UDA50/KDA50-Q Maintenance Course

EY-2061E-W1-0002

Educational Services

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UDA50/KDA50-Q Maintenance Course

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RA8O/RA81 Disk Drive Maintenance Course

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UDA/KDA50-Q MAINTENANCE COURSE

STUDENT WORKBOOK 1

A Portion of Course EY-2061E-PO-0001 (J7093-A)

Prepared by Educational Services

Digital Equipment Corporation

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VAX	IAS	VT
UDA50	MASSBUS	RA80
HSC50	RA60	RA81

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GENERAL

The UDA5Ø is a disk controller made for UNIBUS systems. It consists of two hex-height modules that interface the UNIBUS with up to four disk drive units in a radial configuration. Radial configuration means there is a separate I/O cable from the UDA5Ø to each drive (see Figure 1).

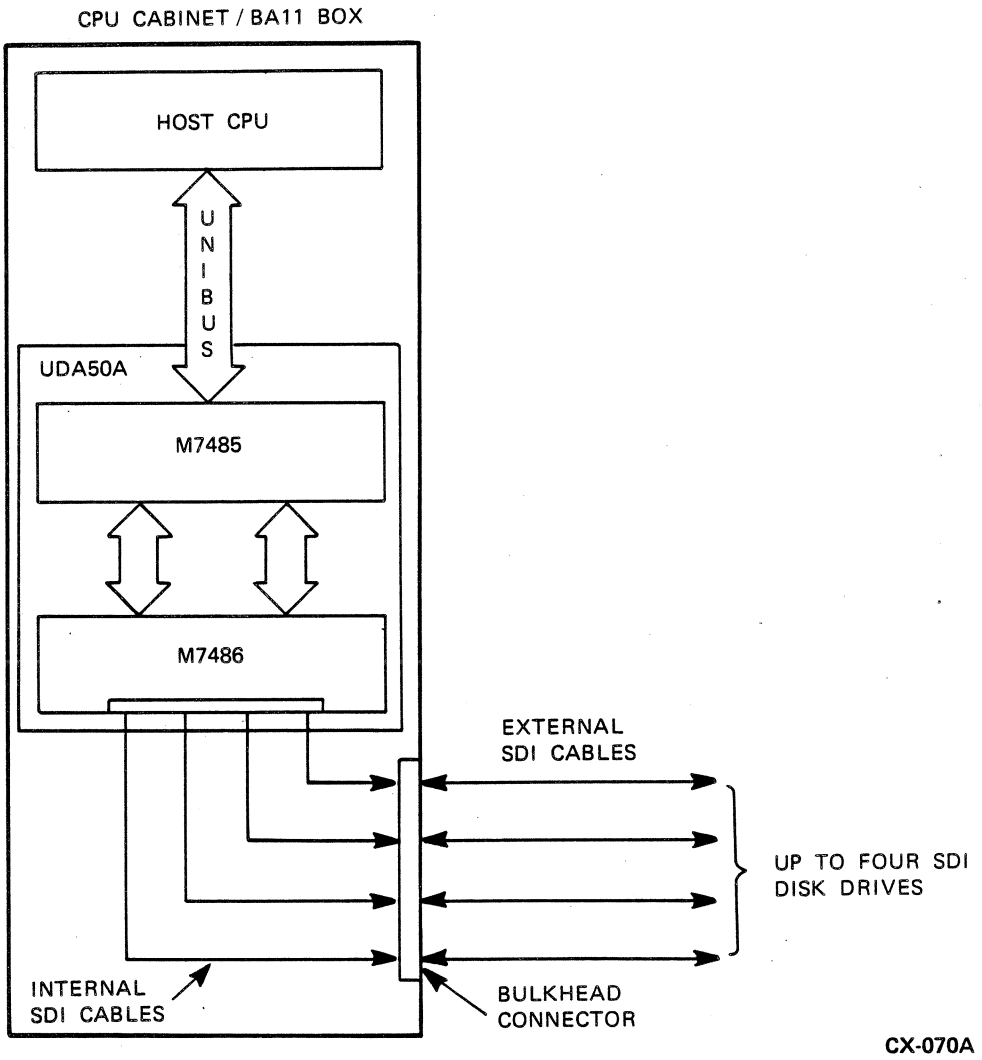


Figure 1 UDA5Ø Disk Subsystem Configuration

The UDA5Ø is an intelligent controller containing a micro-programmable processor that is capable of performing a variety of functions. Some of these functions include:

- Data handling
- Error detection
- Error correction
- Optimization of the disk drive activities
- Decoding of software generated logical block numbers (LBN) into physical disk addresses (based on the physical geometry of each disk)
- Updating drive status available to the host
- Performing data error analysis
- Executing error recovery strategies
- Performing bad block revectoring
- Communicating with the drive using the SDI protocol
- Communicating with the host processor using MSCP

OVERVIEW OF MSCP SUBSYSTEM

Mass storage control protocol (MSCP) is a form of communication with intelligent mass storage devices. In an MSCP subsystem, the controller is the logical area that contains the intelligence to perform the detailed I/O handling tasks. This arrangement allows the host to simply send command messages (requests for reads or writes) to the controller and receive response messages back from the controller.

The host uses two levels of software to accomplish its tasks. The higher level is called a class driver and its knowledge is limited to the class of devices (such as disks) and their capacity. It keeps the budget (request/response credit balance) and monitors the queues. The class driver does not have to know the nature of the communications link (I/O bus), controller, or devices being used.

The second level of host software is called the port driver and has the task of passing messages to/from the communications link or bus. It is not aware of the meaning of the messages, and it does not have to know the exact nature of the controller or devices being used. It provides the communications services that are required by that particular communications link and keeps track of available buffer spaces (for the message queues) as part of the task of keeping the credit balance.

In the controller architecture, there are also two levels of software. The lower of these two is also a port driver and, like the port driver in the host, is concerned only with passing messages on and off of the bus. The higher level of controller software is the MSCP server. It constitutes the intelligence and, therefore, defines the functionality of the controller.

The UDA5Ø concerns itself with determining the number of drives, their type, geometry, unit number, availability, status, etc. The UDA5Ø receives requests and sends responses to the host, transfers the data to/from the drive, and buffers the data as necessary. The UDA5Ø performs error detection and recovery and makes appropriate reports on these matters to the host.

Because the UDA5Ø handles error detection and recovery, the host sees a "perfect media", an important characteristic of an MSCP subsystem.

The drives that connect to the UDA5Ø use their own standard disk interface (SDI) for communication with the controller. Any type of SDI drive can be used on the UDA5Ø. This physical path and the protocol are invisible to the host.

SDI BUS SIGNALS

The SDI bus is a four-line cable that carries signals from the UDA5Ø to one disk drive (Figure 2). Four cables are required for a maximum subsystem configuration. Two of the lines on each cable send signals to the drive; two of the lines receive signals from the drive.

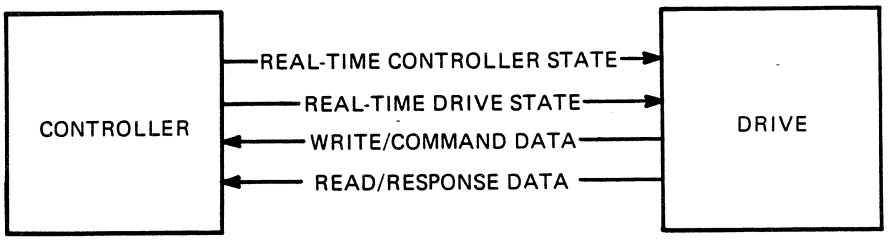


Figure 2 Standard Disk Interface Bus

One of the SDI lines is called the real-time drive state and serially transmits six drive status signals. These status signals are sent continuously to the UDA5Ø as long as the drive is powered on and in an on-line state.

The real-time controller state line carries continuous signals. Four controller status bits are always available to the selected drive on this line.

The third is the write/command data line. It is a multipurpose line carrying different types of UDA5Ø signals to the drive. The data line carries the data to be written on the disk (during the execution of write data commands). At other times, various commands can be sent to the drive via this line (for example, seek or get status commands).

The read/response data line is the last on the SDI bus. It is also a multipurpose line that carries signals from the drive to the UDA5Ø. During read data commands, the data read from the disk is transmitted on this line. At other times, it carries responses as a result of the command messages sent on the write/command data line.

