AA-M185C-TC

UDA50 Maintenance Guide

Digital Equipment Corporation
Colorado Springs, Colorado

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Digital Equipment Corporation
Colorado Springs, Colorado

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VAX	IAS	VT
UDA50	MASSBUS	RA80
HSC50	RA60	RA81

CONTENTS

Page

FIGURES

TABLES

(Cont.)

1 INTRODUCTION

1.1 SCOPE OF MANUAL

The *UDA50 Maintenance Guide* describes the maintenance and troubleshooting procedures needed to support the UDA50 Disk Controller. This guide covers both UDA50-resident diagnostic and UDA50 host-resident diagnostic operating procedures. When troubleshooting disk subsystem problems, refer to the service manual of the specific disk product.

1.2 UDA50 FIELD REPLACEABLE PARTS

The maintenance philosophy planned for the UDA50 Disk Controller is module replacement. Field Service personnel should not attempt to replace or repair component parts within these modules. UDA50 Field Replaceable Units (FRUs) consist of two hex modules, two flat cable assembly, an I/O bulkhead assembly, and some assorted hardware. Figure 1-1 illustrates the major Field Replaceable Units (FRUs) in a UDA50 assembly.

2 INTRODUCTION

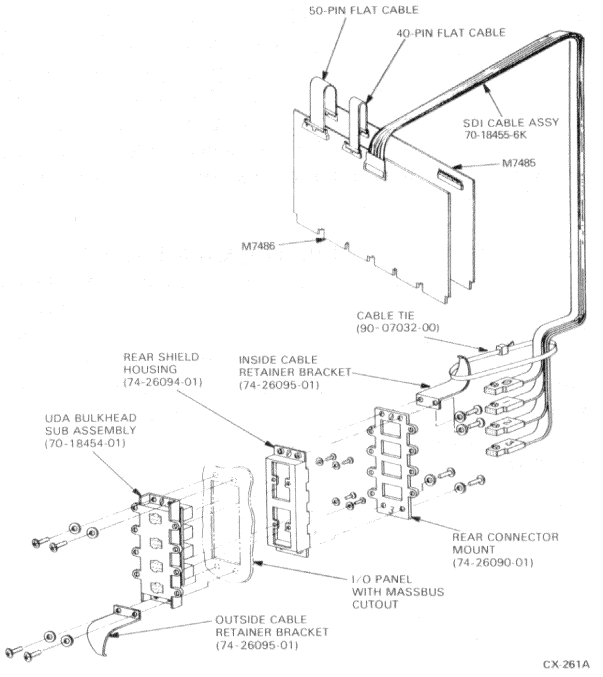

Figure 1-1 UDA50 Illustrated Parts

1.3 UDA50 MAINTENANCE FEATURES

The UDA50 Disk Controller has the following maintenance features:

- UDA50-resident diagnostics
- UDA50 LED maintenance displays
- UDA50 host-resident diagnostics

The UDA50-resident diagnostic is a PROM-based microcode program that performs UDA50 self-diagnosis upon powerup or hard initialization.

A UDA50 maintenance display is located on each UDA50 module. Each display consists of four LEDs. These LEDs display current resident diagnostic activity and error codes caused by malfunctions. Figures 1-2 and 1-3 show the location of the maintenance LEDs on each module.

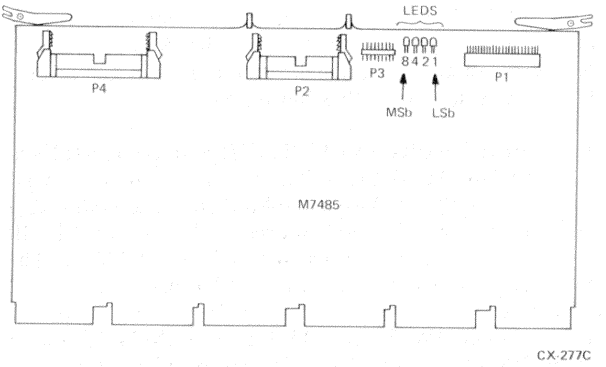

Figure 1-2 Diagnostic LED Locations on UDA50 Module M7485

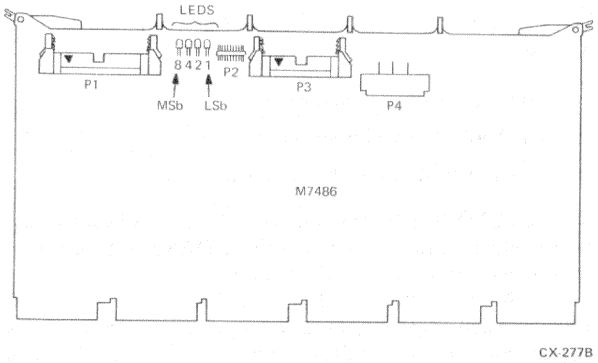

Figure 1-3 Diagnostic LED Locations on UDA50 Module M7486

The UDA50 host-resident diagnostics contain four tests that isolate subsystem faults to the UNIBUS or disk drives. A system exerciser program is also provided to test the performance of the entire disk subsystem.

1.4 UDA50 ADDRESS SWITCHES AND JUMPERS

The UDA50 Disk Controller contains two registers visible to the UNIBUS I/O page: the Initializing and Polling (IP) register and the Status and Address (SA) register. The IP register is typically assigned an octal address of 772150. The SA register address is always the IP address plus two.

Figure 1-4 shows the UNIBUS address selector switches and the jumper (W13) on UDA50 module (M7485) used to set the UNIBUS address for the IP register. Figure 1-5 shows the position of the UNIBUS address switches and jumpers to select UNIBUS address 772150. Alternate addresses are 760334 and 760340.

