

# **RTE-6/VM DVM33/DVN33**

## **Reference Manual**



# PRINTING HISTORY

The Printing History below identifies the Edition of this Manual and any Updates that are included. Periodically, Update packages are distributed which contain replacement pages to be merged into the manual, including an updated copy of this Printing History page. Also, the update may contain write-in instructions.

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# Preface

This instruction manual describes the DVM33 driver, the software interface for devices connected to the HP 12821A Disc Interface. Before attempting to use the driver, you should be familiar with the information contained in the HP 12821 Disc Interface Manual (12821-90006) and the HP CS80 Instruction Set Programming Manual (5955-3442). Other related manuals are defined in the Index to Operating System Manuals (92084-90001).

To facilitate references to the information, this manual is organized into seven chapters:

- Chapter 1 introduces the DVM33/DVN33 driver and defines the software components and operating environment. This section also contains a functional overview of the driver.
- Chapter 2 defines the DVM33 read and write request operating mode. These include track and sector addressing and block-addressed requests. Special read/write requests such as retrieving DESCRIBE information, track-map information also are described. This chapter also defines the use of the special EXEC call provided to allow a utility program to directly control a CS80 device.
- Chapter 3 describes the methods for obtaining the device status. The error fields (reject errors, fault errors, access errors and information errors) returned in the status information words are defined together with the most probable causes of the errors.
- Chapter 4 describes the cartridge tape drive (CTD) control requests, and defines the disc cache memory scheme used with the CTD cartridge tapes.
- Chapter 5 defines the routines that can be used to directly control the CS80 discs. Examples are provided for the disc-control routines.
- Chapter 6 provides procedures for generating a CS80 drive into your system. Procedural steps are provided for generating the Equipment Table (EQT) Device Reference Table (DRT) and Interrupt Table entries. The disc Track Map Table format also is given.
- Chapter 7 defines the DVM33 error-message format and lists the most likely causes of I/O errors.



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# Chapter 1

## General Information

### Introduction

Driver DVM33 is the RTE-6/VM operating system software interface for devices connected to the HP 12821A Disc Interface Card. Up to four of the following disc and cartridge tape drives may be driven by a single card:

HP 7908P/R Disc Drive  
HP 7911P/R " "  
HP 7912P/R " "  
HP 7935H " "  
Cartridge Tape Drive (CTD)

Refer to the HP 12821A Disc Interface Installation and Service Manual (12821-90006) for details of installation and cabling restrictions. A second driver may be used with another 12821A card to increase the number of devices that can be connected to the system. This driver, uniquely identified by the system as DVN33, is a copy of DVM33 with components edited as necessary to rename entry points. Functionally, it is identical to DVM33.

### Components

The software components of the DVM33 and DVN33 consist of the following modules:

<u>name</u>	<u>Description</u>
%DVM33	Binary relocatable module of DVM33
;%\$TM33	Track Map Table (required only if DVM33 is not a system disc driver)
;\$CSERR	Error reporting module
;\$DTCLB	Direct Command Library
%DVN33	Binary relocatable module of DVN33
;%\$TN33	Track Map Table for DVN33

## Operating Environment

The operating environment for driver DVM33 (and DVN33) is the RTE-6/VM operating system. The hardware components are the following:

- HP 1000 M/E/F Series Computer
- HP 12821A Disc Interface Card
- HP 7908/7911/7912/7935 Disc Drives
- Cartridge Tape Drives

The disc drives are referred to as the Command Set 80 (CS80) drives. Each drive may contain several devices; for example, a 7908 and a CTD may be in the same drive unit with one disc drive controller. A sample disc subsystem configuration is shown in Figure 1-1. Refer to Chapter 6 of this manual and to the HP 12821A Disc Interface Manual for configuration information.

## Related Manuals

The following manuals are related to DVM33 and may be ordered from any Hewlett-Packard Sales Office.

HP CS80 Instruction Set Programming Manual	5955-3442
HP 12821A Disc Interface Manual	12821-90006
RTE Operating System Driver Writing Manual	92200-93005
RTE-6/VM Programmer's Reference Manual	92084-90005
RTE-6/VM Utility Programs Reference Manual	92084-90007
RTE-6/VM System Manager's Reference Manual	92084-90009
RTE-6/VM On-Line Generator Reference Manual	92084-90010



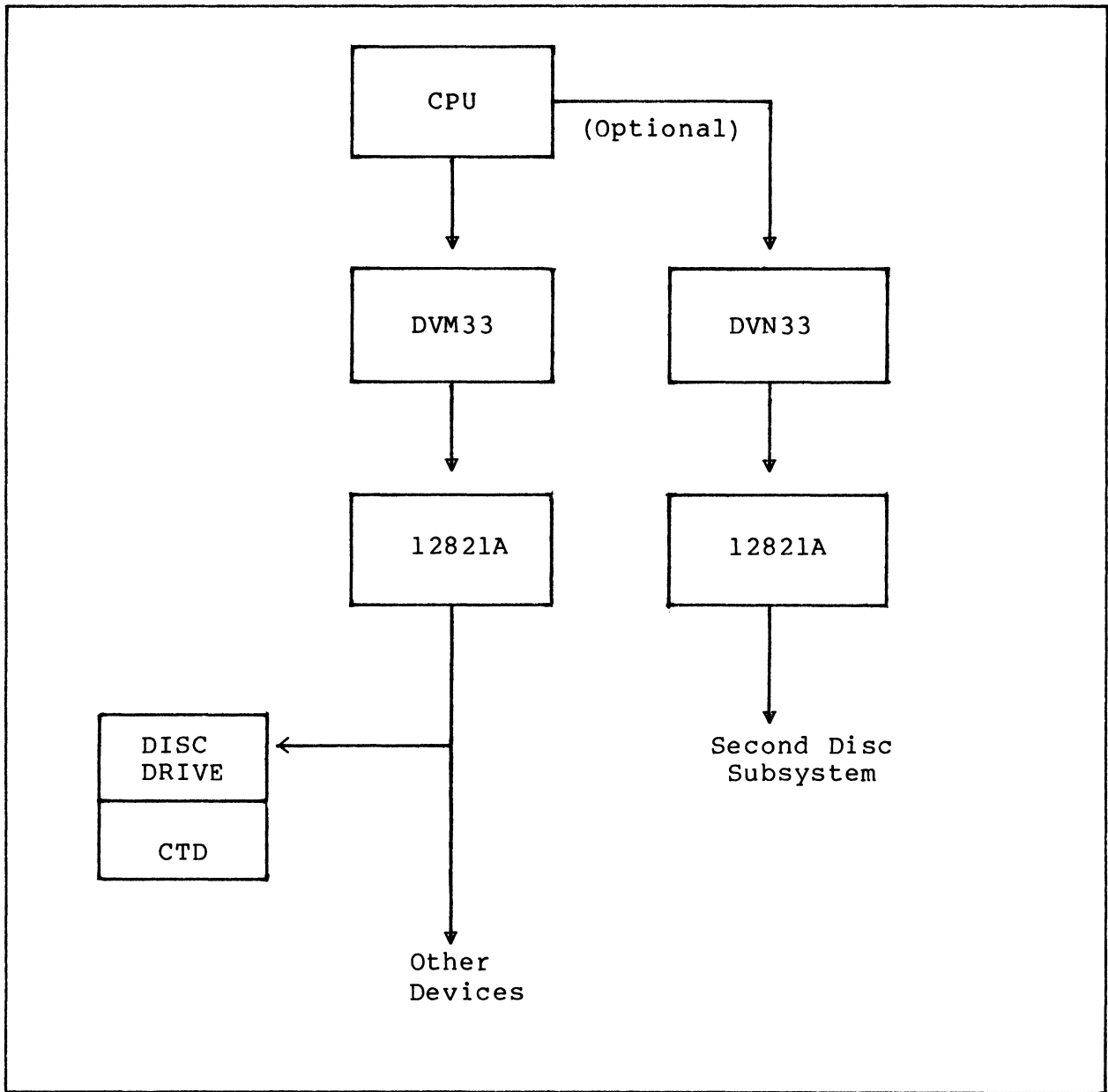


Figure 1-1. Sample Disc Subsystem Configuration

## Functional Overview

Driver DVM33 provides the means with which programmers can write application programs to access the CS80 disc or cartridge tape drives. Calls can be included in Assembly or FORTRAN programs to invoke the driver for disc or tape drive access.

The driver communicates with the CS80 disc or tape drives through the 12821A Disc Interface Card. A drive is accessed by means of a select code number between 0 and 7, assigned during the operating system generation and set with a switch on the drive.

While all drives accessed by DVM33 have 128-word sectors, the number of sectors per track can vary. The capacities of each drive are given in Chapter 6 of this manual.

Each word (or integer) as used in this manual contains 16 bits. DVM33 supports transfers on 64-word logical sector boundaries. Due to the read-modify-write sequence required for 64-word logical-sector access, performance degradation occurs with read requests beginning on odd sectors, or write requests ending in even sectors.

All devices are addressed in block mode (at the driver level) so that they appear uniform in format. This also allows standard access to all CS80 disc devices without concern for track size and number of surfaces.

To optimize disc access time, all CS80 disc drives are in "pack" mode. This means that the drive attempts to seek to the next surface before seeking to the next cylinder. Fixed and removable packs are physically separate volumes that are addressed individually. This "pack" mode facility also makes it possible for DVM33 to handle transfers of up to 32k in one operation with no interruptions, thus significantly improving disc access times on RTE systems.

DVM33 has four modes of operations: standard RTE EXEC read and write (the primary operating mode), status request, CTD control, and direct disc control. These operations are briefly described below and detailed in the following chapters.

## **EXEC Read and Write**

The EXEC read and write operation includes the use of pack (cylinder) mode to speed up long transfers (up to 32k in one contiguous transfer). This type of request uses track and sector or block addresses in its EXEC parameters. This mode also uses caching requests through a disc buffer to improve the speed of an integrated CTD.

## **Status Requests**

The status request operation consists of using calls to obtain information about the state or configuration of a device. This includes requests to return status, subchannel size, track map information, and the CS80 DESCRIBE information.

## **CTD Control**

The CTD control operation consists of using calls to control the operation of an integrated CTD drive. If a cache exists, this operation includes opening and closing the cache, writing file marks, and unloading the tape.

## **Direct Disc Control**

This mode of operation provides calls that allow programs such as SWTCH, FORMT, and the backup utilities to control the disc directly. These requests bypass all checking and mapping of logical to physical subchannels. They are available through a library called \$DTCLB. This library can be changed as required to reflect CS80 disc and operating system changes.

## **Optimizing CS80 Disc Usage**

The CS80 disc drives are low cost, high performance drives. DVM33 takes advantage of the high-speed features in the drive to minimize access times.

CS80 drives are laid out in pack mode to minimize track seek times. This means that for any volume (fixed or removable pack) the drive attempts to seek to the next surface before moving the head to the next cylinder. Consequently, the use of this mode is forced and surface mode operation is not allowed. The main benefit derived from this mode of operation is the ability to transfer up to 32k words of data in one operation.

The CS80 drives have built-in error detection and correction algorithms. This ensures that the best possible data are transferred. The system is warned when data blocks should be spared before data is actually lost.

Sparing on CS80 drives is invoked by a command. When invoked by a program (e.g., the FORMC utility), the device controller chooses the optimal sparing algorithm, and places the best guess at the data in a spare area previously not accessible to the user. All spared accesses are transparent and guaranteed to minimize latency time.

Because of the error correction and detection schemes, verify after write is not supported. It is not optimized for fast execution and requires considerable overhead for the device controller. The verify command is provided as part of the formatting process, which should uncover nearly all of the defects on a pack (refer to the description of FORMC in the RTE-6/VM Utility Programs Reference Manual).

The error rate on a CS80 drive is projected to be better than 1 in  $10E13$ . This, in conjunction with the diagnostic testing done by the power-on sequence, helps to ensure a high level of data integrity without the need to verify.

Even with long transfers and pack mode operation, some careful planning of disc subchannels can affect performance tremendously. Care should be taken to place frequently accessed subchannels adjacent to each other on the disc, or on totally different surfaces. The most frequently used subchannels should be placed near the center of the disc to minimize seek times.