UDA5Ø PHYSICAL DESCRIPTION

The UDA5Ø controller is made up of two modules, the M7485 (UDA module #1) and the M7486 (UDA module #2). These modules are interconnected by means of two ribbon cables. See Figure 3. These two modules occupy either standard UNIBUS or modified UNIBUS hex-height small peripheral controller (SPC) locations.

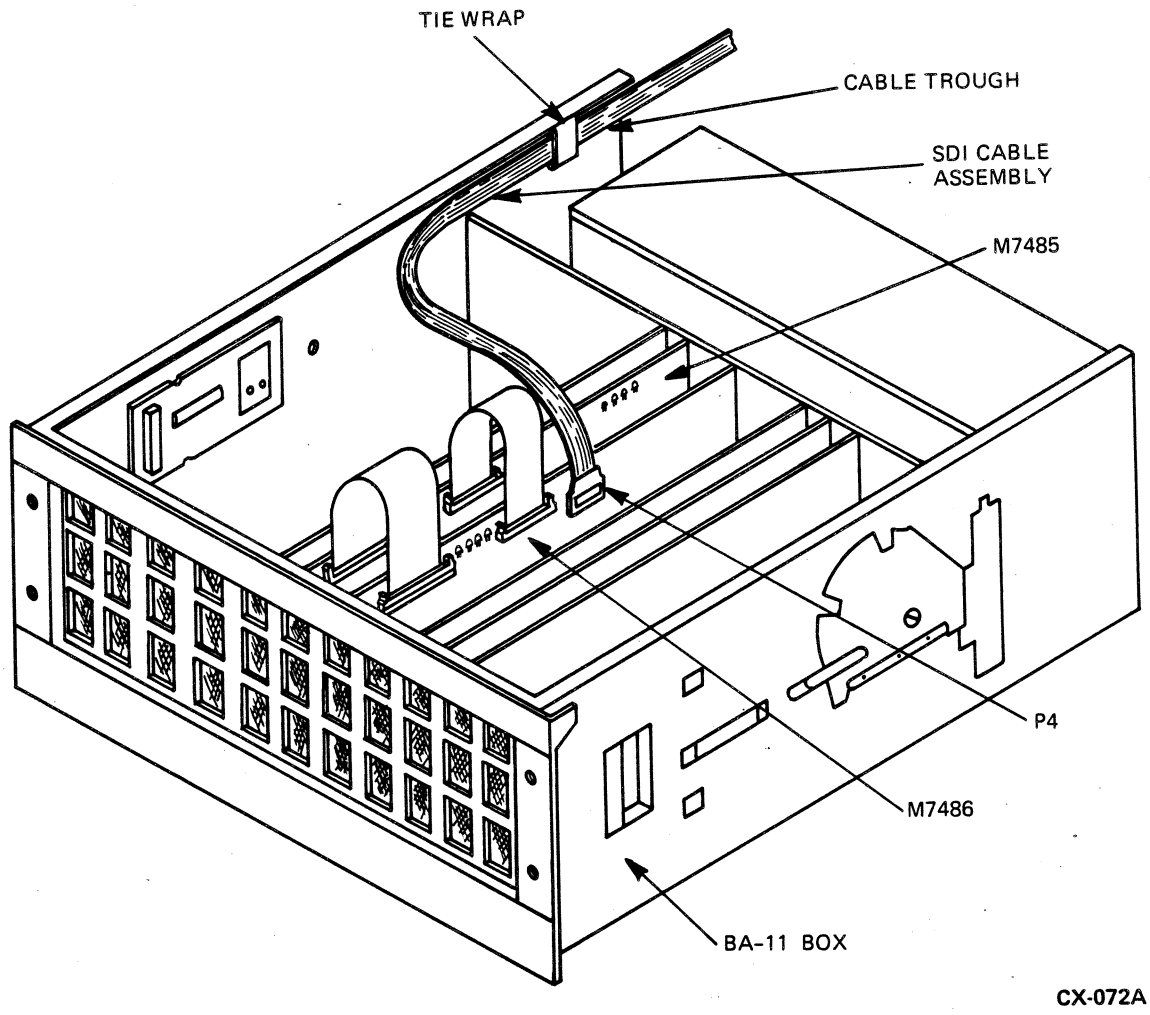


Figure 3 UDA5Ø Intermodule Flat Ribbon Cables

The M7485 module contains a DIP switch assembly for selecting the UNIBUS address for the two registers (IP and SA). In addition to the switch assembly, an address jumper plug (consisting of jumpers W4 and W5) aids in the address selection. Both switch and jumper assemblies are shown in Figure 4. The installation procedure discussed in the UDA5Ø User Guide gives setup instructions for the address selection. Figure 3 also shows the SDI cable from the UDA5Ø to the drives. The cable connects to P4 on the M7486 board and is routed to a cabinet bulkhead connector (not shown). At the bulkhead connector the SDI cable splits into four separate cables. These four SDI cables are routed from the bulkhead connector to each drive in the subsystem (maximum of four).

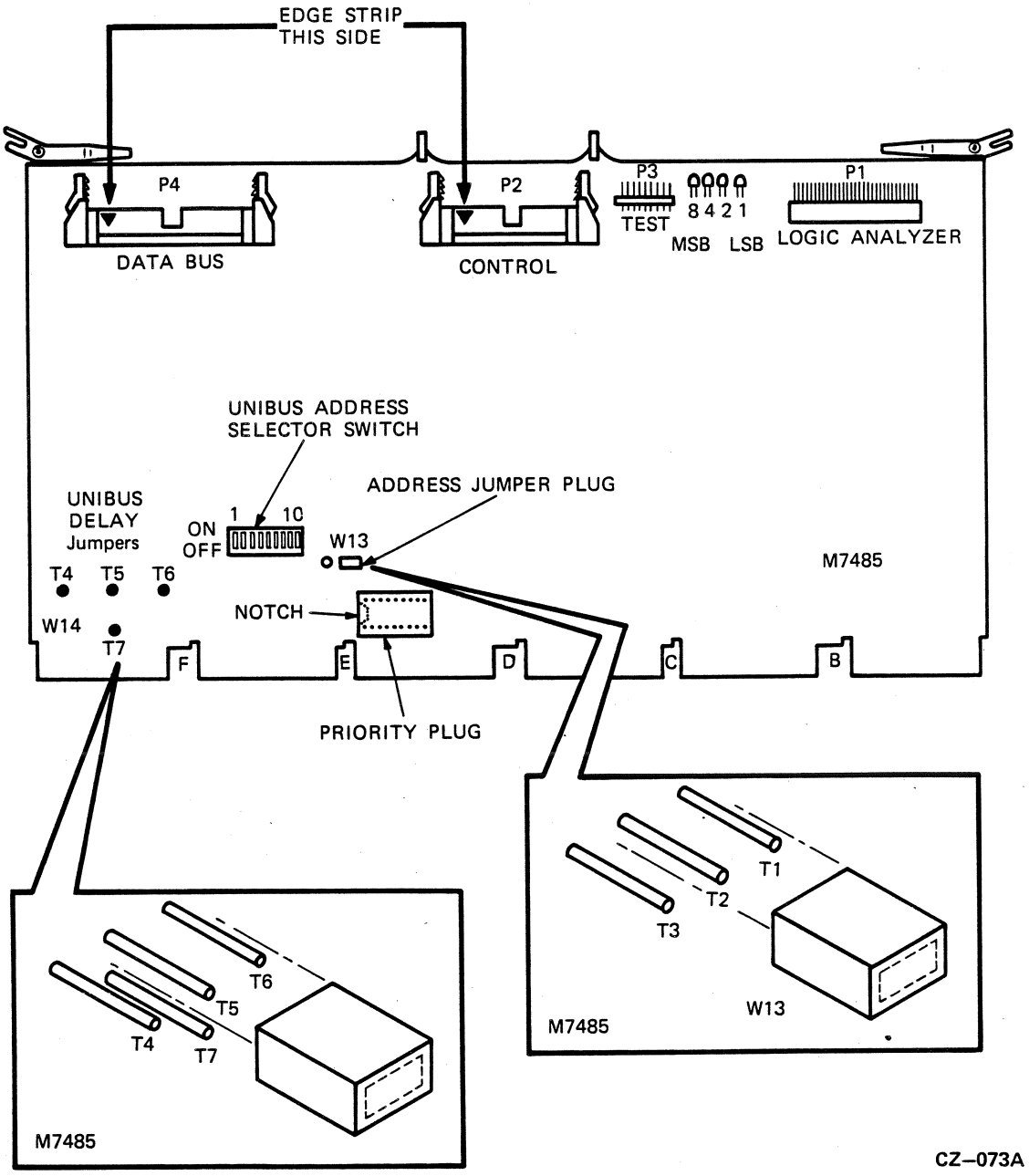


Figure 4 UNIBUS Address Selector Switch and Jumper Locations

UNIBUS OVERLOADING

A set of jumpers has been inserted on the M7485 module to prevent UNIBUS data overloading. The location of these jumpers on UDA5Ø module M7485 is shown in Figure 4. Table 1 shows the amount of delay, jumper configuration, and system configuration.