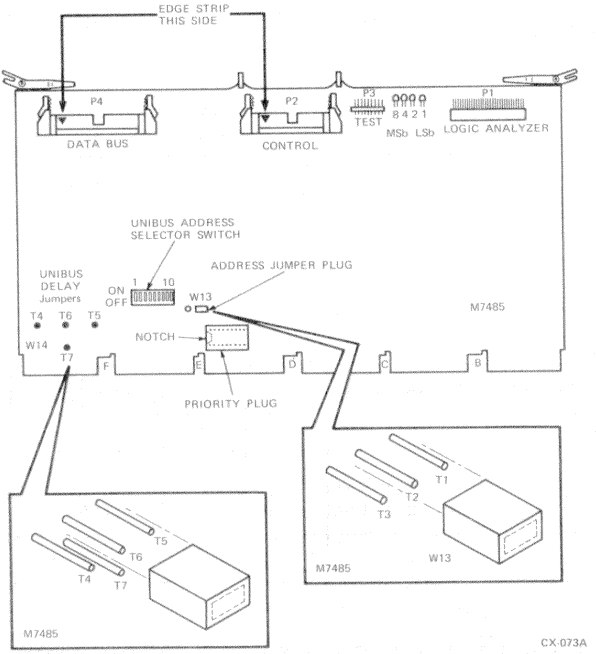

Figure 1-4 M7485 Address Switch and Jumper Locations

UNIBUS ADDRESS BITS	17 16 15	14 13 12	11 10 9	8 7 6	5 4 3	2 1 0
OCTAL CODE	7	7	2	1	5	0
BINARY CODE	1 1 1	1 1 1	0 1 0	0 0 1	1 0 1	0 0 0
UDA50 SWITCH SETTING	1 1 1	1 1 S10 (ON)	S9 S8 S7 OFF ON OFF	S6 S5 S4 OFF OFF ON	S3 S2 S1 ON OFF ON	W13 0 0 T1,T2
	ALWAYS ONES					ALWAYS ZEROS

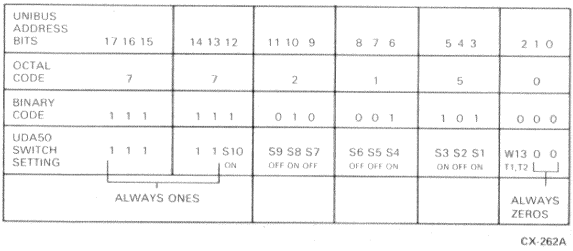

Figure 1-5 UDA50 Switch Setting for Address 772150

NOTE

The UNIBUS address switches and jumpers should be set for a floating address when a second UDA50 is installed on a system. Check the system configuration and UNIBUS addresses of all devices. Common floating addresses are 760340 and 760330.

In past disk products, a vector address was also physically selectable. This is not true with the UDA50 Disk Controller. A vector address, typically 154 (octal), will be supplied by the software.

1.5 UNIBUS TUNING

Sometimes data-late conditions experienced by a UNIBUS system may be remedied by tuning the UNIBUS. This involves changing the relative positions of the Nonprocessor Request (NPR) devices on the bus. The device at the front of the bus (near the host) has the highest priority; the device at the end of the bus has the lowest priority.

1.5.1 UNIBUS Device Positions

The NPR devices are placed along the UNIBUS according to the amount of buffering. The one with the least amount of buffering should be placed at the front of the UNIBUS. The heavily buffered UDA should be placed at the end of the UNIBUS (lowest NPR priority).

1.5.2 UDA NPR Priority Jumper

A jumper inserted on the M7485 module helps tune the UNIBUS system. The jumper changes the average number of UDA NPR requests over a given amount of time by delaying a request for 0, 6.2, or 10 microseconds. Table 1-1 shows the amount of delay and jumper configuration.

Table 1-1 UNIBUS Delay

Amount of Delay	Jumper Configuration
0 microseconds	T4-T6
6.2 microseconds	T5-T6
10 microseconds	T6-T7

The following list explains which systems cannot use a UDA and requirements necessary for those systems that can:

- The UDA/RK07/DMR11 configuration (on an 11/70 only) gives data late errors from the RK07 regardless of the UDA's jumper setting. Either an RK07 or a UDA, but not both, can be configured on the 11/70 when a 1 megabit per second DMR11 is present.
- On PDP-11 and VAX systems, no more than two UDAs may be installed on a UNIBUS with nonbuffered UNIBUS peripheral devices.

NOTE

If a bus repeater is used, data late errors are more likely.

1.6 UDA50 PRIORITY PLUG

All UDA50 M7485 modules are shipped with a recommended level 5 priority plug and need not be changed for the majority of installations. If another priority level is required, the current priority plug is removed and the new one inserted. The location is shown in Figure 1-4. It is inserted so the notch on the priority plug aligns with the hole on the module socket.

1.7 INSTALLATION OF BOOTSTRAP ROM

The proper bootstrap ROM is shipped with the UDA50. Bootstrap ROM 23-767A9-00 must be installed on the PDP-11 bootstrap ROM module M9312. Bootstrap ROM 23-990A9-00 must be installed on the VAX 11/750.

1.8 RELATED DOCUMENTATION

Digital customers can order the following list of UDA50 related manuals:

- *UDA50 USER GUIDE* (EK-UDA50-UG)
- *UDA50 SERVICE MANUAL* (EK-UDA50-SV)
- *UDA50 MAINTENANCE GUIDE* (AA-M185A-TC)
- *UDA50 FIELD MAINTENANCE PRINT SET* (MP-01331)

Employees:

The *User Guide*, *Service Manual* and *Illustrated Parts Breakdown* can be ordered directly from Publication and Circulation Services, 10 Forbes Road, Northboro, Massachusetts 01532 (RCS Code: NR12, Mail Code: NR03/W3).

The *Maintenance Guide*, *Field Maintenance Print Set* ,Maintenance Guide Looseleaf Binder can be ordered directly from the Software Distribution Center, 444 Whitney Street, Northboro, Massachusetts 01532 (RCS Code: MSDC, Mail Code: NR02-1/J6).

Non-Employees: The above documents can be ordered directly from the Peripherals and Supply Group at Digital Equipment Corporation, P.O. Box CS2008, Nashua, New Hampshire 03061, or by calling toll free: 800-258-1710.

Outside the United States, consult local DIGITAL offices.

New

M7485 12A @ 5V
M7486 60mA @ +15V
1·4A @ -15V

Old

M7461-YA 11A @ 5V
M7462 60mA @ +15V
2A @ -15V

2 UDA50 FAULT ISOLATION

2.1 UDA50-RESIDENT DIAGNOSTICS

Resident diagnostic information from the UDA50 Disk Controller is found in the UDA50 LED error codes and in the UDA50 Status/Address (SA) register contents. This information is also supplied to the host CPU for error logs and diagnostic error reports. The UDA50-resident diagnostics are initiated when power is applied to the UDA50 Disk Controller.

2.1.1 UDA50 LED Error Codes

Table 2-1 lists the LED error codes and indicates the FRU most likely at fault.