# Chapter 2

## READ and WRITE Requests

### General

Read and write requests to DVM33 are the usual mode of operation. These requests are optimized to provide minimum transfer time for requests up to 32k words using DMA. Error correction is done in the disc controller to provide data integrity. Any errors that occur during a disc operation are automatically retried by the disc controller. This relieves the system of unnecessary retry overhead and optimizes the chances that retry will work.

Upon successful completion of the request, the B-register contains the transmission log in positive words or characters depending on what was requested. The A-register contains EQT word 5, which is the drive status. Refer to the error condition section for fault conditions.

For read and write requests with non zero subfunctions, refer to the following sections for descriptions of their operation.

Two special EXEC reads are supported that are normally illegal in the RTE operating system. Both require that the subfunction be set to zero. If an EXEC read requests a TRACK = -1 and SECTOR = 0, the B register is returned with the number of tracks in the subchannel and IBUF(1) contains the number of 64-word logical sectors per track. A read request with TRACK = -1 and SECTOR = -1 returns status information (refer to the Status Request Section). All other negative tracks and sectors will abort the program.

TABLE 2.1 Read and Write Calling Sequence, Assembly and FORTRAN

Assembly:	
EXT EXEC	Where:
.	RTRN = Return address
.	ICODE= Request code
JSB EXEC	1=> Read
DEF RTRN	2=> Write
DEF ICODE	ICNWD= Control word
DEF ICNWD	Bits 0->5 = LU# of subchannel
DEF IBUFR	Bits 6->10 = Control Subfunction:
DEF IBUFL	0=> Standard Read or Write
DEF IADD1	1=> Block Addressing
DEF IADD2	2=> Block Addressing, cached access (CTD)
	3=> Block Addressing, Write File Mark (CTD)
	21B => Return Describe Information
	22B => Return Track Map Information
	23B => Direct Control Mode
	IBUFR= Starting address of data buffer
	IBUFL= Length of transfer positive # words or negative number of characters (rounded to even number)
	IADD1= Track number in standard addressing mode (high order word of block # in Block mode)
	IADD2= Sector number in standard addressing mode (low order word of block # in Block mode)
FORTRAN:	
CALL EXEC (ICODE, ICNWD, IBUFR, IBUFL, IADD1, IADD2)	

## Track and Sector Requests

The usual mode of operation for the driver is track and sector addressing. In this mode, the calling program passes track and sector addresses to the driver. This address is then converted to the block address on the disc, according to the specifications in the track map table. Requests that do not start on an even sector incur a latency, as the driver must buffer the data. Write requests should be multiples of 128 words beginning on an even sector and ending in odd sector. Requests that do not start on an even sector and end in and odd one will incur a latency in order to do a read-modify-write that preserves the rest of the block. Sectors that are not filled by a write will be filled with random data.

## Block Addressed Requests

Block addressing is supported to allow a program to access a disc or CTD as a contiguous segment of 128-word blocks for disc or 512-word blocks for CTD.

For disc requests, the subchannel is seen as a group of blocks ranging from 0 to n with  $n = ((\#tracks * \#blocks\text{-}per\text{-}track) - 1)$ . The block address is a double word with the high word in IADD1 and the low word in IADD2.

For CTD requests, the block address is a 512-word block on the tape. The double-word address (IADD1 and IADD2) is passed directly to the tape if a subfunction of 1 is specified. If a subfunction of 2 is specified, the request is passed through a cache on the disc before it goes to the CTD. Cached mode is transparent to the program and, if enabled, increases the performance significantly. (Refer to Chapter 4 of this manual for a discussion of the caching scheme.)

## Special Read and Write Requests

Two special read requests return information about the disc or CTD. The first, a read with a subfunction of 22B, will return information from the track map table. The second call, a read with a subfunction of 21B, will return the CS80 DESCRIBE information for the address pointed to by the LU in the EXEC call.

A third type of request, a write with a subfunction of 3, is used to write a file mark on a CTD. This subfunction is related to the use of the CTD and its cache. Refer to the section on CTD usage for particulars of when to write the file mark.

A fourth type of request, subfunction 23B, allows a program to control directly the disc subsystem. The format of the calls is dependent on the function being performed. These calls are described in Chapter 5 of this manual.

## **Retrieving the Track Map Table**

A read with a subfunction of 22B will return information from the track map table. If a length of 8 is requested, the driver will return the track map table for the subchannel of the LU requested. If a length of 513 is requested, the driver will return the entire track map table. The format of the table is shown in Appendix A.

## **Retrieving the DESCRIBE Information**

A read request with a subfunction of 32B will return the CS80 DESCRIBE information for the unit pointed to by the track map for the requested LU. The call returns 37 bytes, so a length of at least 37 bytes must be specified. Refer to the CS80 Reference Manual for details of the information returned by DESCRIBE.

## **Write File Mark**

The Write=File=Mark subfunction posts the contents of the CTD disc buffer, if necessary, and writes a file mark at the block number given in the IADD1 and IADD2 parameters. If the CTD is cached, the cache is posted to the CTD if it has been written on, and then the file mark is written at the block address passed. The cache is left cleared after the request. If the CTD is not cached, the file mark is written at the block address passed in IADD1 and IADD2. Length and buffer address parameters are ignored. File marks use an entire block, which cannot contain any data.

## **Direct CS80 Command Calls**

A special EXEC call is provided to allow a utility program to directly control a CS80 device. This call permits direct device control and access to functions not provided by the normal read and write sequences. This is especially useful for formatting discs, sparing bad blocks and performing diagnostic functions.

All known disc commands are provided in a library, \$DTCLB, that sets up the parameters to the special EXEC call. This special call is of the following form:



CALL EXEC [ICODE, ICNWD, IBUFR, IBUFL, ITYPE]

ICODE= EXEC Function = 1 (the type of call is specified by ITYPE)

ICNWD= Control word:

Bits 0-5 = LU that points to a DVM33 subchannel on the bus  
Bits 6-10= 23B to indicate special mode

IBUFR= Control and Data Buffer:

Word 1 => Primary listen, HP-IB address, ATN, odd parity  
(440B + HP-IB address w/odd parity)

Word 2 => Command, ATN, odd parity (745B for type 0 - 3)  
(762B for type 4 - 6)

Words 3-59 => Command buffer for disc protocol.  
Command specific.  
Last command has sign bit set (LBO).

For words 1 - 59, commands are in low byte;  
control (ATN, LBO) are in the high byte.  
ATN = attention (for commands) = 400B.  
LBO = last byte out flag, data tagged  
with EOI = 100000B.

Word 60 => QSTAT value  
0 = normal completion  
1 = hard error  
2 = power on state  
-1 = timeout on request

Word 61 => User data area

IBUFL= Expect data transfer length in positive words  
or negative bytes

ITYPE= Transaction type:

0 = command-report (QSTAT)  
1 = command-outbound data-report (QSTAT) write  
2 = command-inbound data-report (QSTAT) read  
3 = report (QSTAT)  
4 = transparent command-report (QSTAT) read  
5 = transparent command-outbound data-report (QSTAT)  
6 = transparent command-inbound data-report (QSTAT)

This mode makes no checks on any boundary conditions. The user is in complete control of the disc subsystem and may issue any type of request to any device on the bus.

On return, the A-register is not significant. The B-register contains the transmission log in a positive number of words. There are no error conditions.

## EXEC Function and Subfunction Codes

The EXEC function and subfunction codes are shown and described below.

<u>Function</u>	<u>Sub- Function</u>	<u>Description</u>
1	0	Read Request, Track and Sector addresses Iadd1 = 1 and IADD2 = 0 Subchannel size #Tracks in Breg, Sectors per Track in BUFR(1) IADD1 = 1 and IADD2 = 1 Dynamic Status Request 10 or 20 words in BUFR, depending on length
1	1	Block Addressing
1	2	Block Addressing, Cached Requests (CTD only)
1	21B	Return Describe Information
1	22B	Return Track Map Table
1	23B	Direct Protocol Control mode
2	0	Write Request, Track And Sector Addresses
2	1	Block Addressing
2	2	Block Addressing, Cached Requests (CTD only)
2	3	Write EOF, post and Close Cache (CTD only) write File Mark at address in IADD1 and IADD2
2	23B	Direct Protocol Control mode
3	1	Clear Cache (CTD only) reset cache and check write protect
3	2	Post and Close Cache (CTD only) writes cache to tape if necessary
3	3	Unload tape (CTD only) causes tape to rewind and unload

# Chapter 3

## Status Request

### EQT Status

There are two types of status available to DVM33: EQT status and dynamic status. An EXEC 13 request returns EQT word 5 and, optionally, EQT word 4 and DRT word 2. Normally, these words indicate device type and provide a hint as to the type of error. This is not a dynamic request, but reflects the last request to the driver. The EXEC 13 status request has the form

```
CALL EXEC (ICODE, ICNWD, ISTA1 [,ISTA2 [,ISTA3]])
```

```
ICODE = Request code = 13 decimal
ICNWD = Logical Unit number
ISTA1 = EQT word 5 (see Table 3-1)
ISTA2 = EQT word 4 (optional)
ISTA3 = DRT word 2 (optional)
```

Refer to the RTE-6/VM Programmer's Reference Manual, Appendix C, for a description of EQT 5, EQT 4, and DRT 2.

Table 3-1. Format of Status Bits, EQT Word 5

Bit	Meaning
0	Severe Error. Set if any * bits are true
1*	Channel Errors (Severe bit set for any Reject or DMA length error)
2*	Not ready. Unit not ready for access
3*	Fault. A Fault error has occurred
4*	Unitialized Media
5(*)	EOF/EOV (Severe bit set only for End Of Volume)
6(*)	Unrecoverable data/data-recoverable marginal error (Severe bit set only for unrecoverable data)
7(*)	Write protected volume (Severe bit set only if write failed )

## Dynamic Status Request

A special EXEC call is provided to retrieve all of the status information returned by the controller. This information contains only the target address after a normal completion. Be aware that RTE-6/VM does not guarantee that another request affecting status was not received after the faulty operation and before the status request. DVM33 automatically requests and preserves status after an error return from the controller.

The request requires a length of at least 10 words to retrieve the status in the driver, or a length of at least 20 words for both the status in the driver and the current status words in the controller. The dynamic status request has the following form

```
CALL EXEC (ICODE, ICNWD, IBUFFER, IBUFFL, IOPT1, IOPT2)
```

```
ICODE = Request code = 1 for read
ICNWD = Control word. Bits 5-0 = logical unit
IBUFFER= Buffer for status data
IBUFFL= 10 for status length (status in driver)
        20 for status length (driver status and
        current drive status)
IOPT1 = -1
IOPT2 = -1
```

## CS80 Device Status

CS 80 devices return 10 words of status information ordered by severity, with the most serious errors shown in the first words of status. The 10 words are:

```
word 1 - identification field: status unit, volume
word 2 - reject errors - highest severity
word 3 - fault errors
word 4 - access errors
word 5 - information errors
word 6-10 - parameter area for words 2-5
```

## Identification Field

The identification field format is:

VVVUUUUSSSSSSSS

VVVV       ➤ volume number for this status  
UUUU       ➤ unit number for this status  
SSSSSSSS ➤ other unit requesting service  
          ( ➤1 = none)

## Reject Errors Field

The reject errors field format is:

< x x 1 x x 2 3 4 5 6 7 x 8 x x x >

- 1 ➤ Channel Parity Errors (2000B)  
A channel command was received without odd parity. Generally indicates a programming error.
- 2 ➤ Illegal Opcode (2000B)  
  
An unrecognizable opcode was received. Generally a programing error.
- 3 ➤ Module Addressing (1000B)  
Illegal Unit or Volume was received.
- 4 ➤ Address Bounds (400B)  
The target address exceeded the bounds for this device.
- 5 ➤ Parameter Bounds (200B)  
A parameter other than unit, volume or address is out of bounds for this device.
- 6 ➤ Illegal Parameter (100B)  
A parameter field has the wrong length for the opcode preceding it.

- 7 ➤ Message Sequence Error (40B)  
The message sequence has been violated. This may be a programming error; i.e., an execution message was required, but none was sent, or something was lost and the request should be retried.
- 8 ➤ Message Length error (10B)  
The length of the execution message did not match the length command. A programming error, or a bus fault has occurred.