Table 1 UNIBUS Delay

Amount of Delay	Jumper Configuration	Type of System
Ø usec	T4-T5	UDA installed and the only other disk drive is an RLØ2 or RKØ7 (11/7Ø system with an RKØ7 and and 1Mb DMR will not work*)
6.2 usec	T5-T6	UDA installed with multiple DMR11s, DMC11s or DZ11s
		11/44 system (or any other PDP-11 with ECC memory) using RMØ2 or RPØ4/Ø5/Ø6 disk drives
		11/44 with RLØ2s or RKØ7s
		11/24 system (or any other PDP-11 with non-ECC memory) with 1 or 2 UDAs installed with other disk controllers and a DZ11
		VAX systems should be treated as 11/24s for UNIBUS configuration
		UDA installed on the UNIBUS with one or more real-time data acquisition devices and real-time data overrun or underflow is observed**
1Ø usec	T5-T7	11/44 system with RLØ2s and RKØ7s
		11/7Ø system with a UDA/RLØ2/ DMR11 (1Mb) mix

* The UDA/RKØ7/DMR11 configuration gives data late errors from the RKØ7 regardless of the UDA jumper setting. Because of this, either an RKØ7 or a UDA, but not both, can be configured on the 11/7Ø with a 1Mb DMR present.

** If underflow or overrun conditions are observed after setting the UDA jumper to the 6.2 usec position, the UDA jumper must be set to the 1Ø usec position (T5-T7).

UNIBUS Overload Exceptions

There are exceptions to using the UNIBUS delay in preventing overload and the number of UDAs that can be installed on a system. They are:

1. The UDA should not be installed on a UNIBUS system with a bus repeater because of UNIBUS delays. Other devices such as RKØ7, RMØ2, and RPØ4/Ø5/Ø6 may also experience data late conditions.

2. The UDA should be installed after all non-buffered devices so the UDA buffering can help the UNIBUS access for these devices.

3. On PDP-11 systems, there may be no more than two UDAs installed on a UNIBUS. However, on VAX systems no more than one UDA should be installed on a UNIBUS with non-buffered UNIBUS peripheral devices.

LED ERROR CODES

Both UDA5Ø modules have a four-digit LED display to aid in fault isolation. Figures 4 and 5 show the location of the LEDs. Software initialization causes a battery of tests to be run by the UDA5Ø microprocessor. If any of the tests fail, a code is displayed in the lights. The meaning of the codes may be found in a table in the UDA5Ø Service Manual or the UDA5Ø Maintenance Guide.

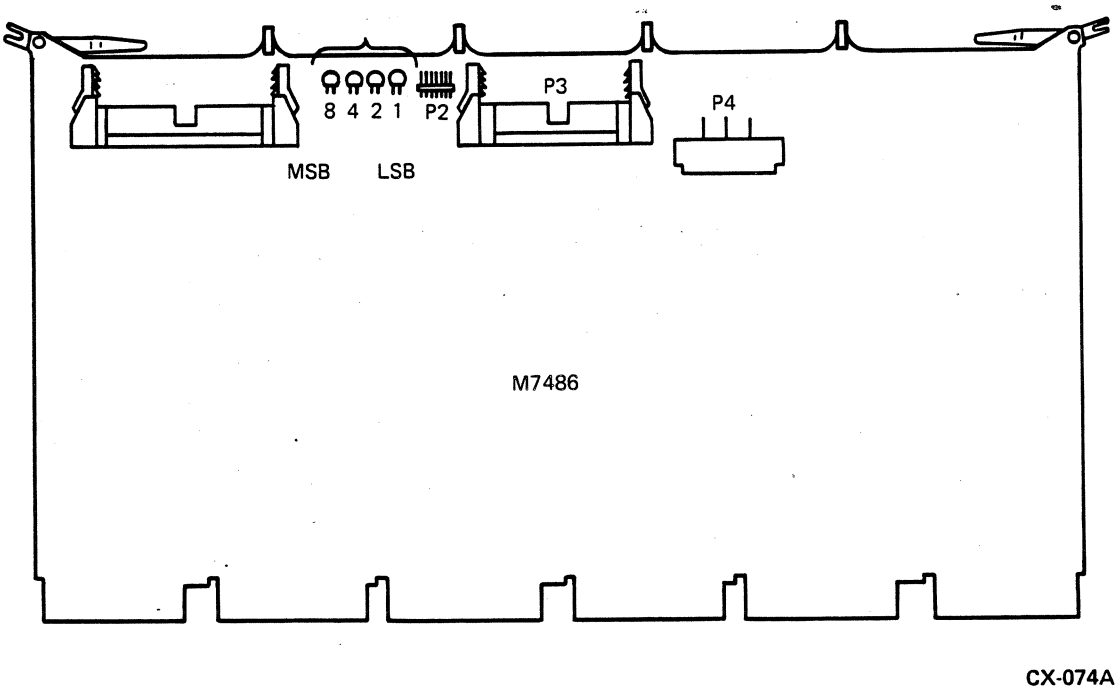


Figure 5 Diagnostic LED Locations on UDA5Ø Modules

An error code is displayed when one or more of the initialization routines fail. An initialization routine is started by the operating system when the UDA5Ø develops a problem.

The same basic information displayed in the LED error codes is also found in the SA register of the UDA5Ø. System software uses the contents of the SA register for error logging and printing error reports.

Table A-1 in Appendix A is a reproduction of the LED error and symptom code table found in the UDA5Ø Maintenance Guide. Each combination of LED displays is shown along with the symptom and the probable cause of the failure. This table should be used whenever an initialization routine failure calls out a LED display code. Note the placement of the LEDs in Figures 4 and 5. Now refer to Table A-1.

HOST-RESIDENT DIAGNOSTICS

A different approach must be taken to isolate faults if no LED error code exists in the UDA5Ø. The first step is to examine the customer error log to ascertain the source of the problem. The next step is to cycle the power off and then back on, resetting much of the logic. The UDA5Ø will then start the initialization routine. Only the first phase will run, however, as completion takes host software interaction. If the first phase passes, the next step is to run the available host-resident diagnostics.

Host-resident diagnostics available to diagnose UDA5Ø problems are the PDP-11 CZUDC and the VAX EVRLA. Both diagnostic programs have the same tests and error messages with the exception of the program name (that is, CZUDC or EVRLA). The programs consist of the following four tests.

- Test 1: UNIBUS interrupt/address test (checks out UDA5Ø functionality).
- Test 2: Disk-resident diagnostic test (runs the drive resident diagnostics).
- Test 3: Disk function test (performs minimum drive functional tests).

- Test 4: Disk exerciser test (performs a limited read and write test only in the diagnostic cylinder area). There are two modes of operation for test 4.
  - Default operation on the diagnostic cylinder or customer area with all parameters selected by the default answers shown below.
  - Manual intervention to the test using new parameters that may include the customer data area. This manual intervention is referred to as a fifth test in test printouts.

PDP-11 Subsystem Diagnostics Preparation

The PDP-11 subsystem diagnostics CZUDC (UDA5Ø host-resident diagnostics) run on any disk drive that can be cabled to the UDA5Ø. The MSCP and SDI bus structure compensates for differences between disk drives. Also included with the PDP-11 subsystem diagnostic is a disk formatter program (CZUDE). The formatter (CZUDE) is not a diagnostic. Do not run it unless specifically instructed to.