Table 2-1 LED Error and Symptom Codes

M7485 LEDs 8 4 2 1	M7486 LEDs 8 4 2 1	Error Symptoms	Most Likely Failure
0 0 0 1	x x x x	Hex 1; undefined	Undefined
0 0 1 0	0 0 0 0	Hex 2; microcode stuck in init step 2	M7485 or software
0 0 1 1	0 0 0 0	Hex 3; microcode stuck in init step 3	M7485 or software

(Cont.)

Table 2-1 LED Error and Symptom Codes

M7485 LEDs 8 4 2 1	M7486 LEDs 8 4 2 1	Error Symptoms	Most Likely Failure
0 1 0 0	0 0 0 0	Hex 4; microcode stuck in init step 4 or UNIBUS timeout error	M7485 or host inactive
B L I N K 0 1 0 1	0 0 0 0	Hex 4/5; test complete UDA50 communicating with host software	No problem
0 1 1 0 x x x x	x x x x 0 1 1 0	Hex 6; undefined	Undefined
0 1 1 1 x x x x	x x x x 0 1 1 1	Hex 7; undefined	Undefined
1 0 0 0	0 0 0 0	Hex 8; wrap bit 14 set in SA register	M7485 or software
1 0 0 1 0 0 0 0	0 0 0 0 1 0 0 1	Hex 9; board one error	M7485

(Cont.)

Table 2-1 LED Error and Symptom Codes

M7485 LEDs 8 4 2 1	M7486 LEDs 8 4 2 1	Error Symptoms	Most Likely Failure
1 0 1 0	0 0 0 0	Hex A; board two error	M7486
1 0 1 0	1 0 1 0		
1 0 1 1	x x x x	Hex B; undefined	Undefined
x x x x	1 0 1 1		
x x x x	1 1 0 0	Hex C; Timeout error,	Many
1 1 0 0	x x x x	check error code in SA register	causes
1 1 0 1	x x x x	Hex D; RAM parity error	M7486
x x x x	1 1 0 1		
1 1 1 0	x x x x	Hex E; ROM parity error	M7485
x x x x	1 1 1 0		
1 1 1 1	1 1 1 1	Hex F; sequencer error	M7485
Cycling pattern	Cycling pattern	None	No problem *

* The LEDs normally cycle while the UDA50 is waiting for the host to start the initialization process. At that time, it responds to the initialization and the cycling pattern stops. This normally occurs in about two seconds.

	The cycling pattern continues beyond the start of the host software initialization process. The UDA50 is not responding to the host CPU.	M7485

Note: 1 = LED ON 0 = LED OFF x = May be ON or OFF

When two codes are given for the same error, both indicate the same failure.

2.1.2 Status/Address Register Error Codes

The contents of this register may be examined manually through the CPU console at the UDA50 UNIBUS address plus 2. It is also reported in the error log and diagnostic reports if an error occurs. This address is normally 772152. Table 2-2 lists the SA error codes and indicates the FRU most likely at fault.

Table 2-2 SA Register Error Codes

Error Code (Octal)	Error Description	Most Likely FRU Failed
100001	UNIBUS packet read error	M7485*
100002	UNIBUS packet write error	M7485*
100003	UDA ROM or RAM parity error	M7485 or M7486
100004	UDA RAM parity error	M7486
100005	UDA ROM parity error	M7485
100006	UNIBUS ring read error	M7485*
100007	UNIBUS ring write error	M7485*
100010	UNIBUS interrupt master failure	M7485
100011	Host access timeout error	M7485*
100012	Host exceeded command limit	M7485*
100013	UDA SI hardware fatal error	M7486
100014	DM XFC fatal error	M7486
100015	Hardware timeout of instruction loop	M7485*
100016	Invalid virtual circuit identifier	M7485*

(Cont.)

Table 2-2 SA Register Error Codes

Error Code (Octal)	Error Description	Most Likely FRU Failed
100017	Interrupt write error on UNIBUS	M7485*
104000	Fatal sequence error	M7485
104040	D processor ALU	M7485
104041	D processor control ROM parity error	M7485
105102	D processor with no BD #2, or RAM parity error	M7486
105105	D processor RAM buffer error	M7486
105152	D processor SDI error	M7486
105153	D processor write mode wrap serdes error	M7486
105154	D processor read mode serdes, RSGEN & ECC error	M7486
106040	U processor ALU error	M7485
106041	U processor control register error	M7485
106042	U processor DFAIL/control ROM parity/BD #1 test CNT	M7485

(Cont.)

Table 2-2 SA Register Error Codes

Error Code (Octal)	Error Description	Most Likely FRU Failed
106047	U processor constant PROM error with D processor running SDI test	M7485
106055	Unexpected trap found, abort diagnostic	M7485
106071	U processor constant PROM error	M7485
106072	U processor control ROM parity error	M7485
106200	Step 1 data error (MSB not set)	M7485 or RE-INIT
107103	U processor RAM parity error	M7486
107107	U processor RAM buffer error	M7486
107115	Test count was wrong (BD #2)	M7486
112300	Step 2 error	M7485
122240	NPR error	M7485
122300	Step 3 error	M7485
142300	Step 4 error	M7485

* Possibly the host CPU is at fault.

2.2 UDA50 SUBSYSTEM DIAGNOSTICS

The UDA50 host-resident diagnostics for both the PDP-11 CPU family and the VAX CPU family are described briefly in the following paragraphs. A more detailed description is found in the *UDA50 Service Manual* or the program listing.

If the diagnostic programs report errors, refer to the troubleshooting procedure in Paragraph 2.3.

2.2.1 PDP-11 Subsystem Diagnostics

The following paragraphs describe the various PDP-11 subsystem diagnostics. A more detailed explanation is found in the *UDA50 Service Manual*.

2.2.1.1 CZUDE – UDA50 Disk Formatter Program – CZUDE is not a diagnostic. Do not run unless specifically asked to do so.

2.2.1.2 CZUDC – UDA50 and Disk Drive Diagnostic – This diagnostic consists of the following four tests:

- Test 1 – UNIBUS addressing test
- Test 2 – Disk-resident diagnostic test
- Test 3 – Disk functional test
- Test 4 – Disk exerciser test

2.2.1.3 CXDUB – DECX11 Module – The DECX11 module operates in two modes:

2.2.2 VAX Subsystem Diagnostics

The following paragraphs describe the various VAX subsystem diagnostics. A more detailed explanation is found in the *UDA50 Service Manual*.

2.2.2.1 ZZ-EVRLB – UDA Disk Formatter – EVRLB is not a diagnostic. Do not run unless specifically asked to do so.

2.2.2.2 ZZ-EVRLA – UDA50 Disk Subsystem-Diagnostics – The VAX UDA50 host-resident diagnostic contains the same four tests as the PDP-11 version.