## Fault Errors Field

The fault errors field format is:

< x 1 x 2 x x 3 x 4 x 5 6 7 x 8 9 >

- 1 ➤ Cross Unit Error (40000B)  
An error has occurred during a copy data operation. The units involved are listed in the parameter area.
- 2 ➤ Controller Fault (10000B)  
A hardware controller fault has occurred. Run the diagnostic or call your local HP Customer Engineer (C.E.).
- 3 ➤ Unit Fault (1000B)  
A hardware unit fault has occurred. Run the diagnostic or call your local C.E.
- 4 ➤ Diagnostic Result (200B)  
The hardware failed a diagnostic test, indicated in the parameter field. Run the diagnostic or call your local C.E.
- 5 ➤ Release for Operator Request (40B)  
Release is required by the drive to service an operator request; i.e., load or unload. Programs should grant or deny this request as appropriate for the application.

- 6 ▶ Release Required for Diagnostic (20B)  
Release is required for diagnostics initiated from the front panel. This request must be granted to complete a CTD load, but may be denied if necessary.
- 7 ▶ Release for Internal Maintenance (10B)  
Release is required so that the drive can update its logs. If release is not granted, error information may be lost.
- 8 ▶ Power Fail (2B)  
Power to the drive failed, or state was lost.
- 9 ▶ Release Completed (1B)  
The drive has returned from automatic release.

## Access Errors Field

The access errors field format is:

< 1 2 3 4 5 6 x x 7 8 x 9 10 x x x >

- 1 ▶ Illegal Parallel Operation (100000B)  
The operation requested cannot be executed in parallel with other operations in progress. This error should not occur on RTE as no parallel operations are permitted.
- 2 ▶ Uninitialized Medium (40000B)  
The medium is unformatted in this device, or an unusable medium has been loaded. The medium should be formatted before further access is attempted.
- 3 ▶ No Spare Areas Available (20000B)  
No spare areas are left for the spare block command. Either the medium should be replaced, or the drive should be serviced to determine if more spare areas can be recovered.
- 4 ▶ Not Ready (10000B)  
The selected unit is not ready for access. The medium may not be loaded or the device may not be on-line.

- 5 -> Write Protect (4000B)  
The device is write protected. This error only occurs on commands which write to the device.
- 6 -> No Data Found (2000B)  
A block accessed during read has not been written. This generally occurs on tape that has not been initialized.
- 7 -> Unrecoverable Data Overflow (200B)  
The last transaction had more than one unrecoverable data error. Address of the first error is in the parameter area.
- 8 -> Unrecoverable Data error (100B)  
The controller was unable to read data at address in parameter area. The data cannot be totally recovered, although reading with maximum retries will get the controller's best guess.
- 9 -> End of file (20B)  
An end of file mark was encountered during the read. The address in the parameter area is the address of the block after the end of file mark.
- 10 -> End of Volume (10B)  
The last access attempted to access past the end of the volume. The parameter area contains the address of the last block on the volume.

## Information Errors Field

The information field format is:

< 1 2 3 4 5 x x 6 x 7 8 9 x 10 x x >

- 1 -> Release for Operator request (100000B)  
The controller requests release to allow load/unload, save/restore. Release may be ignored or denied if necessary. System will grant release during idle time if it a release request occurs.



- 2 → Release for diagnostic request (40000B)  
Release for diagnostic generated by front panel or self test. If ignored, system will grant release during idle time.
- 3 → Release for Internal Maintenance (20000B)  
Request release to update error logs or perform maintenance. If release is not granted, system will release during idle time.
- 4 → One Spare Left (10000B)  
There is only one spare block left on this volume. The medium should be backed up and replaced or serviced to see if spares can be recovered.
- 5 → Data Overrun (4000B)  
During a transfer, a latency occurred when the system could not accept data as fast as the device can send. No data was lost.
- 6 → Auto Sparring Invoked (2000B)  
A defective block was automatically spared. No data was lost.
- 7 → Recoverable Data Overflow (100B)  
The last request generated more than one recoverable data error. The first error is in the parameter area.
- 8 → Marginal Data  
The last request generated an error which was recovered with difficulty. The block should be spared before it becomes uncorrectable.
- 9 → Recoverable Data Error (20B)  
The last request generated an error which was recovered by retry or error correction. No data was lost.
- 10 → Maintenance Track Overflow (4B)  
The maintenance track on the device has overflowed. The error and fault logs are full. The drive should be serviced to recover this information before it is lost.

## Parameter Field

The Parameter Field contains the parameters appropriate to the most serious error seen. This area contains the target or fault address, except for the following errors:

- Spare Block → After the spare block, the parameter area contains the address of the beginning of the affected area in the first 3 words. The last 2 words contain the length, in bytes, of the affected field.
- Cross Unit → The parameter area contains a list of units that experienced errors. Each unit is 1 byte long, and the list is terminated by a byte of 377B.
- Diagnostic Results → The first 3 words of the parameter area contain the diagnostic numbers which failed. Each number is 1 byte long.

# Chapter 4

## Cartridge Tape Drive Control Requests

### General

Driver DVM33 provides a set of requests for controlling the cartridge tape drive (CTD). These control requests allow a program to make use of the disc buffer for the CTD, write file marks on the tape, and unload the tape from the drive. These calls and a brief explanation of how to use the CTD are given in this chapter.

### Using the Cartridge Tape Drive

The cartridge tape drive is a high capacity device. It requires that data be transferred in a continuous streaming mode, with or without buffering. Non-buffered control, read, and write requests go directly to the CTD. Buffering involves creating a disc buffer, called the disc cache, at generation time. The disc cache is 64k bytes long in an area reserved on the associated disc drive. This area is used only for the CTD disc buffering. Buffering improves transfer times to the CTD by at least an order of magnitude for total transfers over 8k bytes on a tape. Programs that access the CTD should use cached requests whenever possible to increase performance and maximize tape usage.

### Caching Scheme

If a program is to use the CTD, it should lock the LU of the CTD to itself to protect the integrity of the disc buffer and tape. At this point it is necessary to initialize the disc buffer and cache pointers to a known state. This is accomplished by issuing EXEC calls to the CTD LU, clearing the cache. This will clear all the cache pointers and check the CTD for write protected and certified tapes. It is possible now to read and write to the cache. The cache is set up for forward reference; that is, the blocks in the cache are a duplicate of a contiguous set of blocks on the CTD, beginning with the first block accessed. This set of

blocks is accessed from the disc buffer until the buffer is overflowed, closed, or has a file mark written to it.

At this point, if the buffer has been written into, it is posted and a new buffer is brought in if necessary. If an end-of-file mark is encountered on a read, it will show up when that block is accessed. This process of reading and writing continues until all the desired data is transferred. The program should then close the cache to ensure that the last set of blocks written is posted and the cache is reset. The program also has the option of writing an end-of-file mark on the tape, and it may also programmatically unload the CTD. The close, write-file-mark, and unload functions are all implemented as EXEC control calls.

## **Clear Cache**

Cache clearing is accomplished with a subfunction code of 1 in an EXEC control call. The subfunction codes are explained in Chapter 2 of this manual. The control call allows a program to clear the CTD cache before the CTD is accessed. If the cache is not cleared, it is possible to overwrite random data on the CTD. This call also checks the CTD for write-protected and certified cartridges. This status is returned in the A-register (EQT word 5) regardless of whether or not caching is used.

## **Close Cache**

Cache closing is accomplished with a subfunction code of 2 in the EXEC control call. This call is used to terminate cleanly the use of the disc buffer for the CTD. This call posts the disc buffer to the CTD if the buffer has been written and leaves the cache in a clear state. This call guarantees that blocks written into the disc buffer are moved to the CTD. If no cache is present, driver DVM33 takes no action and returns to the program.

## **Unload Tape**

Unloading tape from a cartridge tape drive can be done programmatically with a subfunction code of 3 in an EXEC control call. This call rewinds the tape so that the cartridge can be removed. It can be used for both cached or uncached CTD; and DVM33 returns to the programs in either case.

An example program using the CTD control calls is shown on the following page.

```

FTN4X
    INTEGER CTD,DISC,TRACK,SECTR,LENTH
    INTEGER BLOCK(2),BUFFR(8192),SIZE(2)
    INTEGER*4 DBLCK,DSIZE
    EQUIVALENCE (DBLCK,BLOCK(1)),(DSIZE,SIZE(1))
    .
    .
C
C   SET UP THE CTD, DISC LUS, AND INITIALIZE LENGTH AND BLOCK
C
        CTD = 10
        DISC = 20
        LENTH = 8192
        DBLCK = 0
        SECTR = 0
C
C   FIND OUT HOW LONG THE TAPE IS (BUFFR(17) AND BUFFR(18))
C   REFER TO THE CS80 REF. MANUAL FOR DESCRIBE FIELDS
C
        CALL EXEC(1,CTD+2100B,BUFFR,-37,0,0)
        SIZE(1) = BUFFR(17)
        SIZE(2) = BUFFR(18)
C
C   CLEAR THE CTD CACHE
C
        CALL EXEC(3,CTD+100B)
C
C   MOVE DATA FROM DISC TO CTD BY WAY OF THE CACHE
C
        DO 10 TRACK = 1,1000
        CALL EXEC (1,DISC,BUFFR,LENTH,TRACK,SECTR)
C
        CALL EXEC (2,CTD+200B,BUFFR,LENTH,BLOCK(1),BLOCK(2))
10  DBLCK = DBLCK + LENTH/512
C
C   CLOSE THE CACHE NOW AND WRITE A FILE MARK
C
        DBLCK = DBLCK + 1
        CALL EXEC (2,CTD+300B,BUFFR,0,BLOCK(1),BLOCK(2))
C
C   UNLOAD THE TAPE FOR THE USER
C
        CALL EXEC (3,CTD+300B)
    .
    .
    .

```



# Chapter 5

## Direct Disc Control

### Control Function Routines

Direct disc control can be done through a group of routines contained in a command library, \$DTCLB. The control functions available and the associated routine are listed below.

<u>Command</u>	<u>Routine</u>
Cancel	XCNCL
Channel Independent Clear	XCICL
Cold Load Read	XCOLD
Complementary Commands	XCOMP
Copy Data	XCOPY
Describe	XDESC
Initialize Media	XINMD
Initiate Diagnostic	XDIAG
Initiate Utility	XUTIL
Locate & Read	XLCRD
Locate & Verify	XLCVF
Locate & Write	XLCWR
Read Loopback Test	XRLPB
Release	XRELS
Release denied	XRELD
Request status	XRQST
Selected Device Clear	XSDCL
Spare Block	XSPRE
Unload	XUNLD
Write File Mark	XFMRK
Write Loopback Test	XWLPB

## Disc Control Routines CALL Format

The calling format for the direct disc control routines is as follows:

CALL routine (LU,IADDR,ICOMP,IBUF)

Where:

LU            Target LU. Gets routine to the correct driver.

IADDR        HP-IB Address of CS80 drive.

ICOMP        A 24-word array describing parameters for all the possible complementary commands. ICOMP is a static buffer, not changed by \$DTCLB routines. The meaning of each word is described in Table 5-1.

IBUF         An array. The first 60 words are reserved for use by the routine in building a command. The use of word 61 on is dependent upon the particular routine. On return, words 58 thru 60 contain the following:

IBUF(58)	A-register contents
IBUF(59)	B-register contents
IBUF(60)	QSTAT

If IBUF(60) is a 1, the full status is returned in IBUF(2) thru IBUF(11). The QSTAT associated with the request status command is returned in IBUF(1).



Table 5-1. Complementary Command Array (ICOMP)

Word	Meaning
1	Unit number
2	Volume
3	Address Mode 0 ==> Block 1 ==> 3 vector
4	Target address
5	Target address
6	Target address
7	Set Block Displacement =1 ==> No block displacement 1 ==> Valid block displacement in words 8 & 9
8	Block displacement
9	Block displacement (Note: Block displacement is a signed 6-byte integer. The first two bytes will be filled with the sign bit)
10	Set length flag =1 ==> No length 1 ==> Valid length in 11 and 12
11	Length
12	Length
13	Burst Size (Set Bit 15 to tag bursts with EOI)
14	RPS Time 1
15	RPS Time 2
16	Number of read retries
17	Set status mask flag =1 ==> No status mask 1 ==> Valid status mask in 18-22
18	Status mask
19	Status mask
20	Status mask
21	Status mask
22	Set release =1 ==> No Set release
23	Set address return mode 0 ==> Block 1 ==> 3 vector
24	Set device specific options

## Complementary Commands

To use a complementary command, simply set the appropriate word or words in the ICOMP array. All other words should be set to =1. Not all complementary commands are compatible with all commands. Refer to the CS80 Reference Manual for specifics.