The CZUDC diagnostic program will ask both hardware and software questions of the user. A sample printout of these questions, when the default conditions are selected, is shown below.

```
CHANGE HW (L)?  N

# UNITS (D) ?  1

UNIT Ø
UNIBUS ADDRESS OF UDA (Ø) 172150
VECTOR (Ø) 154 ?
BR LEVEL (D)  5  ?
UNIBUS BURST RATE (D)  ?
DRIVE NUMBER (D) Ø ?
EXERCISE ON CUSTOMER DATA AREA IN TEST 4 (L) N ?

CHANGE SW (L) ?  N

ENTER MANUAL INTERVENTION MODE FOR SPECIAL DIAGNOSIS (S) N ?
```

The remaining software questions apply to test 4 only.

```
ERROR LIMIT (D) 32 ?
READ TRANSFER LIMIT IN MEGABYTES - Ø FOR NOLIMIT (D) Ø ?
SUPPRESS PRINTING SOFT ERRORS L) Y ?
DO INITIAL WRITE ON START (L) Y ?
ENABLE ERROR LOG (L) N ?
```

If the manual intervention question is answered yes, the following series of questions will be asked. Manual intervention should be used only to further isolate problems after running the test with the default answers shown above.

```
THE FOLLOWING QUESTIONS REFER TO UNIT xx UDA AT xxxxxx DRIVE xxx

NUMBER OF BAD BLOCKS (D) Ø ?

BAD BLOCK (A)  ?

DO YOU WANT TO CHANGE TESTING PARAMETERS FOR THIS DRIVE (L) N ?
```

Answer this question "N" to bypass further questioning. A "Y" answer results in the following questions.

```
READ ONLY (L) N ?

WRITE ONLY (L)  N ?

CHECK ALL WRITES BY READING (L) N ?

RANDOMLY CHECK WRITES BY READING (L) Y ?

DATA PATTERN - Ø FOR RANDOM SELECTION (D) Ø ?

ENABLE ECC DATA CORRECTION (L) Y ?

COMPARE ALL DATA READ (L) N ?

RANDOMLY COMPARE DATA READ (L) Y ?

ENABLE RETRIES?  (L) Y ?

RANDOM ACCESS MODE (L) Y ?

DO YOU WISH TO:
  Ø - TEST ENTIRE AREA SELECTED
  1 - SPECIFY BEGIN/END SETS TO TEST
  2 - SPECIFY TRACKS AND CYLINDERS TO TEST
  3 - SPECIFY GROUPS AND CYLINDERS TO TEST
  4 - SPECIFY CYLINDERS TO TEST
(D) Ø ?
```

If answered 1:

```
NUMBER OF BEGIN/END SETS (D) 1 ?
BEGIN BLOCK (A) Ø ?
END BLOCK (A) Ø ?
```

The last two questions will be asked one to four times, depending on the answer to the previous question.

If answered 2:

```
NUMBER OF TRACKS TO TEST (D) 1 ?
TRACK (D) Ø ?
```

The last question may be asked one to seven times, depending on the answer to the previous question.

If answered 3:

NUMBER OF GROUPS TO TEST (D) 1 ?
GROUP (D) Ø ?

The last question may be asked one to seven times, depending on the answer to the previous question.

The following question is asked only if tests 2 or 3 were requested.

DO YOU WISH TO LIMIT THE CYLINDERS TESTED (L) N ?

The following question will be asked if the LIMIT THE CYLINDERS question was answered Y (within options 2 and 3)
or if option 4 was selected for the area to test.

STARTING CYLINDER (A) Ø ?
ENDING CYLINDER (A) Ø ?

The following questions will be asked if data pattern 16 was selected:

NUMBER OF WORDS IN DATA PATTERN 16 (D) 1 ?
DATA WORD (O) Ø ?

VAX Subsystem Diagnostics Preparation

The VAX subsystem diagnostics consist of two programs: ZZ-EVRLA (UDA host-resident diagnostic) and ZZ-EVRLC (SDI generic disk exerciser). Also included with the diagnostic kit for the VAX subsystem is a disk formatter program (ZZ-EVRLB). The formatter (EVRLB) is not a diagnostic. Do not run it unless specifically instructed to.

ZZ-EVRLC tests the read and write ability of any SDI disk drive and displays differences in the read and write data to the operator.

Before running the subsystem EVRLA diagnostic tests, the system must be set up and tested under the diagnostic supervisor. On a VAX, this requires a DW UNIBUS adapter, UDA5Ø disk controller, and an RAnn disk drive to be attached. The following printout shows how to attach these devices.

```
DS> AT
Device type ?  DW78Ø
Device Link?  HUB
Device Name?  DWO
TR?  3
BR?  4
DS> AT
Device type?  UDA5Ø
Device Link?  DWO
Device Name?  DUA
UDAIP?  772150
Vector?  154
BR?  5
Burst Rate?  Ø
DS> AT
Device type?  RAnn
Device link?  DUA
Device Name?  DUAØ
DS>
```

RUNNING THE HOST-RESIDENT DIAGNOSTICS

Host-resident diagnostic CZUDC or EVRLA contain tests 1 through 4 linked together to run automatically in sequence. However, if an attempt to read or write on the customer data area is desired during test 4, manual intervention is necessary.

A detailed description of these diagnostics is available on microfiche under RA8Ø diagnostics (CZUDC).

If a printout of the test progress is wanted, type SET TRACE on a VAX prior to starting the test.

Following is a sample test printout.

```
DS> LOAD EVRLA
DS> SET TRACE
DS> START/TEST:1

.Program:  EVRLA - UDA5Ø DISK SUBSYSTEM DIAGNOSTIC, revision
2.1.,
5 tests at 1Ø:34:53:91.
Testing:  DUA DUAØ

Diagnostic started at:  31-JAN-84 1Ø:34:57:Ø9

Test 1:  UDA Interrupt/Address Test
         Subtest 1:  UDA Address Subtest
         Subtest 2:  UDA Diagnostic Loop Mode Subtest
         Subtest 3:  UDA Interrupt Subtest
         Subtest 4:  UDA Initialization - Sm Ring Buffer Subtest
         Subtest 5:  UDA Initialization - Lg Ring Buffer Subtest
         Subtest 6:  UDA DM Program Addressing Subtest
Test 2:  Disk Resident Diagnostic Test
Test 3:  Disk Function Test
Test 4:  Disk Exerciser
Drive DUAØ on UDA at address 772150 (Ø)
INITIAL WRITE COMPLETE
```

The disk exerciser diagnostic in test 4 will continue to run until halted with a CTRL C. Type CTRL C to return to the diagnostic supervisor prompt (DS>), then type ABORT.

If test 1 passes successfully, chances are that the problem is drive related. Tests 2 through 4 should detect the failure.

INTERPRETING HOST-RESIDENT DIAGNOSTIC MESSAGES

The VAX and PDP-11 diagnostics display the same error messages. Error messages take on three distinct formats which provide SA register contents, data comparison error information, or real-time drive state and status. Consult the drive service manual or maintenance guide for interpretation of the status messages.

Status/Address (SA) Register Contents

The following sample error message gives the UDA50 SA register contents.

```
CZUDC DVC FTL ERR 00037 ON UNIT 00 TEST xxx SUB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
UDA REPORTED FATAL ERROR IN UDASA REGISTER WHILE LOADING DM
PROGRAM
  UDASA CONTAINS 100004
```

For a description of the error and a callout of the most likely faulty FRU, find the SA register contents (100004) in the table in the UDA50 Service Manual or UDA50 Maintenance Guide. Table A-2 in this course is a reproduction of that table.

Data Comparison Errors

The UDA can be put into a mode where the UDASA acts as a wrap port. In this mode, any data being sent to the UDASA will be displayed within a small period of time. If the data in the UDASA does not match the data sent to it, the following error message is displayed. In some instances, a VAX error message prints the name of the failing FRU.

```
CZUDC DVC FTL ERR 00026 ON UNIT 00 TST xxx UB 000 PC: xxxxxx
HOST PROGRAM UDA AT 172150 RUNTIME x:xx:xx
DATA COMPARISON ERROR DURING DIAGNOSTIC PORT LOOP TEST
  DATA SENT TO UDASA 000001
  RECEIVED FROM UDASA 000000

REPLACE UDA50 MODULE M7485.
```

Real-Time Drive State And Status

Note in the following sample error message that the last two lines contain the real-time drive state as supplied by the drive and a status message.

```
CZUDC SFT ERR 04047 ON UNIT 00 TST 04 SUB 000 PC: [nnnn]
DISK EXERCISER DM PC: [nnnn] UDA AT [nnnn] DRIVE [nnnn] RUNTIME
hh:mm:ss
DATA OR STATE CLOCK TIMEOUT DURING WRITE
ATTEMPT attempt
type bm
SECTORS FROM INDEX [nnnn] TRK [nnnn] GRP [nnnn] CYL [nnnn]
ORIGIN OF SEEK:  GRP [nnnn] CYL [nnnn]
REAL TIME STATE 0003
STATUS (R TO L):  0001  1100   0000   0A00   0000   0613   1020
```

The real-time drive state (RTDS) message consists of four hexadecimal digits. Only four state bits within these hexadecimal digits are of diagnostic value to the field service engineer. The rest of the bits are too transitory and are masked out before the RTDS message is printed. The following are the four important state bits.