- Test 1 – UNIBUS addressing test
- Test 2 – Disk-resident diagnostic test
- Test 3 – Disk functional test
- Test 4 – Disk exerciser test

2.3 UDA50 SUBSYSTEM TROUBLESHOOTING

A brief UDA50 subsystem troubleshooting flowchart is illustrated in Figure 2-1.

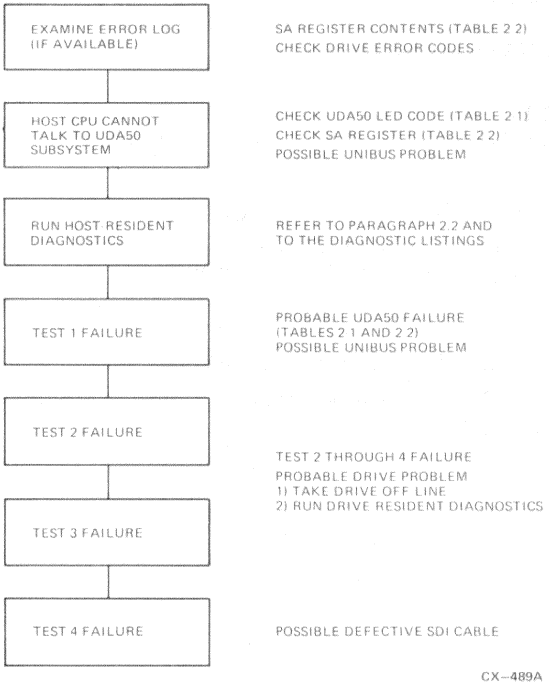

Figure 2-1 UDA50 Subsystem Troubleshooting Flowchart

2.3.1 UDA50-Resident Diagnostics

The UDA50-resident diagnostics are initiated when power is applied to the UDA50 Disk Controller. Refer to Table 2-1 for error code values.

2.3.2 UDA50 Host-Resident Diagnostic

A brief description of the UDA50 host-resident diagnostics is presented in Paragraph 2.2. The UDA50 host-resident diagnostic isolates problems to the UNIBUS or the disk drives. These diagnostics send back error messages concerning drive status or real-time drive state. The drive status error messages are unique to each disk drive and are described in the drive maintenance guide and service manual. The real-time drive state error messages describe what is happening in the drive.

2.3.3 Subsystem Error Message Information

Error messages are typed out during the UDA50 host-resident diagnostic if a problem is detected. Three sample printouts are shown below. Sample 1 shows typical drive error printout when running the PDP-11 XXDP + program. Sample 1A shows typical drive error printout when running the VAX diagnostics. The real-time drive state (RTDS) and the drive status are given in the last examples of samples 1 and 1A. Sample 2 shows a typical UDA50 error printout. The last line of sample 2 gives the contents of the SA register.

Sample 1:

Printout of a Drive Error using XXDP +:

```
CZUDC HRD ERR 04041 ON UNIT 00 TST 004 SUB 000 PC: 21044
DISKEXERCISER
DM PC:5110 UDA AT 172150 DRIVE 032 RUNTIME 00:00:23
COULD NOT FIND REPLACEMENT FOR
LBN WITH HEADER NOT FOUND
LBN TO REPLACE 900
```

```
CZUDC SFT ERR 04006 ON UNIT 00 TST 004 SUB 000 PC: 21044
DISK EXERCISER DM PC:5324 UDA AT 172150 DRIVE 032
RUNTIME 00:00:37
SELECT TRACK AND WRITE LEVEL 1 CMD NOT EXECUTED
ATTEMPT 0
LBN 5252
SECTORS FROM INDEX 13 TRK 1 GRP 0 CYL 6
ORIGIN OF SEEK: GRP 1 CYL 5
REAL TIME STATE 8001
STATUS (R TO L): 0001 1100 0000 0A00 0000 0613 1020
```

Sample 1A:

Printout of a Drive Error using VAX DS:

```
EVRLA - UDA50 DISK SUBSYSTEM DIAGNOSTIC - 2.0
PASS 1, TEST 4, SUBTEST 0, ERROR 4041 19-AUG-1982
12:16:03.71
HARD ERROR WHILE TESTING DUA32: DM PROGRAM REPORTING AN
ERROR

DISK EXERCISER CM PC;5110 UDA AT ADDRESS 772150 DRIVE
_DUA32
COULD NOT FIND REPLACEMENT FOR
LBN WITH HEADER NOT FOUND
LBN TO REPLACE 900

END OF HARD ERROR NUMBER 4041

EVRLA - UDA50 DISK SUBSYSTEM DIAGNOSTIC - 2.0
PASS 1, TEST 4, SUBTEST 0, ERROR 4006 19-AUG-1982
12:16:03.71
SOFT ERROR WHILE TESTING DUA32: DM PROGRAM REPORTING AN
ERROR
```

```
 DISK EXERCISER DM PC;5324 UDA AT ADDRESS 772150 (O)
DRIVE _DUA32
SELECT TRACK AND WRITE LEVEL 1 CMD NOT EXECUTED

ATTEMPT 0
LBN 5252
SECTORS FROM INDEX 13 TRK 1 GRP 0 CYL6
ORIGIN OF SEEK : GRP 1 CYL 5
REAL TIME STATE 8001
STATUS (R TO L) : 0001 1100 0000 0A00 0000 0613 1020

END OF SOFT ERROR NUMBER 4006
```

Sample 2:

Printout of a UDA50 Error using XXDP +

```
CZUDC DVC FTL ERR 00005 ON UNIT 00 TST 001 SUB 002 PC:
023710
UDA INITIALIZE ERROR
UDA RESIDENT DIAGNOSTICS DETECTED FAILURE
UDASA REGISTER - 106040
```

2.3.3.1 Real-Time Drive State Message Interpretation – The real-time drive state message consists of four hexadecimal digits. Listed below are the four state bits within these hexadecimal digits of any diagnostic value to the field service engineer:

- Read/write ready (R/W RDY)
- Drive available (AVAIL)
- Attention (ATTN)
- Receiver ready (RCVR RDY)

The location of these four state bits within the hexadecimal code is shown in Figure 2-2. The interpretation of the RTDS message requires an understanding of the causes and effects of each bit in the RTDS message. It also requires an understanding of drive online, drive offline, drive available and drive unavailable.