The use of word 61 or greater in IBUF is routine dependent. Usage by these routines is described below.

<u>Routine</u>	<u>Usage</u>																					
XCNCL	Not used																					
XCICL	Not used																					
XCOLD	Return area for read data																					
XCOMP	Not used																					
XCOPY	<table border="0" style="width: 100%;"> <tr> <td style="width: 35%; text-align: left;">Source:</td> <td style="width: 30%;"></td> <td style="width: 35%; text-align: left;">Destination:</td> </tr> <tr> <td>IBUF(61) Unit</td> <td></td> <td>IBUF(67) Unit</td> </tr> <tr> <td>IBUF(62) Vol</td> <td></td> <td>IBUF(68) Vol</td> </tr> <tr> <td>IBUF(63) Addr Mode</td> <td></td> <td>IBUF(69) Addr Mode</td> </tr> <tr> <td>IBUF(64) Addr</td> <td></td> <td>IBUF(70) Addr</td> </tr> <tr> <td>IBUF(65) Addr</td> <td></td> <td>IBUF(71) Addr</td> </tr> <tr> <td>IBUF(66) Addr</td> <td></td> <td>IBUF(72) Addr</td> </tr> </table>	Source:		Destination:	IBUF(61) Unit		IBUF(67) Unit	IBUF(62) Vol		IBUF(68) Vol	IBUF(63) Addr Mode		IBUF(69) Addr Mode	IBUF(64) Addr		IBUF(70) Addr	IBUF(65) Addr		IBUF(71) Addr	IBUF(66) Addr		IBUF(72) Addr
Source:		Destination:																				
IBUF(61) Unit		IBUF(67) Unit																				
IBUF(62) Vol		IBUF(68) Vol																				
IBUF(63) Addr Mode		IBUF(69) Addr Mode																				
IBUF(64) Addr		IBUF(70) Addr																				
IBUF(65) Addr		IBUF(71) Addr																				
IBUF(66) Addr		IBUF(72) Addr																				
XDESC	Return area for DESCRIBE data																					
XFMRK	Not used																					
XFORM	IBUF(61) = Option IBUF(62) = Interleave Factor																					
XINTP	IBUF(61) = Option																					
XDIAG	IBUF(61) = Not used IBUF(62) = Not used IBUF(63) = Length in bytes of param string IBUF(64) = IBUF(66) Parameter string left justified																					
XLCRD	Return area for read data																					
XLCVF	Not used																					
XLCWR	Source area for write data																					
XRELS	Not used																					
XRELD	Not used																					
XRLPB	IBUF( 61 = 62) Loopback Length in bytes On Return: Return area for Loopback data																					
XRQST	Return area for Status information																					
XSDCL	Not used																					
XSPRE	Parameter field																					
XUNLD	Not Used																					

XUTIL	IBUF(61) Utility number
	IBUF(62) Type of execution message
	0 ==> No execution message
	1 ==> Device receives mesg
	2 ==> Device sends mesg
	IBUF(63) Length in bytes of param string
	IBUF(64) → IBUF(67) Parameter string left
	justified.
	IBUF(68) Length of execution mesg in bytes
	IBUF(69) → IBUF(??) Execution mesg if
	IBUF(62)=1
	On return:
	IBUF(61) → IBUF(??) Contains execution mesg
	if execution mesg was
	sent or received
XWLPB	IBUF(61 → 62) Loopback Length in bytes
	IBUF(63 → ?) Source for Loopback data

## Examples

Following are examples using the direct disc control routines.

### **XLCRD/XLCWR/XLCVF/XSPRE Usage**

Assuming you have an LU and HP → IB address, the following is a FORTRAN calling sequence to read one block from a disc starting at block 100 for a length of 2 (disc) blocks (512 bytes) and write them to block 200 of the same disc. A verify is then issued to ensure that the data at block 200 can be read.

Note that IBUF must be at least 188 words long (60 words for XLCRD and 128 words for the data from the disc).

In this example, note that only those values that change for the next call need be changed in the ICOMP array. In the call to XLCWR, the only change is in the block number from the previous call. In the call to XLCVF, the same area that was just written is also being verified, so no change is necessary in the ICOMP array.

If a series of blocks is to be read, equate ICOMP(5) and ICOMP(6) to a 4 → byte integer and keep incrementing the integer by one (or more) for each successive read. Using four of the available six bytes is sufficient to cover the maximum block address possible.

The spare command is very similar to the locate and read command in terms of calling sequence. To spare block 100, you would go

through the same sequence as for XLCRD. Setting the length in ICOMP would have no effect, however, on the spare command.

```

C          CLEAR ICOMP ARRAY
      DO 10 I=1,24
          ICOMP(I)=1
10 CONTINUE
      .
      .
C
C          DO THE READ
      ICOMP(1)=0          !UNIT 0
      ICOMP(2)=0          !VOLUME 0
      ICOMP(3)=0          !BLOCK ADDRESSING
      ICOMP(4)=0          !3 WORD
      ICOMP(5)=0          ! BLOCK ADDRESS
      ICOMP(6)=100        !           OF 100
      ICOMP(10)=1         !INDICATE LENGTH IS SET
      ICOMP(11)=0         !DOUBLE WORD
      ICOMP(12)=512       ! NUMBER OF BYTES
      CALL XLCRD(LU,IADDR,ICOMP,IBUF)
C
C          DO WRITE
      ICOMP(6)=200        !NEW BLOCK NUMBER
      CALL XLCWR(LU,IADDR,ICOMP,IBUF)
C
C          VERIFY BLOCK WRITTEN
      CALL XLCVF(LU,IADDR,ICOMP,IBUF)
      .
      .

```

## XINMD Usage

The following will format disc unit 0, volume 0, retaining all factory and field spares and setting a block interleave factor of 1. (Refer to the RTE-6/VM Utility Programs Reference Manual for a description of interleaving.)

```

      DO 10 I=1,24
          ICOMP(I)=1
10 CONTINUE
      .
      .
      ICOMP(1)=0          !UNIT 0
      ICOMP(2)=0          !VOLUME 0
      ICOMP(61)=0         !KEEP FACTORY & FIELD SPARES
      ICOMP(62)=1         !INTERLEAVE
C
      CALL XINMD(LU,IADDR,ICOMP,IBUF)

```

## **XRELS/XRELD Usage**

To release unit 0:

```
      DO 10 I=1,24
        ICOMP(I)=1
10    CONTINUE

      .
      .
      .
      ICOMP(1)=0                !UNIT 0
      CALL XRELS(LU,IADDR,ICOMP,IBUF)
```

To deny release, the sequence is exactly the same but the call is to XRELD.

## **XRQST/XDESC Usage**

Status and describe information requests have similar calling sequences, however the set volume command has no effect on the request status command. To get the status of unit 0, the sequence would be

```
      DO 10 I=1,24
        ICOMP(I)=1
10    CONTINUE

      .
      .
      .
      ICOMP(1)=0                !UNIT 0
      CALL XRQST(LU,IADDR,ICOMP,IBUF)
```

Status is returned (in packed format) in IBUF(61) and on. IBUF(59) has the contents of the B-register, which should be the number of bytes transferred (this should be 20).

To issue a DESCRIBE command, you would also set ICOMP(2) to the volume number. The description is returned (in packed format) in IBUF(61) and on. IBUF(59) contains the number of bytes returned.

## XCOPY Usage

Use the following sequence to copy 10 blocks (2560 bytes) on unit 0, volume 0 starting at block 100, to unit 1, volume 0, block 200.

```
      DO 10 I=1,24
        ICOMP(I)=-1
10    CONTINUE
      .
      .
      .
      ICOMP(1) =15           !TALK TO CONTROLLER UNIT
      ICOMP(10)=1          !INDICATE LENGTH IS SET
      ICOMP(11)=0         !DOUBLE WORD
      ICOMP(12)=2560      !      NUMBER OF BYTES
C
C      SET FROM UNIT/VOL/ADDR
      IBUF(61)=0          !UNIT 0
      IBUF(62)=0          !VOLUME 0
      IBUF(63)=0          !ADDR MODE IS BLOCKS
      IBUF(64)=0          !6 BYTE
      IBUF(65)=0          !  BLOCK
      IBUF(66)=100       !      ADDRESS
C
C      SET DEST UNIT/VOL/ADDR
      IBUF(67)=1          !UNIT 1
      IBUF(68)=0          !VOLUME 0
      IBUF(69)=0          !ADDR MODE IS BLOCKS
      IBUF(70)=0          !6 BYTE
      IBUF(71)=0          !  BLOCK
      IBUF(72)=200       !      ADDRESS
C
C      COPY DATA
      CALL XCOPY(LU,IADDR,ICOMP,IBUF)
```

Note that the XCOPY routine returns no data (except, of course, the QSTAT and A $\rightarrow$  and B $\rightarrow$  register returns). What is placed in IBUF(61) onwards remains intact after the call. If you wish to do a series of copy commands you could increment the block addresses in IBUF(70) thru IBUF(72) and IBUF(64) thru IBUF(66) by the appropriate number, then go back and call XCOPY again.

## XCOMP Usage

XCOMP sends only complementary commands in the command message. This has the effect of permanently changing the disc parameters, as opposed to sending the complementary commands with another command (which causes them to be in affect only for that command sequence). The following sequence illustrates the use of XCOMP.

```
      DO 10 I=1,24
        ICOMP(I)=1
10 CONTINUE
      .
      .
      .
C
C      CHANGE SELECTED DISC PARAMETERS
      ICOMP(7)=1          !FLAG FOR BLOCK DISP
      ICOMP(8)=0          !DOUBLE WORD
      ICOMP(9)=10         ! BLOCK DISP OF 10 BLOCKS
      ICOMP(13)=1024      !SET BURST SIZE TO 1024 BYTES
      CALL XCOMP(LU,IADDR,ICOMP,IBUF)
```

The parameters set in the above will be in effect for all subsequent commands to the disc that do not send their own values for them in complementary commands. The parameters will remain set until another call to XCOMP or until the disc is powered on or cleared.





# Chapter 6

## Configuration Information

### General

This chapter contains configuration information for DVM33. Useful information concerning this process may be found in:

RTE-6/VM Online Generator Reference Manual P.N. 92084-90010  
RTE-6/VM System Manager's Manual P.N. 92084-90009  
RTE-6/VM Programmer's Reference Manual P.N. 92084-90005  
RTE-6/VM Utility Programs Reference Manual P.N. 92084-90007

These manuals will help you generate and configure a system with CS80 drives. Follow the procedures below to generate a CS80 drive into your system.

### Program Input Phase

During the program input phase of the generation process, load the driver, error module and track map table along with the other I/O drivers by making the following entry:

Prog. Input Phase

```
  .  
  .  
  .  
RE, %DVM33  
RE, %$TM33 * only relocate the track map table  
            * if DVM33 is not the system disc driver  
RE, %$CSERR * this is the extended error reporting module, a  
            * memory resident program. Its presence is not  
            * required, but it provides extremely useful  
            * information to service personnel.
```

## Table Generation Phase

During the table generation phase make the following entries:

### 1. Equipment Table Entry [EQT]

An EQT entry must be made for the EQT you wish to have pointing to DVM33.

Equipment Table Entry

·  
·  
·

EQT n?  
sc, DVM33, D, T=x

where:

n is the EQT entry number  
sc is the select code of the 12821A interface card  
(CS80 devices only - ICD discs require a separate card)  
x is the timeout value chosen for the disc subsystem

### 2. Device Reference Table [DRT] entry

A Device Reference Table entry must be made for each subchannel to be accessed by the system.

Device Reference Table

·  
·  
·

lu = EQT ?  
n,m

where:

lu is a Logical Unit number  
n is the EQT entry number associated  
with the LU  
m is the EQT subchannel number associated  
with the LU

#### NOTE

All disc LU numbers must be less than 64. RTE-6/VM allows 64 subchannels per EQT.

### 3. Interrupt Table Entry

An interrupt table entry must be defined for the 12821A interface card:

Interrupt Table

.