- 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 6. The interpretation of the RTDS message requires an understanding of the causes and effects of each bit. It also requires an understanding of what is meant by drive online, drive offline, drive available and drive unavailable. Definitions of each of the four RTDS message bits, and the online and available states follow.

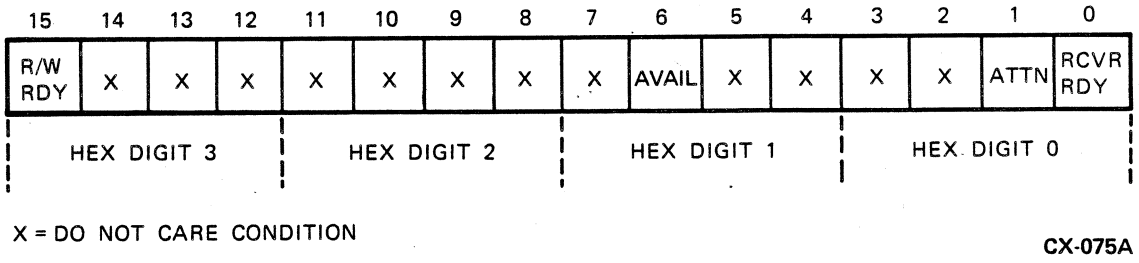


Figure 6 Real-Time Drive State Bits

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 via the drive control protocol.
- Drive unavailable -- The drive is operating, is visible to, and may at times communicate with the controller. However, the controller may not fully utilize the drive because it is online to the other controller.
- Drive available -- The drive is visible to, capable of communicating with, and capable of executing an online command. However, the drive is not currently online to either controller.

- Drive online -- The drive is dedicated to the exclusive use of one controller and is not available to the other.

The following paragraphs explain the causes, effects, and relationships among the four state bits within the RTDS message.

- RCVR RDY (receiver ready) -- When asserted, this bit indicates 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.

- ATTN (attention) -- This notifies the controller that a potentially significant status change has occurred in the drive.

  The drive asserts this signal in the online state whenever any of its generic status bits change. The following three cases are exceptions to this rule.

  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 regardless of whether a command is in progress or not. The drive will continue to assert this signal until it receives a valid get status command from the controller. At this point, the drive will negate the ATTN signal.

  A spinning drive in the available state always asserts the ATTN signal. The ATTN signal is negated if any condition arises that would prevent the available drive from spinning up under controller command.

- R/W RDY (read/write ready) -- This indicates that the drive is capable of handling a data transfer to or from the disk surface.

  Upon receipt of the start frame of a command, the drive negates R/W RDY prior to reasserting RCVR RDY. The signal will remain negated until the drive has processed the command and has transmitted the end frame of the response (if required).

  Any head motion negates 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.

- AVAIL (available) -- When asserted, this bit indicates that the drive has entered the drive available state. The signal is negated when the drive leaves the available state.

Table A-3, Appendix A, describes the possible drive state codes. The error printout example 8ØØ1 indicates that the signal read/write ready is active and the drive is ready to receive. This represents the normal condition of a drive in a UDA5Ø subsystem.

Status Message Bytes

The status line information found in the error message above is the result of the diagnostic performing a get status command. Fourteen of fifteen possible status bytes are printed in the error message. Figure 7 shows the breakdown of the fifteen status bytes. The first byte is not printed because it is a UDA5Ø response code to the get status command. Bytes 9 through 15 contain drive-specific status bits. The drive service manual or maintenance guide should be consulted for interpretation.

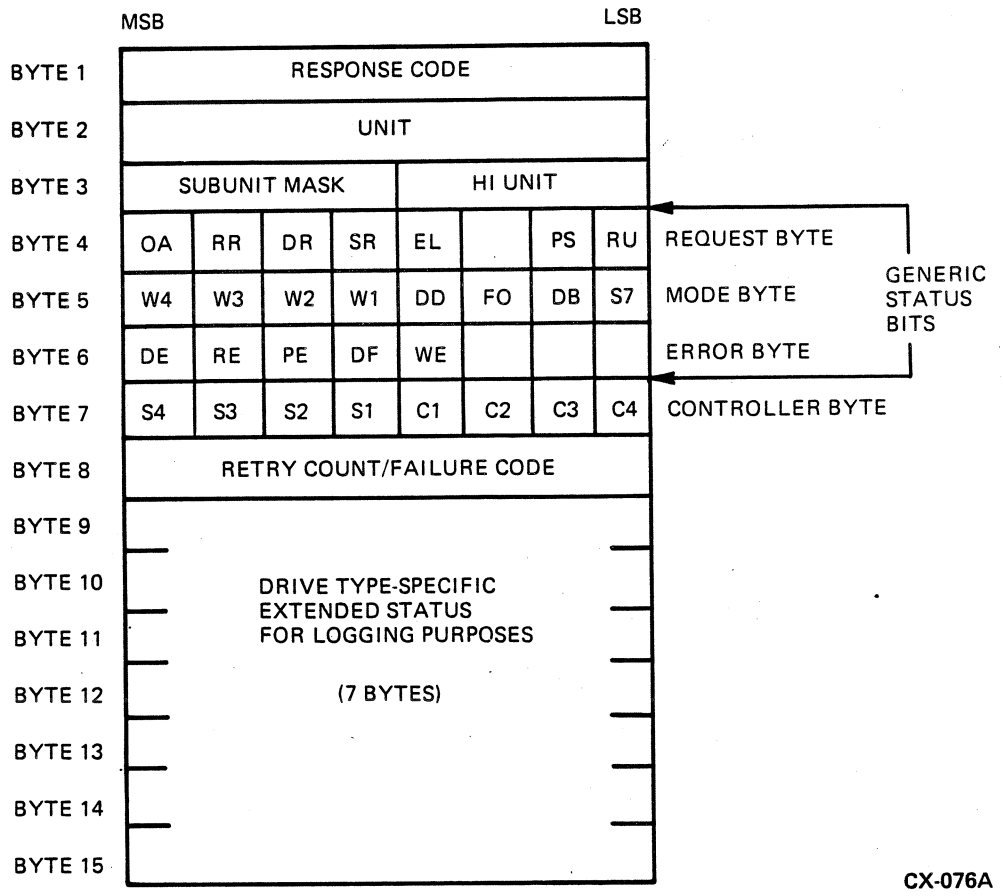


Figure 7 Drive Status Bytes

Table A-4, Appendix A, describes status bytes 1 through 8 as shown in Figure 7.

Status Message Interpretation

Figure 8 shows the breakdown of the status results from the real time drive state and status sample error message.