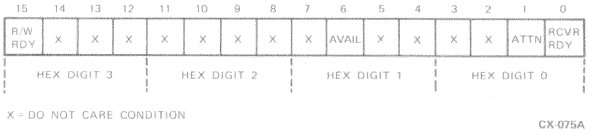

Figure 2-2 Real-Time Drive State Bits

The following four terms define the state of the drive as seen from the controller:

- Drive Offline – The drive is not operational and may not communicate with the controller via the drive control protocol.
- Drive Unavailable – The drive is operating, is visible to, and at times is communicating with the controller. However, the controller may not fully utilize the drive because it is online to another controller.
- Drive Available – The drive is visible to, is capable of communicating with, and is capable of executing an online command. However, the drive is not currently online to any specific controller.
- Drive Online – The drive is dedicated to the exclusive use of a particular controller and is not available to any alternate controller.

The following paragraphs explain the causes, effects, and interrelationships of the four state bits within the RTDS message:

- RECEIVER READY – The drive is ready to receive a command on the SDI interface WRITE/COMMAND line. RCVR RDY is negated while the drive is processing a command.
- ATTENTION – The controller is notified a potentially significant status change has occurred in the drive.

  The drive asserts this signal when in the online state and whenever any of its generic status bits change (see Figure 2-3), except for the following three cases:

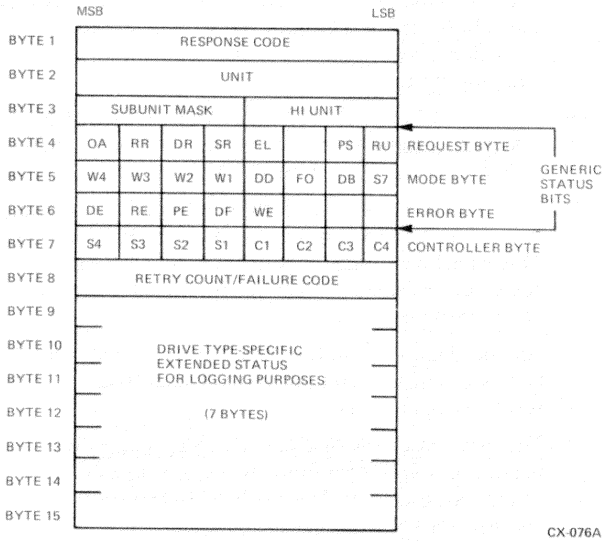

Figure 2-3 Drive Status Bytes

1. A generic status bit changes as a direct consequence of the correct operation of a command.
2. A generic status bit changes as the result of an error in the reception, validation, or execution of a command.
3. The RE status bit changes due to a transmission error outside of a command. The RE bit is described in byte 6 of the drive status message.

An online drive may assert ATTN whether a command is in progress or not. The drive will continue to assert this signal until a valid get status command is received from the controller. At this point, the drive will negate the ATTN signal.

A drive in the available state (spinning) always asserts the ATTN signal. The ATTN signal is negated if any condition occurs to prevent the available drive from spinning up under controller command.

- READ/WRITE READY – When R/W RDY is asserted, it indicates the drive is capable of handling a data transfer to or from the disk surface.

  When the drive receives a start frame of a command, this signal is negated prior to reasserting RCVR RDY. This signal will remain negated until the drive has processed the command and has transmitted the end frame of the response.

  Any head motion will lower this signal until the operation is completed, and the drive is again ready to perform I/O operations.

  The drive asserts R/W RDY after the successful completion of a seek operation. If the operation is unsuccessful, the drive will keep the R/W RDY signal negated and use ATTN to signal the problem.

- AVAILABLE – When AVAIL is asserted, it indicates the drive is in the drive available state relative to the controller. It is asserted whenever the drive enters the drive available state and is negated when the drive leaves that available state.

Use the definitions given above to interpret the RTDS message in Table 2-3.

Table 2-3 Real-Time Drive State Code Interpretation

RTDS Hex Code	Description
0000	The drive is either in initialization or in an off-line state.
0001	The drive is online. Possibly an error state was recently cleared, or the drive spun down with the RUN/STOP switch out.
0002	This code indicates an invalid drive state. ATTN is asserted and the drive cannot receive controller commands with RCVR RDY negated.
0003	The drive is online and one of two conditions exist. 1. The disks are spinning, and there is an error state. 2. The disks are not spinning, and there is a switch change active.

(Cont.)

Table 2-3 Real-Time Drive State Code Interpretation

RTDS Hex Code	Description
0040	This code indicates an invalid drive state. RCVR RDY should be asserted if the drive is in the available state.
0041	The drive is available but cannot be spun up. The RUN/STOP switch is not pushed in, or there could be an open module interlock preventing spinup.
0042	This code indicates an invalid drive state. ATTN is asserted and the drive cannot receive controller commands with RCVR RDY negated.
0043	The drive is available and capable of being spun up.
8000	This code indicates an invalid drive state. R/W RDY should not be asserted with RCVR RDY negated.
8001	This is the normal drive online state.
8002	This code indicates an invalid drive state. ATTN is asserted and RCVR RDY is negated, preventing the drive from receiving controller commands.
8003	The drive is online and one of two conditions exist:

(Cont.)

Table 2-3 Real-Time Drive State Code Interpretation

RTDS Hex Code	Description
	1. One of the switches on the drive operator control panel has been pushed. 2. The drive is reporting a successful retry of a seek with recalibration.
8040	This code indicates an invalid drive state. R/W RDY and AVAIL should never be asserted together. Also, ATTN should be asserted when the drive is available and capable of being spun up.
8041	This code indicates an invalid drive state. R/W RDY and AVAIL should never be asserted together. Also, ATTN should be asserted when the drive is available and capable of being spun up.
8042	This code indicates an invalid drive state. R/W RDY and AVAIL should never be asserted together. Also, ATTN is asserted and the drive cannot receive controller commands with RCVR RDY negated.
8043	This code indicates an invalid drive state. R/W RDY and AVAIL should never be asserted together.
FFFF	The controller is unable to get a valid drive state.

2.3.3.2 Status Message Bytes – The status line found in error message sample 1 is the result of the diagnostic performing a get status command. Fourteen of fifteen status bytes are printed out by the error message. Figure 2-4 shows the breakdown of the fifteen status bytes. The first byte is not printed out since it is a response code to the get status command. Bytes 9 through 15 contain drive-specific status bits and the drive service manual or maintenance guide should be consulted for interpretation. Table 2-4 gives a bit description of status message bytes.