.

.

SC, EQT, n

where:

sc is the select code of the 12821A card  
(CS80 devices only)

n is the EQT number from step 1

If you want a second CS80/12821 subsystem in your system, follow the steps above for another select code and EQT using %DVN33 and \$TN33 instead of %DVM33 and \$TM33 respectively.

The track map tables can be built by editing the source files, &\$TM33/&\$TN33, or by following the track map table format given in this chapter.

## Device Timeout

The device timeout value should be set depending whether or not CTD operations are included. Some CTD operations may take 10 to 20 seconds. In this case, it is recommended that the timeout value be set with the system "TO" command.

If the system does not include any CTD, a shorter value may be set at generation time. A typical timeout value is 2 sec.

If a CTD tape drive is on the system, the timeout value should be set to allow for the longest CTD seek-time expected (about 20 seconds for a short tape and 60 second for a long tape).

## Track Map Table Format

The track map table format is shown below. The first word of the table contains the negative number of subchannels. Each subchannel definition is eight words long; the subchannel definitions are in ascending order.

## Disc Track Map Table Format

	15	8 7	0
word 0	reserved		HP→IB Address
word 1	Unit number		Volume number
word 2	High word	{ { { {	of starting block number
word 3	Middle word		
word 4	Low word		
word 5	#TRACKS		
word 6	#SECTORS/TRACK		
word 7	RESERVED		
	15	8 7	0

## CTD Track Map Table Format

	15	8 7	0
word 0	1	reserved	HP→IB address
word 1	CTD unit no.		CTD Volume
word 2	c	Disc cache unit	Disc volume
word 3	high	{ start block of cache { on disc	
word 4	low		
word 5	reserved		
word 6	reserved		
word 7	reserved		

15 8 7 0

1 - set indicates a CTD.

c - set indicates a cached CTD. 0 for noncached CTD  
reserved words must be set to zero

## CS80 Devices

The common characteristics of the CS80 devices are shown below.

Model	Capacity (MBytes)	XFER Rate (KBy)	# of surf.	# of cyl.	Sec/ Trk (128w)	# of blocks	Access Time (ms)
7908A	16	561	5	370	35	64,750	50
7911A	27	835	3	572	64	109,824	35
7912A	64	835	7	572	64	256,256	35
7935	404	950	13	1321	92	1,579,916	32
CTD	67/16	35				65,408/16,352	700



# Chapter 7

## Error Conditions

### General

This chapter defines the DVM33 error message format and lists the most likely causes of I/O errors.

### IO07 Error

Illegal request, driver rejects call; program aborted. Reasons:

- a. Requested subchannel out of range. Subchannel associated with requested LU is not defined in track map table.
- b. Request too large. Requested starting address + length overflowed subchannel.
- c. Requested negative track (Except track =-1 for read) or track too large.
- d. Requested sector was negative or larger than number of sectors per track. (Except sector=-1 which is used for status requests).

### Track Error

Unrecoverable error was encountered.

Error Format:

```
TRnnnnnn EQTeq Usu S(or U)
SCODE sc EQTeq SUBCH su
ADDRESS a QSTAT q
ssssss ssssss ssssss ssssss
ssssss ssssss ssssss ssssss
ssssss ssssss
```

where: nn = logical track number  
eq = EQT number  
su = subchannel on EQT  
S(orU) = system (S) or user (U) request  
sc = select code of device  
a = HP-IB address of device  
q = Error reporting message from device  
sssss = 10 words of CS80 status returned from the  
device after the error

The last 5 lines of error status information are returned through a memory resident program, CSERR, and displayed only on the system console. If this program is not generated in, these messages will not appear. If this program is generated in and the messages do not appear, a channel error has occurred which indicates problems with cabling. Consult the 12821A Interface Manual for cabling restrictions.

This error is caused by any condition that prevents the transfer from successfully completing. This is not a fatal error. The B-register contains the track in error, or the low order block for block addressed requests. The A-register contains EQT word 5 status, which indicates the error.

## IO NOT READY Error

Error Format:

IONR Lnn Exx Syy zzz

where:nn = LU number  
xx = EQT number  
yy = Subchannel number  
zzz = Status byte from EQT word 5

This error is caused by:

- a. An attempt to access a nonexistent or offline device.
- b. Device controller is offline to service pack dismount or head realignment.
- c. A hardware fault taking the controller offline.
- d. Device did not respond in specified timeout period, or within 20 seconds if no timeout was specified.



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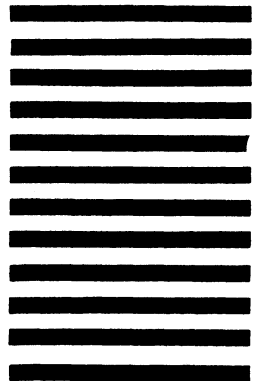


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Telex: 031-2463  
Cable: BLUESTAR  
A,CM,C,E,M

Blue Star Ltd.  
1-1-117/1 Sarojini Devi Road  
SECUNDERABAD 500 033  
Tel: 70126  
Telex: 0155-459  
Cable: BLUEFROST  
A,E

Blue Star Ltd.  
T.C. 7/603 Poornima  
Maruthankuzhi  
TRIVANDRUM 695 013  
Tel: 65799  
Telex: 0884-259  
Cable: BLUESTAR  
E

**INDONESIA**  
BERCA Indonesia P.T.  
P.O.Box 496/Jk1.  
Jin. Abdul Muis 62  
JAKARTA  
Tel: 373009  
Telex: 31146 BERSAL IA  
Cable: BERSAL JAKARTA  
A,C,E,M,P

BERCA Indonesia P.T.  
P.O. Box 174/Sby.  
J.L. Kutei No. 11  
SUBABE-SURABAYA  
Tel: 68172  
Telex: 31146 BERSAL SD  
Cable: BERSAL-SURABAYA  
A\*,E,M,P

**IRAQ**  
Hewlett-Packard Trading S.A.  
Mansoor City 9B/3/7  
BAGHDAD  
Tel: 551-49-73  
Telex: 2455 HEPAIRAQ IK  
CP

**IRELAND**  
Hewlett-Packard Ireland Ltd.  
Kestrel House  
Clanwilliam Court  
Lower Mount Street  
DUBLIN 2, Eire  
Tel: 680424, 680426  
Telex: 30439  
A,C,CM,E,M,P

Cardiac Services Ltd.  
Kilmore Road  
Artane  
DUBLIN 5, Eire  
Tel: (01) 351820  
Telex: 30439  
M



**ISRAEL**

Electronics Engineering Division  
Motorola Israel Ltd.  
16 Kremenski Street  
P.O. Box 25016  
TEL-AYIV 67899  
Tel: 338973  
Telex: 33569 Motil IL  
Cable: BASTEL Tel-Aviv  
A,CM,C,E,M,P

**ITALY**

Hewlett-Packard Italiana S.p.A.  
Traversa 99C  
Giulio Petrone, 19  
I-70124 BARI  
Tel: (080) 41-07-44  
M

Hewlett-Packard Italiana S.p.A.  
Via Martin Luther King, 38/111  
I-40132 BOLOGNA  
Tel: (051) 402394  
Telex: 511630  
CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.  
Via Principe Nicola 43G/C  
I-95126 CATANIA  
Tel: (095) 37-10-87  
Telex: 970291  
C,P

Hewlett-Packard Italiana S.p.A.  
Via G. Di Vittorio 9  
I-20063 CERNUSCO SUL NAVIGLIO  
Tel: (2) 903691  
Telex: 334632  
A,CM,CP,E,MP,P

Hewlett-Packard Italiana S.p.A.  
Via Nuova san Rocco A  
Capodimonte, 62/A  
I-80131 NAPOLI  
Tel: (081) 7413544  
A,CM,CS,E

Hewlett-Packard Italiana S.p.A.  
Viale G. Modugno 33  
I-16156 GENOVA PEGLI  
Tel: (010) 68-37-07 E.C

Hewlett-Packard Italiana S.p.A.  
Via Turazza 14  
I-35100 PADOVA  
Tel: (49) 664888  
Telex: 430315  
A,CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.  
Viale C. Pavese 340  
I-00144 ROMA  
Tel: (06) 54831  
Telex: 610514  
A,CM,CS,E,MS,P\*

Hewlett-Packard Italiana S.p.A.  
Corso Giovanni Lanza 94  
I-10133 TORINO  
Tel: (011) 682245, 659308  
Telex: 221079  
CM,CS,E

**JAPAN**

Yokogawa-Hewlett-Packard Ltd.  
Inoue Building  
1348-3, Asahi-cho  
ATSUGI, Kanagawa 243  
Tel: (0462) 24-0451  
CM,C\*,E

Yokogawa-Hewlett-Packard Ltd.  
3-30-18 Tsuruya-cho  
Kanagawa-ku, Yokohama-Shi  
KANAGAWA, 221  
Tel: (045) 312-1252  
Telex: 382-3204 YHP YOK  
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.  
Sannomiya-Daichi Seimei-Bldg. 5F  
69 Kyo-Machi Ikuta-Ku  
KOBE CITY 650 Japan  
Tel: (078) 392-4791  
C,E

Yokogawa-Hewlett-Packard Ltd.  
Kumagaya Asahi Yasoji Bldg 4F  
4-3 Chome Tsukuba  
KUMAGAYA, Saitama 360  
Tel: (0485) 24-6563  
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.  
Mito Mitsui Building  
4-73, San-no-maru, 1-chome  
MITO, Ibaragi 310  
Tel: (0292) 25-7470  
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.  
Sumitomo Seimei Bldg.  
11-2 Shimo-sasajima-cho  
Nakamura-ku  
NAGOYA, Aichi 450  
Tel: (052) 581-1850  
CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.  
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5-4-20 Nishinakajima, 5-chome  
Yodogawa-ku, Osaka-shi  
OSAKA, 532  
Tel: (06) 304-6021  
Telex: YHPOSA 523-3624  
A,CM,CP,E,MP,P\*

Yokogawa-Hewlett-Packard Ltd.  
29-21 Takaido-Higashi 3-chome  
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Telex: 232-2024 YHPTOK  
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Tel: (03) 331-6111  
Telex: 232-2024 YHPTOK  
A,CM,CP,E,MP,P\*

**JORDAN**

Mouasher Cousins Company  
P.O. Box 1387  
AMMAN  
Tel: 24907, 39907  
Telex: 21456 SABCO JO  
E,M,P

**KOREA**

Samsung Electronics  
4759 Shinkil, 6 Dong  
Youngdeungpo-Ku,  
SEOUL  
Tel: 8334311, 8334312  
Telex: SAMSAN 27364  
A,C,E,M,P

**KUWAIT**

Al-Khalidiya Trading & Contracting  
P.O. Box 830 Safat  
KUWAIT  
Tel: 42-4910, 41-1726  
Telex: 2481 Areeg k1  
A,E,M

Photo & Cine Equipment  
P.O. Box 270 Safat  
KUWAIT  
Tel: 42-2846, 42-3801  
Telex: 2247 Malin  
P

**LUXEMBOURG**

Hewlett-Packard Belgium S.A./N.V.  
Blvd de la Woluwe, 100  
Woluwedal  
B-1200 BRUSSELS  
Tel: (02) 762-32-00  
Telex: 23-494 paloben bru  
A,CM,CP,E,MP,P

**MALAYSIA**

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Sdn. Bhd.  
Suite 2.21/2.22  
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Jalan Ampang  
KUALA LUMPUR  
Tel: 483544  
Telex: MA31011  
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Protel Engineering  
Lot 319, Satok Rd.  
P.O. Box 1917  
KUCHING, SARAWAK  
Tel: 535-44  
Telex: MA 70904 Promal  
Cable: Proteleng  
A,E,M

**MEXICO**

Hewlett-Packard Mexicana, S.A. de  
C.V.  
Avenida Periferico Sur No. 6501  
Tepepan, Xochimilco  
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Telex: 017-74-507  
A,CP,E,MS,P  
Hewlett-Packard Mexicana, S.A. de  
C.V.  
Rio Volga 600  
Colonia del Valle  
MONTERREY, N.L.  
Tel: 78-42-93, 78-42-40, 78-42-41  
Telex: 038-410  
CS