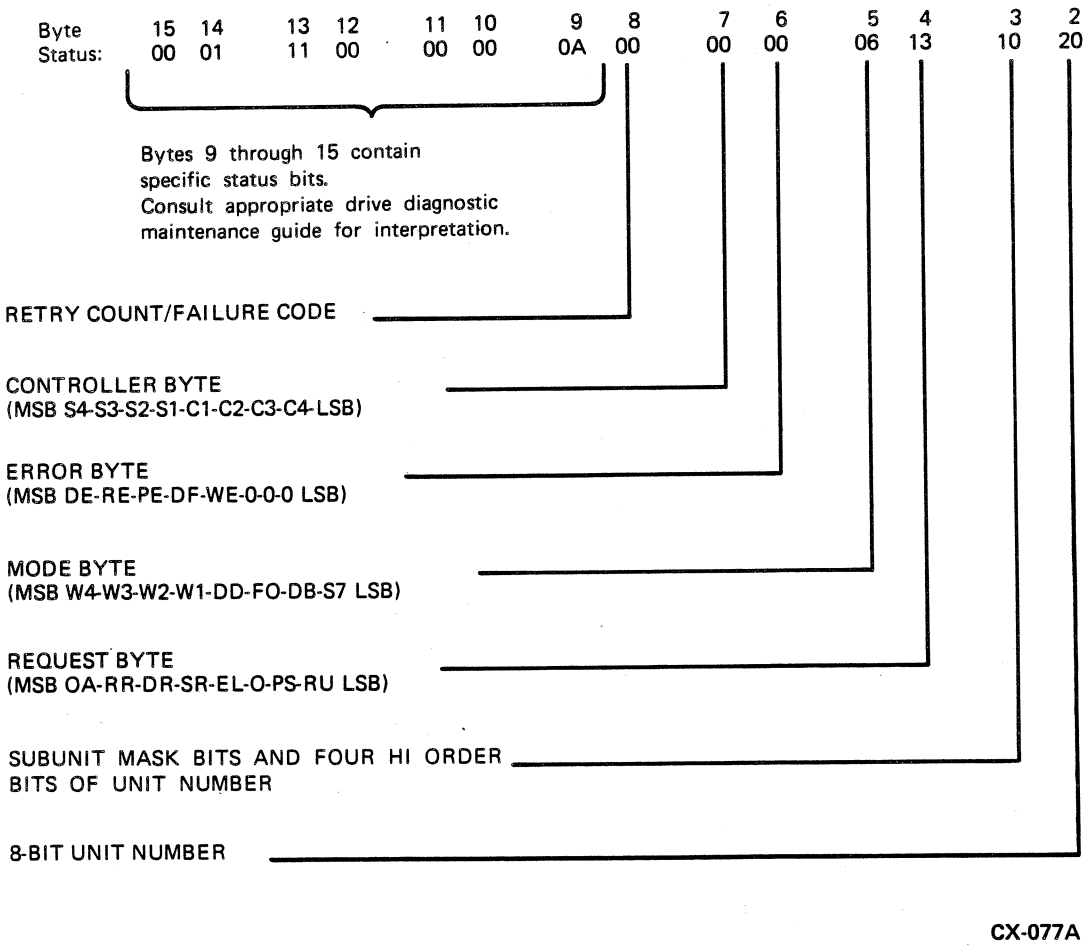


Figure 8 Status Message Interpretation

- Byte 1 is the get status response code and is not printed out.
- Byte 2 and the lower half of byte 3 comprise a three-digit hexadecimal unit number. In the example, the unit number is Ø2Ø (hexadecimal) or 32 (decimal).
- Byte 3 (upper half) reflects the subunit mask and indicates the drive sending the status is subunit zero (ØØØ1).

- Byte 4 is the request byte and breaks down as follows:

1	3
ØØØ1	ØØ11

  - The RU bit is set indicating the drive RUN switch is 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 UDA5Ø.)
  - The SR bit is set indicating the drive spindle is up to speed.
  - The OA bit is not set indicating the drive is at a drive available state. If it had been set, it would indicate online.
  - The RR bit is not set indicating the selected drive does not need an 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:

Ø	6
ØØØØ	Ø11Ø

  - The DB bit is set indicating that it is possible for the host to use a diagnostic cylinder on the drive.
  - The FO bit is set indicating that the drive can be formatted.
  - No bits set in the W4 to Wl field indicate that no subunit is write protected.
  - The DD bit is not set indicating that the drive has not been disabled by a controller due to some error or diagnostic routine.
  - The S7 bit is not set indicating that the 512 byte/ sector format is selected for the drive.

- Byte 6 is the error byte, and for this example none of the above errors have occurred. (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 to S1 bits being cleared indicate that the UDA50Ø is to interrupt the host CPU whenever any drive on the subsystem raises its available line to the UDA50Ø.

- Byte 8 is the retry count/failure code, and for this example, no retries by the diagnostic have been attempted.

SUBSYSTEM ERROR MESSAGES

In addition to the three error messages above, the subsystem diagnostic tests may also print out one of the following:

- Host error message
- UDA initialization error message
- Interrupt handler error message
- Diagnostic machine error message

A sample printout of each of these four types of subsystem error messages is given here for the EVRLA diagnostics. Each error message contains a number and a description of the cause of the error.

1. Sample printout of a host error message:

```
EVRL? - UDA5Ø DISK SUBSYSTEM DIAGNOSTIC -
PASS [PASS NO.], text 2, subtest Ø, error 5 [date]
[time]
System fatal error when testing [DEVICE NAME]:  CHANNEL
SERVICES INTERRUPT DISABLE FAILURE - ABORTING.
```

2. Sample printout of a UDA initialization error message:

```
EVRL? - UDA5Ø DISK SUBSYSTEM DIAGNOSTIC - [REV]
Pass [PASS NO.], test [TEST NO.], subtest [TEST NO]
error 1Ø7 [DATE] [TIME]
Device fatal error when testing [DEVICE NAME]:  UDA DID
NOT RETURN CORRECT DATA IN UDASA REGISTER DURING
INITIALIZATION

For UDA at address [ADDRESS] (Ø)
     UDASA Expected:  [EXPECTED] (X)
     UDASA Received:  [RECEIVED] [SET BITS]
     XOR:             [XOR VALUE]
Replace UDA module [MODULE NUMBER]
```

3. Sample printout of an interrupt handler error message:

```
EVRL? - UDA5Ø DISK SUBSYSTEM DIAGNOSTIC - [REV]
Pass [PASS NO.], test [TEST NO.], subtest [TEST NO.],
error 8Ø2 [DATE] [TIME]
System fatal error when testing [DEVICE NAME]:
UNEXPECTED INTERRUPT ENCOUNTERED
```

4. Sample printout of a diagnostic machine (DM) error message:

```
EVRL? - UDA5Ø DISK SUBSYSTEM DIAGNOSTIC - [REV]
Pass [PASS NO.], test 2, subtest Ø, error Ø2ØØ5 [DATE]
[TIME]
Hard error when testing [DEVICE NAME]:  DM PROGRAM
REPORTING AN ERROR

DISK RESIDENT DM PC:  [PC ADDRESS] UDA at address
[ADDRESS]
DRIVE [NAME] ERROR DURING RECEIVE OF ECHO RESPONSE FROM
DRIVE
ECHO DATA [DATA]
```

Each of the above subsystem error messages gives an error number in the printout. For example, in the DM error message sample printout, an error number of Ø2ØØ5 is given. A description of the error may be found in Table A-5.

HOST ERROR LOG EXAMINATION

This section assumes that you already know how to run the error log program or that you have access to an operator who can run error log reports for you. Training courses are available on this topic.

This section focuses on how to interpret error log reports that you might encounter for MSCP/SDI devices. We shall examine sample error log printouts for both VMS (SYE) and RSTS (ERRDIS). They report similar information but in different formats. Therefore, decoding charts are provided. Each student may select the error log format that applies to his operating system.

COMMON ERROR LOG MESSAGE DEFINITIONS

Even though the error log printouts on different operating systems vary in appearance, there is common message information. Read the following definitions before examining the individual sample printouts.

1. Command reference number - A command reference number is given for each error log event message. It is the MSCP command number that caused the error message to be reported. The command reference number is zero if the error message is not related to an outstanding MSCP command. When a seek command is issued, the drive attempts a number of retries. Each retry for that seek command has the same command reference number.

2. Drive number (logical unit address) - A unit message number refers to the logical unit number of the device. The unit number may be zero if the error message does not refer to a specific device or unit.

3. Sequence number - A sequence number is assigned to an MSCP packet when it is passing information to the host error logger. The use of the sequence number is dependent on the MSCP server in the controller microcode. If the sequence number is zero, the controller does not support the use of this feature.

4. Message format - A format code associated with each error log event determines the error message format. It is important to determine the format code first to interpret the remainder of the error message correctly. The format code will reveal whether the error event is reporting a controller error (code Ø), a host memory access error (code 1), a disk transfer error (code 2), or an SDI error (code 3). Use Table A-6 in Appendix A to decode the format of each error log event.

5. Message Flags - The error log message flags report which of the following three operating conditions apply. Refer to Table A-7 in Appendix A to decode these message flags.

   - Operation successful flag - If set, this flag indicates that the operation causing this error log message has been successfully completed. If clear, this flag indicates that the operation is not yet successfully completed.

- Operation continuing flag - If set, this flag indicates that the retry sequence for this operation is continuing. If clear, the retry sequence for this operation has terminated. Ignore this flag status if the operation successful flag is set. If the "operation successful" and the "operation continuing" flags are both clear, then the error log message is reporting a hard (unrecoverable) error.

- Sequence number reset flag - If set, this flag indicates that the MSCP command sequence number has been reset by the MSCP server since the last error log message sent. Note that this bit is always set if the MSCP server does not implement the error log sequence number feature. If clear, this flag indicates that the command sequence number has not been reset, implying that the it may be used to detect missing error log messages.

6. Status/Event code - The status/event code identifies a specific error or event being reported by this error log message. Refer to Table A-8 for a list of all the UDA MSCP status/event error log codes.

7. Controller identification - The controller identification message provides the controller unique number, device class, and the controller model. The controller unique number is blasted into ROM. The device class refers to whether it is a mass storage controller or some other disk or tape device. Refer to Table A-9 for device class values and Table A-10 for the controller model values.

