47
:STORE,P[,name <sub>1</sub> ,name <sub>2</sub> . . . ]	Store all or specified temporary Loader-Generated programs as permanent files	2-47
:STORE,R,file[,logical unit]	Store a relocatable file from the JBIN area of disc after an assembly or compilation or from a peripheral I/O device	2-47
:STORE,S,file,logical unit[,C]	Store a source statement file from a peripheral I/O device	2-47
:STORE,X,file,logical unit	Store absolute binary programs	2-47
:TOF[,logical unit]	Issue a top-of-form to a list device	2-54
:TRACKS	Print the disc track status of the current user disc	2-55
:TYPE	Return to keyboard mode from batch mode	2-57
:UD[,,[label] [,n] ]	Change the subchannel assignment for the user disc, or request label and subchannel information for a user disc	2-59
:UP,n	Declare an I/O device up	2-58



# ***INDEX 2***

## ***Summary of EXEC Calls***

Consult Section III for the complete details on each EXEC call.

RCODE	Name	Function	Page
-19	BASE PAGE STORE	Store values into base page memory locations (Value to be stored in the A register, absolute location address in the B register)	3-6
1, 2	I/O READ/WRITE	Transfer input or output (1 = read or 2 = write)	3-20
3	I/O CONTROL	Carry out control operations	3-17
6	PROGRAM COMPLETION	Signal end of program	3-30
7	PROGRAM SUSPENSION	Suspend calling program	3-33
8	SEGMENT LOAD	Load segment of calling program	3-35
10	PROGRAM LOAD	Transfer a main program into main memory	3-31
11	TIME REQUEST	Request the time-of-day	3-38
13	I/O STATUS	Request device status	3-23
14, 15	FILE READ/WRITE	Read or write a user data file (14 = read or 15 = write)	3-13
16	WORK AREA STATUS	Ascertain if <i>n</i> contiguous work tracks are available	3-41
17	WORK AREA LIMITS	Ascertain first and last tracks of work area	3-39
18	FILE NAME SEARCH	Ascertain if a file name exists in the directory	3-9

RCODE	Name	Function	Page
23	USER DISC CHANGE	Change the current user disc subchannel	3-43
24	EFMP CALLS	Execute EFMP functions	Section VII
27, 28	USER EXEC CALLS	Execute user EXEC modules \$EX36 or \$EX37 (RCODE = 27 for \$EX36; RCODE = 28 for \$EX37; up to five words of parameter information)	Section XII
29	SEGMENT RETURN	Return from a segment to the main program at the instruction immediately following the segment load call	3-37
30	MEMORY PROTECT CONTROL	Control memory protect from a user program	3-29
31	(Reserved for future assignment)		
32	FILE CREATE	Allows user to create a user disc file under program control.	3-7
33	FILE PURGE	Allows user to purge a user disc file under program control.	3-11
34	FILE RENAME	Allows user to rename a user disc file under program control.	3-15
35	MEMORY MANAGEMENT (INITIALIZE)	Reserves a block of memory under a unique block name identifier specified by the user.	3-26
36	MEMORY MANAGEMENT (STATUS REQUEST)	Requests number of words allocated to specified block name identifier, or number of remaining unallocated words if block name identifier is omitted.	3-28
37	(Reserved for future assignment)		
38	MEMORY MANAGEMENT (BUFFER ALLOCATION)	Allocates buffer area from memory space. If the block name identifier is specified, the buffer allocation is from the area reserved for the block name. If not, the allocation is from the available memory area.	3-24
39	(Reserved for future assignment)		
40	(Reserved for future assignment)		
41	MEMORY MANAGEMENT (BUFFER RELEASE)	Permanently releases buffer space. If the buffer resides within an area reserved under a block name identifier, the logical address space remains reserved.	3-25

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