**MOROCCO**

Dolbeau  
81 rue Karatchi  
CASABLANCA  
Tel: 3041-82, 3068-38  
Telex: 23051, 22822  
E  
Gerep  
2 rue d'Agadir  
Boite Postale 156  
CASABLANCA  
Tel: 272093, 272095  
Telex: 23 739  
P

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Hewlett-Packard Nederland B.V.  
Van Heuven Goedhartlaan 121  
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P.O. Box 667  
NL 1080 AR AMSTELVEEN  
Tel: (20) 47-20-21  
Telex: 13 216  
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Hewlett-Packard Nederland B.V.  
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NL 2900 AA CAPELLE, IJssel  
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Telex: 21261 HEPAC NL  
A,CM,CP

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169 Manukau Road  
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Epsom, AUCKLAND  
Tel: 68-7159  
Cable: HEWPACK Auckland  
CM,CS,E,P\*

Hewlett-Packard (N.Z.) Ltd.  
4-12 Cruickshank Street  
P.O. Box 9443  
Kilbirnie, WELLINGTON 3  
Tel: 877-199  
Cable: HEWPACK Wellington  
CM,CP,E,P  
Northrop Instruments & Systems  
Ltd.  
Eden House, 44 Khyber Pass Road  
P.O. Box 9682  
Newmarket, AUCKLAND  
Tel: 794-091  
A,M  
Northrop Instruments & Systems  
Ltd.  
Terrace House, 4 Oxford Terrace  
P.O. Box 8388  
CHRISTCHURCH  
Tel: 64-165  
A,M  
Northrop Instruments & Systems  
Ltd.  
Sturdee House  
85-87 Ghuznee Street  
P.O. Box 2406  
WELLINGTON  
Tel: 850-091  
Telex: NZ 3380  
A,M

**NIGERIA**

The Electronics Instrumentations  
Ltd.  
MGB/S70 Oyo Road  
Okuseun House  
P.M.B. 5402  
IBADAN  
Tel: 461577  
Telex: 31231 TEIL NG  
A,E,M,P  
The Electronics Instrumentations  
Ltd.  
144 Agege Motor Road, Mushin  
P.O. Box 6645  
Mushin, LAGOS  
A,E,M,P

**NORTHERN IRELAND**

Cardiac Services Company  
95A Finaghy Road South  
BELFAST BT 10 OBY  
Tel: (0232) 625-566  
Telex: 747626  
M

**NORWAY**

Hewlett-Packard Norge A/S  
Folke Bernadottesvei 50  
P.O. Box 3558  
N-5033 FYLLINGSDALEN (BERGEN)  
Tel: (05) 16-55-40  
Telex: 16621 hpnas n  
CM,CS,E  
Hewlett-Packard Norge A/S  
Oesterndalen 18  
P.O. Box 34  
N-1345 OESTERAAAS  
Tel: (02) 17-11-80  
Telex: 16621 hpnas n  
A\*,CM,CP,E,MS,P

**OMAN**

Khimji Ramdas  
P.O. Box 19  
MUSCAT  
Tel: 72-22-17, 72-22-25  
Telex: 3289 BROKER MB MUSCAT  
P

**PAKISTAN**

Mushko & Company Ltd.  
10, Bazar Road  
Sector G-6/4  
ISLAMABAD  
Tel: 28624  
Cable: FEMUS Rawalpindi  
A,E,M  
Mushko & Company Ltd.  
Oosman Chambers  
Abdullah Haroon Road  
KARACHI 0302  
Tel: 511027, 512927  
Telex: 2894 MUSHKO PW  
Cable: COOPERATOR Karachi  
A,E,M,P\*

**PANAMA**

Electrónico Balboa, S.A.  
Apartado 4929  
Panama 5  
Calle Samuel Lewis  
Edificio "Alfa" No. 2  
CIUDAD DE PANAMA  
Tel: 64-2700  
Telex: 3480380  
Cable: ELECTRON Panama  
A,CM,E,M,P  
Foto Internacional, S.A.  
P.O. Box 2068  
Free Zone of Colon  
COLON 3  
Tel: 45-2333  
Telex: 3485126  
Cable: IMPORT COLON/Panama  
P

**PERU**

Cómpania Electro Médica S.A.  
Los Flamencos 145, San Isidro  
Casilla 1030  
LIMA 1  
Tel: 41-4325  
Telex: Pub. Booth 25424 SISIDRO  
Cable: ELMED Lima  
A,CM,E,M,P

**PHILIPPINES**

The Online Advanced Systems  
Corporation  
Rico House, Amorsolo Cor. Herrera  
Street  
Legaspi Village, Makati  
P.O. Box 1510  
Metro MANILA  
Tel: 85-35-81, 85-34-91, 85-32-12  
Telex: 3274 ONLINE  
A,C,E,M  
Electronic Specialists and  
Proponents Inc.  
690-B Epitanio de los Santos  
Avenue  
Cubao, QUEZON CITY  
P.O. Box 2649 Manila  
Tel: 98-96-81, 98-96-82, 98-96-83  
Telex: 742-40287  
P

**POLAND**

Buro Informacji Technicznej  
Hewlett-Packard  
Ul. Slawki 2, 6P  
P.00-950 WARSZAWA  
Tel: 39-59-62, 39-67-43  
Telex: 812453 hepa pl



# SALES & SUPPORT OFFICES

Arranged alphabetically by country

## PORTUGAL

Telectra-Empresa Técnica de Equipamentos Eléctricos S.a.r.l.  
Rua Rodrigo da Fonseca 103  
P.O. Box 2531

**P-LISBON 1**  
Tel: (19) 68-60-72  
Telex: 12598  
A,C,E,P

### Mundinter

Intercambio Mundial de Comércio S.a.r.l.  
P.O. Box 2761  
Avenida Antonio Augusto de Aguiar 138

**P-LISBON**  
Tel: (19) 53-21-31, 53-21-37  
Telex: 16691 munter p  
M

## PUERTO RICO

Hewlett-Packard Puerto Rico  
P.O. Box 4407

**CAROLINA**, Puerto Rico 00630  
Calle 272 Edificio 203  
Urb. Country Club

**RIO PIEDRAS**, Puerto Rico 00924  
Tel: (809) 762-7255  
Telex: 345 0514  
A,CP

## QATAR

Nasser Trading & Contracting  
P.O. Box 1563

**DOHA**  
Tel: 22170  
Telex: 4439 NASSER  
M

### Scitecharabia

P.O. Box 2750  
!DOHA  
Tel: 329515  
Telex: 4806 CMPARB  
P

## ROMANIA

Hewlett-Packard Reprezentanta  
Boulevard Nicolae Balcescu 16

**BUCURESTI**  
Tel: 130725  
Telex: 10440

## SAUDI ARABIA

Modern Electronic Establishment  
P.O. Box 193

**AL-KHOBAR**  
Tel: 44-678, 44-813  
Telex: 670136  
Cable: ELECTA AL-KHOBAR  
C,E,M,P

Modern Electronic Establishment  
P.O. Box 1228, Baghdadiah Street

**JEDDAH**  
Tel: 27-798  
Telex: 401035  
Cable: ELECTA JEDDAH  
C,E,M,P

Modern Electronic Establishment  
P.O. Box 2728

**RIYADH**  
Tel: 62-596, 66-232  
Telex: 202049  
C,E,M,P

## SCOTLAND

Hewlett-Packard Ltd.  
Royal Bank Buildings  
Swan Street  
**BRECHIN**, Angus, Scotland  
Tel: 3101, 3102  
CM,CS

Hewlett-Packard Ltd.  
**SOUTH QUEENSFERRY**  
West Lothian, EH30 9TG  
GB-Scotland  
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Telex: 72682  
A,CM,E,M

## SINGAPORE

Hewlett-Packard Singapore (Pty.) Ltd.  
P.O. Box 58 Alexandra Post Office  
**SINGAPORE**, 9115  
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450-452 Alexandra Road  
**SINGAPORE** 0511  
Tel: 631788  
Telex: HPSGSO RS 34209  
Cable: HEWPACK, Singapore  
A,CP,E,MS,P

## SOUTH AFRICA

Hewlett-Packard South Africa (Pty.) Ltd.  
P.O. Box 120  
Howard Place  
Pine Park Center, Forest Drive,  
Pinelands  
**CAPE PROVINCE** 7450  
Tel: 53-7955, 53-7956, 53-7957  
Telex: 57-0006  
A,CM,CS,E,MS,P  
Hewlett-Packard South Africa (Pty.) Ltd.  
P.O. Box 37066  
Overport  
**DURBAN** 4067  
Tel: 28-4178, 28-4179, 28-4110  
CM,CS

Hewlett-Packard South Africa (Pty.) Ltd.  
P.O. Box 33345  
Glenstantia 0010 **TRANSVAAL**  
1st Floor East  
Constantia Park Ridge Shopping Centre  
Constantia Park  
**PRETORIA** Tel: 98-1126 or 98-1220  
Telex: 32163  
C,E  
Hewlett-Packard South Africa (Pty.) Ltd.  
Daphny Street  
Private Bag Wendywood  
**SANDTON** 2144  
Tel: 802-5111, 802-5125  
Telex: 89-84782  
Cable: HEWPACK Johannesburg  
A,CM,CP,E,MS,P

## SPAIN

Hewlett-Packard Española S.A.  
c/Entenza, 321  
**E-BARCELONA** 29  
Tel: (3) 322-24-51, 321-73-54  
Telex: 52603 hpbee  
A,CM,CP,E,MS,P  
Hewlett-Packard Española S.A.  
c/San Vicente S/N  
Edificio Albia II, 7 B  
**E-BILBAO** 1  
Tel: (944) 423-8306, 423-8206  
A,CM,E,MS

Hewlett-Packard Española S.A.  
Calle Jerez 3  
**E-MADRID** 16  
Tel: 458-2600  
Telex: 23515 hpe  
A,CM,E,MP,P

Hewlett-Packard Española S.A.  
Colonia Mirasierra  
Edificio Juban  
c/o Costa Brava 13, 2.  
**E-MADRID** 34  
Tel: 734-8061, 734-1162  
CM,CP

Hewlett-Packard Española S.A.  
Av Ramón y Cajal 1-9  
Edificio Sevilla 1,  
**E-SEVILLA** 5  
Tel: 64-44-54, 64-44-58  
Telex: 72933  
A,CM,CS,MS,P

Hewlett-Packard Española S.A.  
C/Ramon Gordillo, 1 (Entlo.3)  
**E-VALENCIA** 10  
Tel: 361-1354, 361-1358  
CM,CS,P

## SWEDEN

Hewlett-Packard Sverige AB  
Enighetsvägen 3, Fack  
P.O. Box 20502  
S-16120 **BROMMA**  
Tel: (08) 730-0550  
Telex: (854) 10721 MESSAGES  
Cable: MEASUREMENTS  
**STOCKHOLM**  
A,CM,CP,E,MS,P  
Hewlett-Packard Sverige AB  
Sunnanvagen 14K  
S-22226 **LUND**  
Tel: (46) 13-69-79  
Telex: (854) 10721 (via BROMMA office)  
CM,CS  
Hewlett-Packard Sverige AB  
Vastra Vintergatan 9  
S-70344 **OREBRO**  
Tel: (19) 10-48-80  
Telex: (854) 10721 (via BROMMA office)  
CM,CS  
Hewlett-Packard Sverige AB  
Frötlallsgatan 30  
S-42132 **VASTRA-FRÖLUNDA**  
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Telex: (854) 10721 (via BROMMA office)  
CM,CS,E,P

## SWITZERLAND

Hewlett-Packard (Schweiz) AG  
Clarastrasse 12  
CH-4058 **BASLE**  
Tel: (61) 33-59-20  
A,CM  
Hewlett-Packard (Schweiz) AG  
47 Avenue Blanc  
CH-1202 **GENEVA**  
Tel: (022) 32-30-05, 32-48-00  
CM,CP  
Hewlett-Packard (Schweiz) AG  
29 Chemin Château Bloc  
CH-1219 **LE LIGNON**-Geneva  
Tel: (022) 96-03-22  
Telex: 27333 hpag ch  
Cable: HEWPACKAG Geneva  
A,CM,E,MS,P  
Hewlett-Packard (Schweiz) AG  
Zürcherstrasse 20  
Allmend 2  
CH-8967 **WIDEN**  
Tel: (57) 50-111  
Telex: 59933 hpag ch  
Cable: HPAG CH  
A,CM,CP,E,MS,P