8. Drive identification - The drive identification message contains a drive unique number blasted into ROM which is not necessarily the drive serial number on the metal. It also contains a device class number shown previously in Table A-9 and a drive model number given in Table A-11.

9. Hardware and software revisions - These revision levels are given for both the controller and the drive. The values are blasted into ROM on each device.

10. Pack or HDA serial number - This is the low order 32 bits of the serial number of the HDA mounted on the drive. This serial number is written on the media at the factory. The bit field is zero if the format of the media does not provide for a media serial number. The bit field is an undefined number if the media is not mounted or the serial number cannot be read.

11. Header or logical block number - This message gives the logical block number (LBN) of the physical sector where the error occurred. If the high four bits are ØØØØ (binary), then the low 28 bits are the logical block number at which the error occurred. If the high four bits are Ø11Ø (binary), then the low 28 bits are the replacement block number at which the error occurred. Refer to the appropriate device service manual to see how to decode the LBN into its associated logical cylinder or header.

12. Error recovery level - The error recovery level reflects the most recent attempt at a data transfer. Each device has a specified number of error recovery levels that corresponds to the mechanisms it has available to attempt an error recovery. For example, if data cannot be read, the drive might try offsetting its head position slightly in case the it had been altered since the data was written. For each such attempt, the error recovery level will be incremented. The values zero and 255 (all ones) indicate that no special error recovery procedures are used.

13. Error retry count - This message gives the retry count within the current error recovery level of the most recent transfer attempt. This value starts at one and increments for each subsequent attempt at the same error recovery level. It continues until a drive dependent maximum number is reached, at which time the retry count is set to one and the next error recovery level (if any) is tried.

14. Host memory address - This message gives the host memory address being used at the time the error was detected. For a UDA5Ø on a RSTS system, the maximum address will occupy 18 bits (Ø-17). Host memory access errors include UNIBUS parity errors (PA/PB lines) and UNIBUS time-outs (SSyn time out), etc.

15. MSCP error code - This message is printed out at the bottom of the ERRDIS error log printout only. It tells why the MSCP communications between the host and controller failed. Refer to Table A-12 for a list of the MSCP error codes.

16. Status code of packet - The status code of the packet is a summary statement of the condition which prompted the error log entry. The condition statement is obtained from an analysis of the status/event field. This statement is very general and will not give a detailed cause for the error. Refer to Table A-13 for a list of status codes for the packet.

17. SDI status message - An SDI status message is received when the error log is reporting an SDI error event (message format Ø3). In a VMS/SYE error log report, this message is given in the form of three 8 character fields. This message contains the contents of bytes 4 through 15 of the drive status message shown in Figure 7. Bytes 4 through 8 contain controller specific information and bytes 9 through 15 contain drive specific information. Status byte 15 contains the same drive error code that is normally obtained through the hand-held terminal. In the RSTS ERRDIS error log, the SDI status information is found in words 22 through 27 of the MSCP packet. This packet is printed out in the form of thirty 7 character groups. Refer to the sample printout of the ERRDIS error log report.

DECODING VMS ERROR LOG REPORTS

This section shows how to decode the information in a VAX/VMS error log report. Two sample VAX/VMS error log printouts are given with note numbers on the right hand side. Refer to these numbered notes after each sample printout to see how to interpret the error log messages.

Sample Printout of VMS Error Report Sequence 1

```
     I/O SUB-SYSTEM, UNIT _DUA2:

MSLG$L_CMD_REF   B36CØØØ4 |----------------[Note 1]
MSLG$W_UNIT          ØØØ2    UNIT #2. |----[Note 2]

MSLG$W_SEQ_NUM       ØØØØ |----------------[Note 3]
                             SEQUENCE  #Ø
MSLG$B_FORMAT          Ø2 |----------------[Note 4]
                             DISK TRANSFER ERROR
MSLG$B_FLAGS           41 |----------------------[Note 5]
                             SEQUENCE NUMBER RESET
                             OPERATION CONTINUING

MSLG$W_EVENT         ØØ8B |------------------[Note 6]
                             DRIVE ERROR
                             LOST "R/W READY" (TRANSFER)

MSLG$Q_CNT_ID    59C34444 |--------------------------[Note 7]
                 Ø1Ø2ØØ81 |
                             UNIQUE IDENTIFIER, ØØ8159C3444
                             MASS STORAGE CONTROLLER
                             UDA5Ø
MSLG$B_CNT_SVR         Ø2
                             CONTROLLER SOFTWARE VERSION #2.
MSLG$W_CNT_HVR         Ø1
                             CONTROLLER HARDWARE REVISION #1.

MSLG$W_MULT_UNT      12D1
MSLG$Q_UNIT_ID   ØØØØØØØØ |-----------------------[Note 8]
                 Ø2Ø5ØØØØ |
                             UNIQUE IDENTIFIER, ØØØØØØØØØØØØ
                             DISK CLASS DEVICE
                             RA81
MSLG$B_UNIT_SVR        Ø2
                             UNIT SOFTWARE VERSION #2.
MSLG$B_UNIT_HVR        Ø1
                             UNIT HARDWARE REVISION #1.
MSLG$B_LEVEL           ØØ |-----------------------[Note 9]

MSLG$B_RETRY           ØØ |----------------------[Note 10]
MSLG$L_VOL_SER   ØØØØØØC4 |-------------------[Note 11]
                             VOLUME SERIAL #196
MSLG$L_HEADER    ØØØCEAA2 |-------------------[Note 12]
                             LBN #846498
                             GOOD LOGICAL SECTOR
```

Notes For VMS Error Report Sequence 1

Note 1: This is the command reference number for this error and all printouts associated with this error.

Note 2: This drive unit number relates to the error log message.

Note 3: This sequence number is assigned for host MSCP software synchronization.

Note 4: The (Ø2) indicates that the format of this message is that of a disk transfer error. Refer to Table A-6.

Note 5: The (41) indicates that the sequence number reset flag (Ø1) and the operation continuing flag (4Ø) are set. Refer to Table A-7.

Note 6: The (ØØ8B) identifies a specific error or event being reported by this error log message. Refer to Table A-8.

Note 7: The controller identification message decodes as shown in Figure 9. Use Tables A-9 and A-1Ø to decode the device class and controller model.

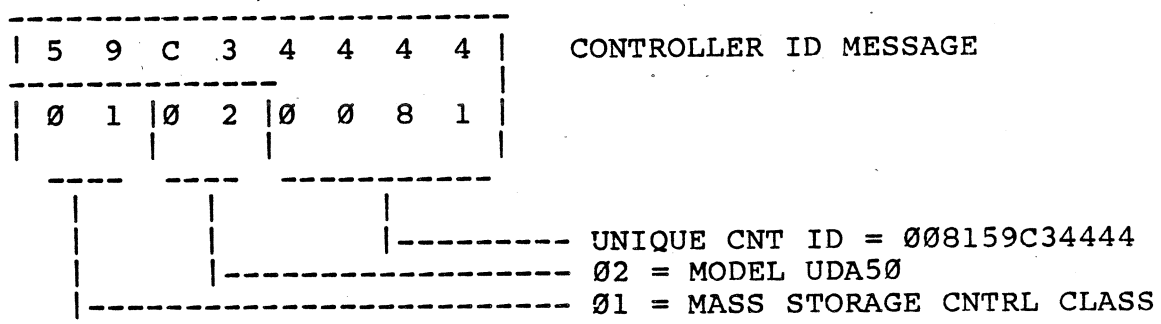


Figure 9 Decode of Controller Identification Message

Note 8: The unit identification message gives the drive unique device number (serial number for RA8Ø/RA81 but a unique number for RA6Ø), the device class, and the drive model. Figure 1Ø shows how to decode the unit identification message. Refer to Tables A-9 and A-11 for the device class and drive model.