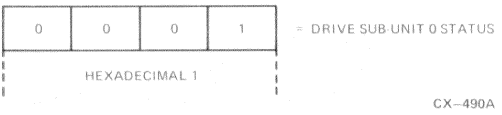

Figure 2-4 Subunit Mask Bit Layout Examples

Table 2-4 Bit Description of Status Message Bytes

Status Byte	Bit Description
Byte 1	Response Code Field – Byte 1 is the response code to a controller command.
Byte 2	Unit Number – The unit number consists of two hexadecimal digits representing the unit number of the selected disk drive returning the status (0-254).

(Cont.)

Table 2-4 Bit Description of Status Message Bytes

Status Byte	Bit Description
Byte 3	Subunit Mask – The subunit mask is a four-bit representation of the subunit that is returning the status message. The right-most bit position represents subunit 0. The left-most bit position represents subunit 3. Only one bit can be set at a time. UDA50 subsystems can handle only drives that contain no subunits. Therefore, the only valid number in this status Byte is a hexadecimal 1. Figure 2-4 shows the bit layout. For drives that contain no subunits (e.g. the RA80), the right-most bit position is always set to a 1 indicating subunit 0.
Byte 3	High Unit Number – Byte 3 contains the upper four bits to a 12-bit (3 hexadecimal digits) unit number.
Byte 4	OA – A binary one in this position indicates the drive is unavailable to the UDA50. A binary zero indicates the drive is available to the UDA50.
Byte 4	RR – A binary one in this position indicates the drive requires an internal readjustment. Some drives do not use this bit.
Byte 4	DR – A binary one in this position indicates there is a request for a diagnostic to be loaded in the drive microprocessor memory. A binary zero indicates that no diagnostic is being requested of the host system.

(Cont.)

Table 2-4 Bit Description of Status Message Bytes

Status Byte	Bit Description
Byte 4	SR – A binary one in this position indicates the drive spindle is up to speed. A binary zero indicates the drive spindle is not up to speed.
Byte 4	EL – A binary one in this bit position indicates there is loggable information in the extended status area (Bytes 9-15). A binary zero indicates that no information is available in the extended status area.
Byte 4	PS – A binary one in this bit position indicates the drive port select switch for this controller is pushed in (selected). A binary zero indicates the switch is out.
Byte 4	RU – A binary one in this position indicates the RUN/STOP switch is pushed in (RUN). A binary zero indicates the switch is out (STOP).
Byte 5	W4-W1 – Binary ones in any of these four bit positions represent the write-protect status for the sub-unit represented. (e.g., a 0001 indicates subunit 0 within the selected drive is write-protected.)
Byte 5	DD – A binary one in this bit position indicates the drive has been disabled by a controller error routine or diagnostic. The FAULT light is on when this bit is set. A binary 0 indicates the drive was enabled by a controller error routine or diagnostic.

(Cont.)

Table 2-4 Bit Description of Status Message Bytes

Status Byte	Bit Description
Byte 5	FO – A binary one in this position indicates the drive can be formatted.
Byte 5	DB – A binary one in this position indicates the diagnostic cylinders on the drive can be accessed.
Byte 5	S7 – A binary one in this bit position indicates the 576 Byte sector format is selected. A binary zero indicates that the 512 Byte sector format is selected. The UDA50 does not support 576 byte format.
Byte 6	DE – A binary one in this position indicates a drive error has occurred and the drive FAULT lamp may be on.
Byte 6	RE – A binary one in this position indicates an error occurred in the transmission of a command between the drive and the UDA50. The error could be a checksum error or an incorrectly formatted command string.
Byte 6	PE – A binary one in this position indicates improper command codes or parameters were issued to the drive.
Byte 6	DF – A binary one in this postion indicates a failure in the initialization routine of the drive.
Byte 6	WE – A binary one in this position indicates a write lock error has occurred.

(Cont.)

Table 2-4 Bit Description of Status Message Bytes

Status Byte	Bit Description
Byte 7	S4-S1 – This is a four-bit representation of the sub-units that have their attention available messages suppressed in the UDA50. The right-most bit position represents subunit 0. The left-most bit position represents subunit 3. If one of the bits is set, it indicates the controller is not to interrupt the host CPU with an attention available message when the specified subunit raises its available real-time drive status line to the UDA50. The S4-S1 bits reflect the result of a change controller flags command where attention-available messages are not desired for certain sub-units.
Byte 7	C1-C4 – This is a four-bit drive status code indicating various states of drive operation. At the present time only three codes are valid. A code of 0000 = drive normal operation. A code of 1000 = the drive is offline due to being under control of a diagnostic. A code of 1001 = the drive is offline due to another drive having the same unit identifier (e.g. serial number, drive type, class etc.).

Table 2-4 Bit Description of Status Message Bytes

Status Byte	Bit Description
Byte 8	RETRY COUNT/FAILURE CODE – This 8-bit Byte contains one of two types of information depending upon the status of the DF bit (Byte 6). The DF bit monitors the drive initialization process. The DF bit remains a zero if initialization is successful. In this case, Byte 8 contains the retry count from the previous operation, i.e., a seek operation required fourteen retries to be successful. If a get status command is initiated, Byte 8 contains the number 14. The DF bit being set indicates the drive initialization failed, and Byte 8 now contains a specific drive error code. This error code can be looked up in the appropriate drive service manual.

2.3.3.3 Status Message Interpretation – A printout of a drive error was given in paragraph 2.3.3 sample 1. The last line of this error printout gave a status message as follows.

```
STATUS:0001 1100 0000 0A00 0000 0613 1020
BYTE:   15 14 13 12 11 10  9  8  7  6  5  4  3  2
```

Use Figure 2-5 to break down the status message byte code. Then use the following byte descriptions to interpret the above status message.