## SYRIA

General Electronic Inc.  
Nuri Basha-Ahna Ebn Kays Street  
P.O. Box 5781

**DAMASCUS**  
Tel: 33-24-87  
Telex: 11215 ITKAL  
Cable: ELECTROBOR DAMASCUS  
E

Sawah & Co.  
Place Azmé  
Boite Postale 2308  
**DAMASCUS**  
Tel: 16-367, 19-697, 14-268  
Telex: 11304 SATACO SY  
Cable: SAWAH, DAMASCUS  
M

## TAIWAN

Hewlett-Packard Far East Ltd.  
Kaohsiung Branch  
68-2, Chung Cheng 3rd Road  
Shin Shin, Chu  
**KAOHSIUNG**  
Tel: 24-2318, 26-3253  
CS,E,MS,P  
Hewlett-Packard Far East Ltd.  
Taiwan Branch  
5th Floor  
205 Tun Hwa North Road  
**TAIPEI**  
Tel: (02) 751-0404  
Cable: HEWPACK Taipei  
A,CP,E,MS,P

Hewlett-Packard Far East Ltd.  
Taichung Branch  
#33, Cheng Yih Street  
10th Floor, Room 5  
**TAICHUNG**  
Tel: 289274  
Ing Lih Trading Co.  
3rd Floor 18, Po-la Road  
**TAIPEI**  
Tel:  
Telex:  
Cable: INGLIH TAIPEI  
A

## THAILAND

UNIMESA Co. Ltd.  
Elcom Research Building  
2538 Sukhumvit Ave.  
Bangchak, **BANGKOK**  
Tel: 393-2387, 393-0338  
Telex: TH81160, 82938, 81038  
Cable: UNIMESA Bangkok  
A,C,E,M  
Bangkok Business Equipment Ltd.  
5/5-6 Dejo Road  
**BANGKOK**  
Tel: 234-8670, 234-8671,  
234-8672  
Cable: BUSIQUIPT Bangkok  
P

## TRINIDAD & TOBAGO

Caribbean Telecoms Ltd.  
P.O. Box 732  
50/A Jerningham Avenue  
**PORT-OF-SPAIN**  
Tel: 624-4213, 624-4214  
A,CM,E,M,P

## TUNISIA

Tunisie Electronique  
31 Avenue de la Liberte  
**TUNIS**  
Tel: 280-144  
E,P

Corema  
1 ter. Av. de Carthage  
**TUNIS**  
Tel: 253-821  
Telex: 12319 CABAM TN  
M

## TURKEY

Teknim Company Ltd.  
Riza Sah Pehievi  
Caddesi No. 7  
Kavaklidere, **ANKARA**  
Tel: 275800  
Telex: 42155  
E  
EMA, Muhendislik Kollektif Sirketi  
Mediha Eldem  
Sokak 4/16  
Yüksel Caddesi, **ANKARA**  
Tel: 17-56-22  
Cable: Emaltrade  
M

## UNITED ARAB EMIRATES

Emilac Ltd.  
P.O. Box 1641  
**SHARJAH**  
Tel: 354121, 354123  
Telex: 68136  
E,M,P,C

## UNITED KINGDOM

see: GREAT BRITAIN  
**NORTHERN IRELAND**  
**SCOTLAND**

## UNITED STATES

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700 Century Park South  
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CM,CS,MP  
Hewlett-Packard Co.  
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**HUNTSVILLE**, AL 35802  
Tel: (205) 881-4591  
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**ANCHORAGE**, AK 99510  
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CM,CS\*\*

**Arizona**  
Hewlett-Packard Co.  
2336 East Magnolia Street  
**PHOENIX**, AZ 85034  
Tel: (602) 273-8000  
A,CM,CP,E,MS

Hewlett-Packard Co.  
2424 East Aragon Road  
**TUCSON**, AZ 85702  
Tel: (602) 889-4631  
CM,CS,E,MS\*\*

**Arkansas**  
Hewlett-Packard Co.  
P.O. Box 5646  
Brady Station  
**LITTLE ROCK**, AR 72215  
Tel: (501) 376-1844, (501)  
664-8773  
CM,MS

# SALES & SUPPORT OFFICES

Arranged alphabetically by country



## UNITED STATES (Cont.)

### California

Hewlett-Packard Co.  
7621 Canoga Avenue  
CANOGA PARK, CA 91304  
Tel: (213) 702-8300  
A,CM,CP,E,P

Hewlett-Packard Co.  
1579 W. Shaw Avenue  
FRESNO, CA 93771  
Tel: (209) 224-0582  
CM,MS

Hewlett-Packard Co.  
1430 East Orangethorpe  
FULLERTON, CA 92631  
Tel: (714) 870-1000  
CM,CP,E,MP

Hewlett-Packard Co.  
5400 W. Rosecrans Boulevard  
LAWNDALE, CA 90260  
P.O. Box 92105  
LOS ANGELES, CA 90009  
Tel: (213) 970-7500  
CM,CP,MP

Hewlett-Packard Co.  
3939 Lankershim Blvd.  
NORTH HOLLYWOOD, CA 91604  
Tel: (213) 877-1282  
Regional Headquarters

Hewlett-Packard Co.  
3200 Hillview Avenue  
PALO ALTO, CA 94304  
Tel: (415) 857-8000  
CM,CP,E

Hewlett-Packard Co.  
646 W. North Market Boulevard  
SACRAMENTO, CA 95834  
Tel: (916) 929-7222  
A\*,CM,CP,E,MS

Hewlett-Packard Co.  
9606 Aero Drive  
P.O. Box 23333  
SAN DIEGO, CA 92123  
Tel: (714) 279-3200  
CM,CP,E,MP

Hewlett-Packard Co.  
3003 Scott Boulevard  
SANTA CLARA, CA 95050  
Tel: (408) 988-7000  
A,CM,CP,E,MP

Hewlett-Packard Co.  
454 Carlton Court  
SO. SAN FRANCISCO, CA 94080  
Tel: (415) 877-0772  
CM,CP

### Colorado

Hewlett-Packard Co.  
24 Inverness Place, East  
ENGLEWOOD, CO 80112  
Tel: (303) 771-3455  
A,CM,CP,E,MS

### Connecticut

Hewlett-Packard Co.  
47 Barnes Industrial Road South  
P.O. Box 5007  
WALLINGFORD, CT 06492  
Tel: (203) 265-7801  
A,CM,CP,E,MS

### Florida

Hewlett-Packard Co.  
P.O. Box 24210  
2727 N.W. 62nd Street  
FORT LAUDERDALE, FL 33309  
Tel: (305) 973-2600  
CM,CP,E,MP

Hewlett-Packard Co.  
4080 Woodcock Drive, #132  
Brownett Building  
JACKSONVILLE, FL 32207  
Tel: (904) 398-0663  
CM,C\*,E\*,MS\*\*

Hewlett-Packard Co.  
P.O. Box 13910  
6177 Lake Ellenor Drive  
ORLANDO, FL 32809  
Tel: (305) 859-2900  
A,CM,CP,E,MS

Hewlett-Packard Co.  
6425 N. Pensacola Blvd.  
Suite 4, Building 1  
PENSACOLA, FL 32575  
Tel: (904) 476-8422  
A,CM,MS

Hewlett-Packard Co.  
110 South Hoover, Suite 120  
Vanguard Bldg.  
TAMPA, FL 33609  
Tel: (813) 872-0900  
A\*,CM,CS,E\*,M\*

### Georgia

Hewlett-Packard Co.  
P.O. Box 105005  
2000 South Park Place  
ATLANTA, GA 30339  
Tel: (404) 955-1500  
Telex: 810-766-4890  
A,CM,CP,E,MP

Hewlett-Packard Co.  
Executive Park Suite 306  
P.O. Box 816  
AUGUSTA, GA 30907  
Tel: (404) 736-0592  
CM,MS

Hewlett-Packard Co.  
P.O. Box 2103  
1172 N. Davis Drive  
WARNER ROBINS, GA 31098  
Tel: (912) 922-0449  
CM,E

### Hawaii

Hewlett-Packard Co.  
Kawaiahao Plaza, Suite 190  
567 South King Street  
HONOLULU, HI 96813  
Tel: (808) 526-1555  
A,CM,CS,E,MS

### Idaho

Hewlett-Packard Co.  
11311 Chinden Boulevard  
BOISE, ID 83707  
Tel: (208) 376-6000  
CM,CS,M\*

### Illinois

Hewlett-Packard Co.  
211 Prospect Road  
BLOOMINGTON, IL 61701  
Tel: (309) 663-0383  
CM,CS,MS\*\*

Hewlett-Packard Co.  
1100 31st Street  
DOWNERS GROVE, IL 60515  
Tel: (312) 960-5760  
CM,CP

Hewlett-Packard Co.  
5201 Tollview Drive  
ROLLING MEADOWS, IL 60008  
Tel: (312) 255-9800  
A,CM,CP,E,MP

### Indiana

Hewlett-Packard Co.  
P.O. Box 50807  
7301 No. Shadeland Avenue  
INDIANAPOLIS, IN 46250  
Tel: (317) 842-1000  
A,CM,CS,E,MS

### Iowa

Hewlett-Packard Co.  
2415 Heinz Road  
IOWA CITY, IA 52240  
Tel: (319) 351-1020  
CM,CS,E\*,MS

### Kansas

Hewlett-Packard Co.  
1644 S. Rock  
WICHITA, KA 67207  
Tel: (316) 265-5200  
CM,CS

### Kentucky

Hewlett-Packard Co.  
10170 Linn Station Road  
Suite 525  
LOUISVILLE, KY 40223  
Tel: (502) 426-0100  
A,CM,CS,MS

### Louisiana

Hewlett-Packard Co.  
P.O. Box 1449  
3229 Williams Boulevard  
KENNER, LA 70062  
Tel: (504) 443-6201  
A,CM,CS,E,MS

### Maryland

Hewlett-Packard Co.  
7121 Standard Drive  
HANOVER, MD 21076  
Tel: (301) 796-7700  
A,CM,CP,E,MS

Hewlett-Packard Co.  
2 Choke Cherry Road  
ROCKVILLE, MD 20850  
Tel: (301) 948-6370  
Telex: 710-828-9685  
A,CM,CP,E,MP

### Massachusetts

Hewlett-Packard Co.  
32 Hartwell Avenue  
LEXINGTON, MA 02173  
Tel: (617) 861-8960  
A,CM,CP,E,MP

### Michigan

Hewlett-Packard Co.  
23855 Research Drive  
FARMINGTON HILLS, MI 48024  
Tel: (313) 476-6400  
A,CM,CP,E,MP

Hewlett-Packard Co.  
4326 Cascade Road S.E.  
GRAND RAPIDS, MI 49506  
Tel: (616) 957-1970  
CM,CS,MS

### Minnesota

Hewlett-Packard Co.  
2025 W. Larpentour Ave.  
ST. PAUL, MN 55113  
Tel: (612) 644-1100  
A,CM,CP,E,MP

### Mississippi

Hewlett-Packard Co.  
P.O. Box 5028  
322 N. Mart Plaza  
JACKSON, MS 39216  
Tel: (601) 982-9363  
CM,MS

### Missouri

Hewlett-Packard Co.  
11131 Colorado Avenue  
KANSAS CITY, MO 64137  
Tel: (816) 763-8000  
Telex: 910-771-2087  
A,CM,CS,E,MS

Hewlett-Packard Co.  
1024 Executive Parkway  
ST. LOUIS, MO 63141  
Tel: (314) 878-0200  
A,CM,CP,E,MP

### Nebraska

Hewlett-Packard  
7101 Mercy Road  
Suite 101, IBX Building  
OMAHA, NE 68106  
Tel: (402) 392-0948  
CM,MS

### Nevada

Hewlett-Packard Co.  
Suite D-130  
5030 Paradise Blvd.  
LAS VEGAS, NV 89119  
Tel: (702) 736-6610  
CM,MS\*\*

### New Jersey

Hewlett-Packard Co.  
Crystal Brook Professional Building  
Route 35  
EATONTOWN, NJ 07724  
Tel: (201) 542-1384  
A\*,CM,C\*,E\*,P\*

Hewlett-Packard Co.  
W120 Century Road  
PARAMUS, NJ 07652  
Tel: (201) 265-5000  
A,CM,CP,E,MP

Hewlett-Packard Co.  
60 New England Avenue West  
PISCATAWAY, NJ 08854  
Tel: (201) 981-1199  
A,CM,CP,E

### New Mexico

Hewlett-Packard Co.  
P.O. Box 11634  
11300 Lomas Blvd., N.E.  
ALBUQUERQUE, NM 87123  
Tel: (505) 292-1330  
Telex: 910-989-1185  
CM,CP,E,MS

### New York

Hewlett-Packard Co.  
5 Computer Drive South  
ALBANY, NY 12205  
Tel: (518) 458-1550  
Telex: 710-444-4691  
A,CM,CS,E,MS

Hewlett-Packard Co.  
9600 Main Street  
CLARENCE, NY 14031  
Tel: (716) 759-8621  
Telex: 710-523-1893

Hewlett-Packard Co.  
200 Cross Keys Office  
FAIRPORT, NY 14450  
Tel: (716) 223-9950  
Telex: 510-253-0092  
CM,CP,E,MS

Hewlett-Packard Co.  
No. 1 Pennsylvania Plaza  
55th Floor  
34th Street & 8th Avenue  
NEW YORK, NY 10119  
Tel: (212) 971-0800  
CM,CP,E\*,M\*

Hewlett-Packard Co.  
5858 East Molloy Road  
SYRACUSE NY 13211  
Tel: (315) 455-2486  
A,CM,CS,E,MS

Hewlett-Packard Co.  
3 Crossways Park West  
WOODBURY, NY 11797  
Tel: (516) 921-0300  
Telex: 510-221-2183  
A,CM,CP,E,MS

### North Carolina

Hewlett-Packard Co.  
P.O. Box 15579  
2905 Guess Road (27705)  
DURHAM, NC 27704  
Tel: (919) 471-8466  
C,M

Hewlett-Packard Co.  
5605 Roanne Way  
GREENSBORO, NC 27409  
Tel: (919) 852-1800  
A,CM,CP,E,MS

### Ohio

Hewlett-Packard Co.  
9920 Carver Road  
CINCINNATI, OH 45242  
Tel: (513) 891-9870  
CM,CP,MS

Hewlett-Packard Co.  
16500 Sprague Road  
CLEVELAND, OH 44130  
Tel: (216) 243-7300  
Telex: 810-423-9430  
A,CM,CP,E,MS

Hewlett-Packard Co.  
962 Crupper Ave.  
COLUMBUS, OH 43229  
Tel: (614) 436-1041  
CM,CP,E\*

Hewlett-Packard Co.  
330 Progress Rd.  
DAYTON, OH 45449  
Tel: (513) 859-8202  
A,CM,CP,E\*,MS

### Oklahoma

Hewlett-Packard Co.  
P.O. Box 366  
1503 W. Gore Blvd., Suite #2  
LAWTON, OK 73502  
Tel: (405) 248-4248  
C

Hewlett-Packard Co.  
P.O. Box 32008  
304 N. Meridian Avenue, Suite A  
OKLAHOMA CITY, OK 73107  
Tel: (405) 946-9499  
A\*,CM,CP,E\*,MS

Hewlett-Packard Co.  
Suite 121  
9920 E. 42nd Street  
TULSA, OK 74145  
Tel: (918) 665-3300  
A\*\*,CM,CS,M\*

### Oregon

Hewlett-Packard Co.  
1500 Valley River Drive, Suite 330  
EUGENE, OR 97401  
Tel: (503) 683-8075  
C

Hewlett-Packard Co.  
9255 S. W. Pioneer Court  
WILSONVILLE, OR 97070  
Tel: (503) 682-8000  
A,CM,CP,E\*,MS

### Pennsylvania

Hewlett-Packard Co.  
1021 8th Avenue  
King of Prussia Industrial Park  
KING OF PRUSSIA, PA 19406  
Tel: (215) 265-7000  
Telex: 510-660-2670  
A,CM,CP,E,MP

Hewlett-Packard Co.  
111 Zeta Drive  
PITTSBURGH, PA 15238  
Tel: (412) 782-0400  
A,CM,CP,E,MP

### South Carolina

Hewlett-Packard Co.  
P.O. Box 6442  
6941-O N. Trenholm Road  
COLUMBIA, SC 29260  
Tel: (803) 782-6493  
CM,CS,E,MS



# SALES & SUPPORT OFFICES

Arranged alphabetically by country

## UNITED STATES (Cont.)

### South Carolina (Cont.)

Hewlett-Packard Co.  
814 Wade Hampton Blvd.  
Suite 10  
GREENVILLE, SC 29609  
Tel: (803) 232-0917  
C

### Tennessee

Hewlett-Packard Co.  
P.O. Box 22490  
224 Peters Road  
Suite 102  
KNOXVILLE, TN 37922  
Tel: (615) 691-2371  
A\*, CM, MS

Hewlett-Packard Co.  
3070 Directors Row  
MEMPHIS, TN 38131  
Tel: (901) 346-8370  
A, CM, CS, MS

Hewlett-Packard Co.  
Suite 103  
478 Craighead Street  
NASHVILLE, TN 37204  
Tel: (615) 383-9136  
CM, MS\*\*

### Texas

Hewlett-Packard Co.  
Suite 310W  
7800 Shoalcreek Blvd.  
AUSTIN, TX 78757  
Tel: (512) 459-3143  
CM, E

Hewlett-Packard Co.  
Suite C-110  
4171 North Mesa  
EL PASO, TX 79902  
Tel: (915) 533-3555  
CM, CS, E\*, MS\*\*

Hewlett-Packard Co.  
5020 Mark IV Parkway  
FORT WORTH, TX 76106  
Tel: (817) 625-6361  
CM, C\*

Hewlett-Packard Co.  
P.O. Box 42816  
10535 Harwin Street  
HOUSTON, TX 77036  
Tel: (713) 776-6400  
A, CM, CP, E, MP

Hewlett-Packard Co.  
3309 67th Street  
Suite 24  
LUBBOCK, TX 79413  
Tel: (806) 799-4472  
M

Hewlett-Packard Co.  
P.O. Box 1270  
930 E. Campbell Rd.  
RICHARDSON, TX 75081  
Tel: (214) 231-6101  
A, CM, CP, E, MP

Hewlett-Packard Co.  
205 Billy Mitchell Road  
SAN ANTONIO, TX 78226  
Tel: (512) 434-8241  
CM, CS, E, MS

### Utah

Hewlett-Packard Co.  
3530 W. 2100 South Street  
SALT LAKE CITY, UT 84119  
Tel: (801) 974-1700  
A, CM, CP, E, MS

### Virginia

Hewlett-Packard Co.  
P.O. Box 9669  
2914 Hungary Spring Road  
RICHMOND, VA 23228  
Tel: (804) 285-3431  
A, CM, CP, E, MS

Hewlett-Packard Co.  
P.O. Box 4786  
3110 Peters Creek Road, N.W.  
ROANOKE, VA 24015  
Tel: (703) 563-2205  
CM, CS, E\*\*

Hewlett-Packard Co.  
P.O. Box 12778  
5700 Thurston Avenue  
Suite 111  
VIRGINIA BEACH, VA 23455  
Tel: (804) 460-2471  
CM, CS, MS

### Washington

Hewlett-Packard Co.  
15815 S.E. 37th Street  
BELLEVUE, WA 98006  
Tel: (206) 643-4000  
A, CM, CP, E, MP

Hewlett-Packard Co.  
Suite A  
708 North Argonne Road  
SPOKANE, WA 99206  
Tel: (509) 922-7000  
CM, CS

### West Virginia

Hewlett-Packard Co.  
4604 MacCorkle Ave., S.E.  
CHARLESTON, WV 25304  
Tel: (304) 925-0492  
A, CM, MS

### Wisconsin

Hewlett-Packard Co.  
150 S. Sunny Slope Road  
BROOKFIELD, WI 53005  
Tel: (414) 784-8800  
A, CM, CS, E\*, MP

### URUGUAY

Pablo Ferrando S.A.C. e.l.  
Avenida Italia 2877  
Casilla de Correo 370  
MONTEVIDEO  
Tel: 403102  
Telex: 901 Public Booth Para Pablo  
Ferrando 919520  
Cable: RADIUM Montevideo  
A, CM, E, M  
Guillermo Kraft del Uruguay S.A.  
Avda. Libertador Brig. Gral.  
Lavalleja 2083  
MONTEVIDEO  
Tel: 234588, 234808, 208830  
Telex: 6245 ACTOUR UY  
P

### U.S.S.R.

Hewlett-Packard Co.  
Representative Office  
Pokrovsky Blvd. 4/17 KV12  
MOSCOW 101000 Tel: 294-2024  
Telex: 7825 HEWPACK SU

### VENEZUELA

Hewlett-Packard de Venezuela C.A.  
Apartado 50933  
3A Transversal Los Ruices Norte  
Edificio Segre 2Y3  
CARACAS 1071  
Tel: 239-4133, 239-4777,  
239-4244  
Telex: 25146 HEWPACK  
Cable: HEWPACK Caracas  
A, CP, E, MS, P

### YUGOSLAVIA

Iskra-Commerce-Representation of  
Hewlett-Packard  
Sava Centar Delegacija 30  
Milentija Popovica 9  
11170 BEOGRAD  
Tel: 638-762  
Telex: 12042, 12322 YU SAV CEN

Iskra-Commerce-Representation of  
Hewlett-Packard  
Koprcka 46  
61000 LJUBLJANA  
Tel: 321674, 315879  
Telex:

### ZAMBIA

R. J. Tilbury (Zambia) Ltd.  
P.O. Box 2792  
LUSAKA  
Tel: 81243  
A, E, M, P

### ZIMBABWE

Field Technical Sales  
45 Kelvin Road, North  
P.B. 3458  
SALISBURY  
Tel:  
C, E, M, P

## FOR COUNTRIES AND AREAS NOT LISTED:

### CANADA

Ontario  
Hewlett-Packard (Canada) Ltd.  
6877 Goreway Drive  
MISSISSAUGA, Ontario L4V 1M8  
Tel: (416) 678-9430  
Telex: 610-492-4246

### EASTERN USA

Maryland  
Hewlett-Packard Co.  
4 Choke Cherry Road  
Rockville, MD 20850  
Tel: (301) 258-2000

### MIDWESTERN USA

Illinois  
Hewlett-Packard Co.  
5201 Tollview Drive  
ROLLING MEADOWS, IL 60008  
Tel: (312) 255-9800

### SOUTHERN USA

Georgia  
Hewlett-Packard Co.  
P.O. Box 105005  
450 Interstate N. Parkway  
ATLANTA, GA 30339  
Tel: (404) 955-1500

### WESTERN USA

California  
Hewlett-Packard Co.  
3939 Lankersim Blvd.  
LOS ANGELES, CA 91604  
Tel: (213) 877-1282

## EUROPEAN AREAS NOT LISTED, CONTACT

### SWITZERLAND

Hewlett-Packard S.A.  
7 Rue du Bois-du-Lan  
CH-1217 MEYRIN 2, Switzerland  
Tel: (022) 83-81-11  
Telex: 27835 hpse  
Cable: HEWPACKSA Geneve

## EAST EUROPEAN AREAS NOT LISTED, CONTACT

### AUSTRIA

Hewlett-Packard Ges.m.b.h.  
Wehistrasse 29  
P.O. Box 7  
A-1205 VIENNA  
Tel: (222) 35-16-210  
Telex: 135823/135066

## MEDITERRANEAN AND MIDDLE EAST AREAS NOT LISTED, CONTACT

### GREECE

Hewlett-Packard S.A.  
Mediterranean & Middle East  
Operations  
35, Kolokotroni Street  
Platia Kefallariou  
GR-Kifissia, ATHENS, Greece  
Tel: 808-0359, 808-0429  
Telex: 21-6588  
Cable: HEWPACKSA Athens

## INTERNATIONAL AREAS NOT LISTED, CONTACT

### OTHER AREAS

Hewlett-Packard Co.  
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3495 Deer Creek Road  
PALO ALTO, CA 94304  
Tel: (415) 857-1501  
Telex: 034-8300  
Cable: HEWPACK