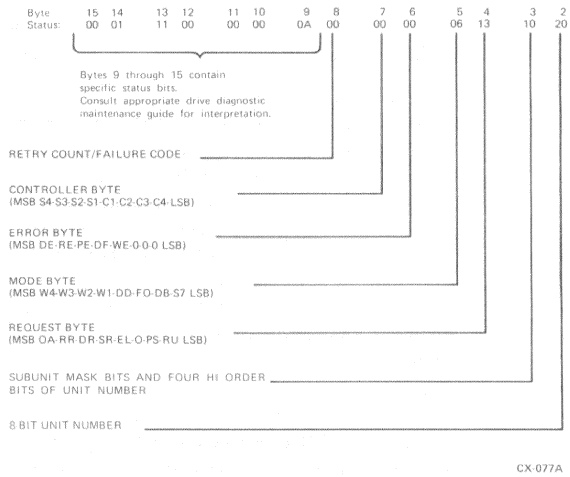

Figure 2-5 Status Message Interpretation

- Byte 1 is the get status response code and is not printed out.
- Byte 2 and the lower half of byte 3 comprise a 3 hexadecimal digit unit number. In the example, the unit number is 020 (hexadecimal) or 32 (decimal).
- Byte 3 (upper half) reflects the subunit mask and indicates the drive sending the status is subunit 0 (0001).
- Byte 4 is the request byte and breaks down as follows.

HEX	1	3
BINARY	0001	0011

  - The RU bit is set indicating the drive has the RUN switch depressed.

- The PS bit is set indicating the port select switch for the UDA requesting the status is depressed. The drive is available to the UDA50.
- The SR bit is set indicating the drive has the spindle up to speed.
- The OA bit is not set indicating the drive is at a drive available state.
- The RR bit is not set indicating the selected drive needs no internal adjustment.
- The DR bit is not set indicating the selected drive has no request for an external diagnostic to be loaded into it.

- Byte 5 is the mode byte and breaks down as follows:

HEX	0	6
BINARY	0000	0110

  - The DB bit is set indicating a diagnostic cylinder is being accessed on the drive.
  - The FO bit is set indicating the drive can be formatted.
  - No bits are set in the W4-W1 field indicating no subunit is write protected.
  - The DD bit is not set indicating the drive has not been disabled by the UDA50 due to some error or diagnostic routine.
  - The S7 bit is not set indicating 512 byte/sector format is selected for the drive.

- Byte 6 is the error byte, and for this example, none of the errors described earlier in this text are active (DE-RE-PE-DF-WE).

- Byte 7 is the controller byte, and for this example, a normal drive status is observed (C1-C4 = zeros). The S4-S1 bits being cleared indicate the UDA50 is to interrupt the host CPU whenever any drive on the subsystem raises its available line to the UDA50.
- Byte 8 is the retry count/failure code, and for this example, no retries by the diagnostic were attempted.

The following tables are all useful in decoding the host error log. A brief explanation of each table and its possible use is given in the following paragraphs. If a more detailed explanation is desired, the *UDA50 Service Manual* should be consulted.

Table 2-5 is a list of the error log event format codes.
Table 2-6 is a list of the error log message flags.

1. Operation successful flag
2. Operation continuing flag
3. Sequence number reset flag

Table 2-5 Error Log Event Format Codes

Format code (Dec.)	Format Code (Octal)	Format Code (Hex)	Format Description
0	0	0	Controller errors
1	1	1	Host memory access errors
2	2	2	Disk transfer errors
3	3	3	SDI errors

Table 2-6 Error Log Message Flags

Bit set in high byte of word 4	Octal	Hex	Error Message Flag Description
7	200	80	Operation successful flag
6	100	40	Operation continuing flag
0	1	1	Sequence number reset flag

Table 2-7 is a list of all the UDA MSCP status/event error log codes.

Table 2-8 is a list of the controller class values. Table 2-9 is a list of the controller model values. Use these tables to help with the controller identification section of the error log message.

Table 2-10 is a list of the drive model number values and is used to decode the drive identification section of the host error log message.

Table 2-11 is a list of the MSCP error codes. This table can only be used in decoding the MSCP error code section of the ERRDIS error log printout.

Table 2-12 is a list of packet codes and the associated condition which prompted the error log entry. This condition is very general and will not give a detailed cause for the error.

The first list in the following table is a group of codes that determine the major status or event being reported such as a media format error or a drive error, etc. Within these major categories are more specialized subcodes that break down the major category further. For example, if a hex code of (B) is a drive error, a hex code of (AB) reveals there is also a drive clock dropout. A separate list is given for each of the subcode values.

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
0	0	Success
1	1	Invalid command
2	2	Command aborted
3	3	Unit offline
4	4	Unit available
5	5	Media format error
6	6	Write protected
7	7	Compare error
8	10	Data error
9	11	Host buffer access error
A	12	Controller error
B	13	Drive error
1F	37	Status/event code mask
Success Subcode (Hex 0)		
20	40	Spindown ignored
40	100	Still connected
80	200	Duplicate unit number
100	400	Already online
200	1000	Still online

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
Invalid Command Subcode (Hex 1)		
1	1	Invalid message length
Command Aborted Subcode (Hex 2)		NOT USED
Unit Offline Subcode (Hex 3)		
3	3	Unit unknown or online to another controller.
23	43	No volume mounted or drive disabled via RUN/STOP switch.
43	103	Unit inoperative – For SDI drives, the controller has marked the drive inoperative due to an unrecoverable error in a previous level 2 exchange, or the drive has a duplicate unit identifier.
83	203	Duplicate unit number
103	403	Unit disabled by field service or diagnostic. For SDI drives, the DD bit is set.
Unit Available Subcode (Hex 4)		NOT USED

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
Media Format Error Subcode (Hex 5)		
A5	245	Format mismatch – Disk is not formatted with 512 byte sectors. The disk's FCT indicates it is formatted with 576 byte sectors, and either the controller or the drive only supports 512 byte sectors.
C5	305	FCT corrupted – Disk is not formatted or the FCT is corrupted.
105	405	RCT corrupted – The RCT search algorithm encounters an invalid RCT enter.
125	445	No replacement block available.
Write-Protected Subcode (Hex 6)		
1006	10006	Unit is software write protected.
2006	20006	Unit is hardware write protected.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
Compare Error Subcode (Hex 7)		NOT USED
Data Error Subcode (Hex 8)		
8	10	Sector written with ''Force Error'' modifier.
48	110	Invalid header – The subsystem reads an invalid or inconsistent header for the requested sector. Causes of an invalid header include header mis-sync, header sync time-out, or an inconsistent header.
68	150	Data sync time-out – Data sync is not found.
88	210	Correctable error in ECC field – A transfer encounters a correctable error in which only the ECC field is affected.
E8	350	Uncorrectable ECC error – A transfer encounters an ECC error that exceeds the correction capability of the subsystem's error correction algorithm.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
108	410	One symbol ECC error
128	450	Two symbol ECC error
148	510	Three symbol ECC error
168	550	Four symbol ECC error
188	610	Five symbol ECC error
1A8	650	Six symbol ECC error
1C8	710	Seven symbol ECC error
1E8	750	Eight symbol ECC error – A transfer encounters a correctable ECC error with the specified number of ECC symbols in error. The number of symbols in error corresponds to the severity of the error.
Host Buffer Access Error Subcode (Hex 9)		
9	11	Host buffer access error – The controller is unable to access a host buffer to perform a transfer and has no visibility into the cause of the error.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
29	51	Odd transfer address
49	111	Odd byte count
69	151	Nonexistent memory error
89	211	Host memory parity error
Controller Error Subcode (Hex A)		
A	12	Reserved for host command timeout expired.
2A	52	SERDES overrun or underrun error – Either the drive is too fast for the controller, or a controller hardware fault has prevented the controller microcode from being able to keep up with the data transfer to or from the drive.
4A	112	EDC error – The sector is read with correct or correctable ECC and an invalid EDC. There is most likely a fault in the ECC logic of this controller or the controller that last wrote the sector.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
6A	152	Inconsistent internal control structure – Some high level check detects an inconsistent data structure. For example, a reserved field contains a nonzero value, or the value in a field is outside its valid range. This error usually implies the existence of a microcode bug.
8A	212	Internal EDC error – Some low level check detects an inconsistent data structure. For example, a microcode implemented checksum or vertical parity (hardware parity is horizontal) associated with internal sector data is inconsistent. This error usually implies a fault in the memory addressing logic of one or more of the controller's processing elements. It may also result from a double bit error or other error that exceeds the error detection capability of the controller's hardware memory checking circuitry.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
10A	412	Data bus overrun – The controller attempts to perform too many concurrent transfers, causing one or more of them to fail due to a data overrun or underrun.
12A	452	Data memory error – The controller detects an error in an internal memory, such as a parity error or a nonresponding address. This subcode only applies to errors not reported via MSCP. These errors do not affect the controller's ability to properly generate end and error log messages. For most controllers, this subcode is only returned for controller memory errors in data or buffer memory and noncritical control structures. If the controller has several such memories, the specific memory involved is reported as part of the error address in the error log message.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
Drive Error Subcode (Hex B)		
2B	53	Drive command timeout – For SDI drives, the controller's timeout expires for either a level two exchange or the assertion of read/write ready after an initiate seek.
4B	113	Controller-detected transmission error – For SDI drives, the controller detects an invalid framing code or a checksum error in a level two response from the drive. The UDA50 also returns this subcode for controller detected protocol errors. All other SDI controllers return subcode 9 for protocol errors.
6B	153	Positioner error (misseek) – The drive reports a seek operation is successful, but the controller has determined the drive has positioned itself to an incorrect cylinder.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
8B	213	Lost read/write ready during or between transfers – For SDI drives, read/write ready is negated when the controller attempts to initiate a transfer or at the completion of a transfer. Read/write ready is previously asserted indicating the completion of the previous seek. This usually results from a drive detected transfer error, in which case an additional error log message may be generated containing the "drive detected error" subcode.
AB	253	Drive clock dropout – For SDI drives, either data clock or state clock is missing when it should be present. This is usually detected by a timeout.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
CB	313	Lost receiver ready for transfer – For SDI drives, receiver ready is negated when the controller attempts to initiate a transfer or does not assert at the completion of a transfer. This includes all cases of the controller's time-out expiring for a transfer operation (level one real-time command).
EB	353	Drive-detected error – For SDI drives, the controller receives a get status or unsuccessful response with the EL flag set. The controller may also receive this response with the DR flag set. It does not support automatic diagnosis for that drive type.
10B	413	Controller-detected pulse or data parity error – For SDI drives, the controller detects a pulse error on either the state or data line, or the controller detects a parity error in a state frame.

(Cont.)

Table 2-7 Error Log Status Event Codes

Hex Code	Octal Code	Description
12B	453	Drive-requested error log (EL bit set)
14B	513	Response length or opcode error – For SDI drives, a level two response from the drive has an invalid opcode, an improper length, or is not a possible response in the context of the exchange.
16B	553	Clock resumption fails after initialization – For SDI drives, the drive clock does not start after a controller attempt to initialize the drive.
18B	613	Clock persists after initialization – For SDI drives, the drive clock continues beyond drive initialization.
1AB	653	Receiver-ready collision – For SDI drives, the controller attempts to assert its receiver ready (to receive a response) and the drive's receiver ready is still asserted (to receive a command).
1CB	713	Response overflow

Table 2-8 Controller Class Values

Class Byte (Decimal)	Subsystem Type
0	Reserved
1	Mass storage controllers
2	Disk class device – DEC Standard 166 format
3	Tape class device
4	Disk class device – DEC Standard 144 format

Table 2-9 Controller Model Values

Model Byte (Decimal)	Controller Type
0	Reserved
1	HSC50
4	VMS MSCP server
5	TU81
6	UDA50

Table 2-10 Drive Model Number Values

Model Byte (Decimal)	Device Model
1	RA80 fixed media disk drive
4	RA60 removable media disk drive
5	RA81 fixed media disk drive

Table 2-11 MSCP Error Codes

Octal Code	Definition
1	Error is logged by the bad block replacement module.
2	Driver is sending a command at the time of the error.
3	Driver can not find a free command packet.
4	Driver determined the unit is hung.
5	Disk unit size is too big (over pack cluster size 16).
6	Controller is offline.
7	Unit is not functional.
10	Command timed out.
12	Data error during read/write command.

Table 2-12 Status Code of the MSCP Packet

Packet Code	MSCP Packet Status
Success	The command or retry of a failed command is unsuccessfully completed.
Invalid command	An invalid command or command parameters are received by the controller.
Command aborted	The controller aborts a command in progress.
Unit Offline	The unit identified in the ''unit number'' field is in the offline state.
Unit available	The unit identified in the ''unit number'' field is in the available state.
Media format error	The pack or HDA mounted in the drive appears to be formatted incorrectly.
Write protected	A command requiring a write operation is attempted on a write-protected unit.
Compare error	A compare host data command finds a difference in the data that is written and the data in host memory like a write check command.
Data error	Invalid or uncorrectable data is obtained from the drive.

(Cont.)

Table 2-12 Status Code of the MSCP Packet

Packet Code	MSCP Packet Status
Host buffer access buffer	The controller encounters an error, like UNIBUS timeout, when trying to access host memory.
Controller error	The controller encounters an internal controller error.
Drive error	The controller discovers an error within a drive. Such errors are usually mechanical in nature since they are reported as data errors.