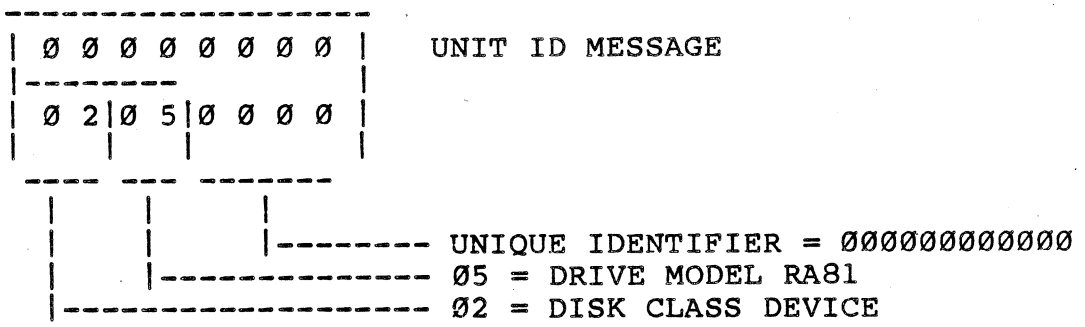


Figure 1Ø Decode of Unit Identification Message

Note 9: This message indicates the error recovery procedure used. Codes of zero and 255 indicate that no special error recovery is used.

Note 1Ø: This message indicates the number of retries attempted under the error recovery procedure given in note 9.

Note 11: The volume serial number gives the serial number of the disk media.

Note 12: The header message gives the logical block number (LBN) of the physical sector where the error occurred on the disk. In the VAX/VMS error log report, the LBN number is given in the right hand column.

Sample Printout Of VMS Error Report Sequence 2

```
     I/O SUB-SYSTEM, UNIT _DUA2:

MSLG$L_CMD_REF    B36C00004 |-------------[Note 1]
MSLG$W_UNIT            0002   UNIT #2.

MSLG$W_SEQ_NUM         0000
                              SEQUENCE #0
MSLG$B_FORMAT            03 |-----------------[Note 2]
                              DISK TRANSFER ERROR

MSLG$B_FLAGS             41
                              SEQUENCE NUMBER RESET
                              OPERATION CONTINUING

MSLG$W_EVENT           00EB |-----------------[Note 3]
                              DRIVE ERROR
                              DRIVE DETECTED ERROR
MSLG$Q_CNT_ID      59C34444
                   01020081
                              UNIQUE IDENTIFIER, 00859C3444
                              MASS STORAGE CONTROLLER
                              UDA50
MSLG$B_CNT_SVR           02
                              CONTROLLER SOFTWARE VERSION #2.

MSLG$W_CNT_HVR           01
                              CONTROLLER HARDWARE REVISION #1.

MSLG$W_MULT_UNT        12D1
MSLG$QUNIT_ID      00000000
                   02050000
                              UNIQUE IDENTIFIER, 000000000000
                              DISK CLASS DEVICE
                              RA81
MSLG$B_UNIT_SVR          02
                              UNIT SOFTWARE VERSION #2.
MSLG$B_UNIT_HVR          01
                              UNIT HARDWARE REVISION #1.
MSLG$L_VOL_SER     000000C4
                              VOLUME SERIAL #196
MSLG$L_HEADER      00000000
                              LBN #0
                              GOOD LOGICAL SECTOR
MSLG$Z_SDI         00000000 |
                   A1000A00 |-------------------[Note 4]
                   1A390804 |
                              RETRY COUNT 0
                              "LED" DISPLAY CODE, 39 (HEX)
                              SERVO FINE POSITIONING ERROR
```

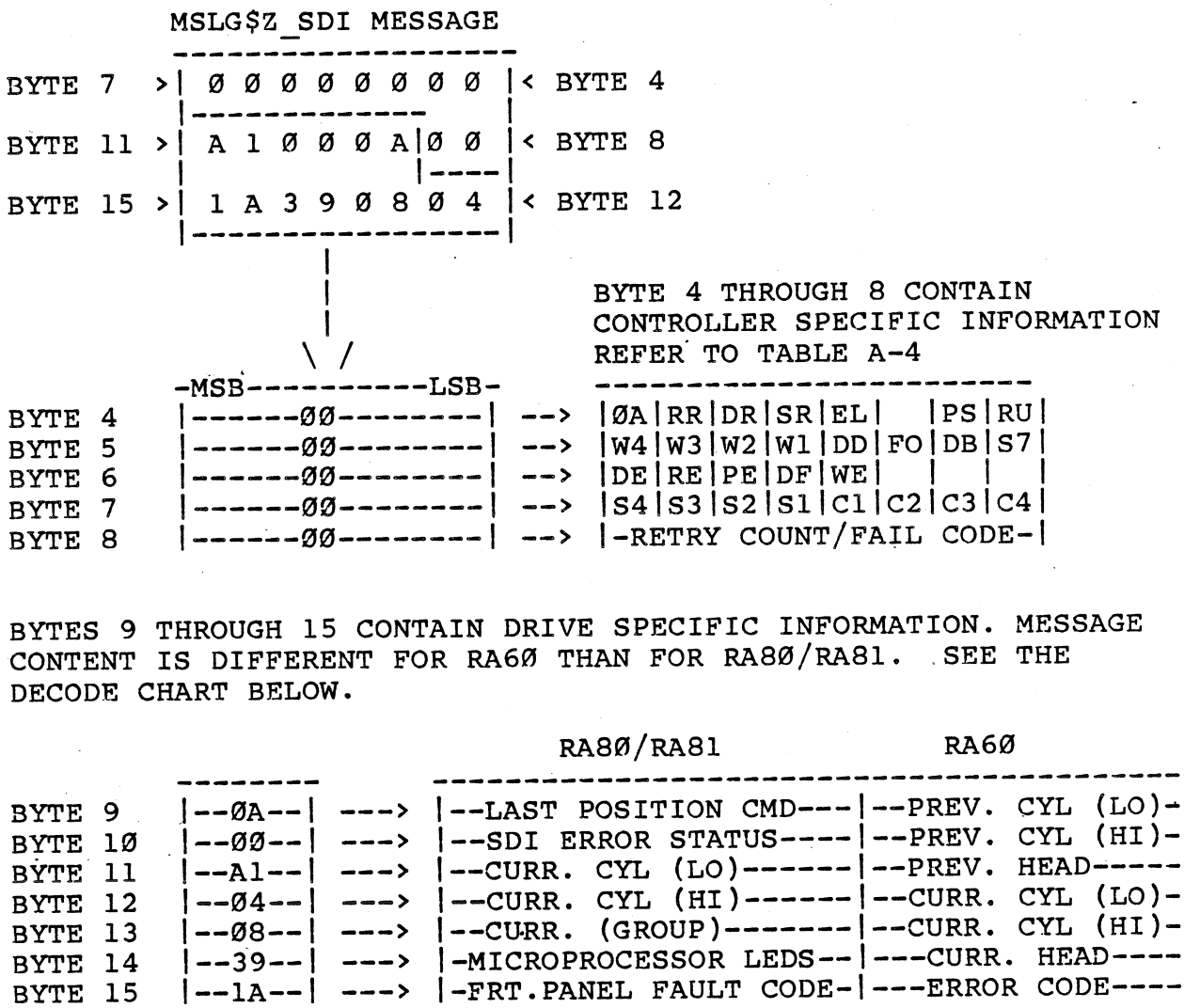
VMS Error Report Sequence 2

Note 1: The command reference number for error sequence 2 is the same as that for error sequence 1. This means that both error events are related to the same MSCP command.

Note 2: This error report has a message format code of (Ø3). Table A-6 shows that code Ø3 is an SDI error report message format. The last message on this report (MSLG$Z_) gives three lines of SDI error code information that is interpreted in note 4.

Note 3: The MSLG$W_EVENT message is reporting a hexadecimal status/event code of (ØØEB). The EB hex code in Table A-8 shows a drive detected error. This information is also given in the verbal description on the right side of the VMS error log printout. It is important to learn how to check these status/event codes because not all error log reports may give this English interpretation on the printout.

Note 4: The MSLG$Z_SDI message gives valuable controller-specific and drive-specific troubleshooting information. This information comes in three lines of hexadecimal characters shown in Figure 11, Decoding VAX/VMS Error Report SDI Message.



BYTES 9 THROUGH 15 CONTAIN DRIVE SPECIFIC INFORMATION. MESSAGE CONTENT IS DIFFERENT FOR RA6Ø THAN FOR RA8Ø/RA81. SEE THE DECODE CHART BELOW.

			RA8Ø/RA81	RA6Ø
BYTE 9	--ØA--	--->	--LAST POSITION CMD---	--PREV. CYL (LO)-
BYTE 1Ø	--ØØ--	--->	--SDI ERROR STATUS----	--PREV. CYL (HI)-
BYTE 11	--A1--	--->	--CURR. CYL (LO)------	--PREV. HEAD-----
BYTE 12	--Ø4--	--->	--CURR. CYL (HI)------	--CURR. CYL (LO)-
BYTE 13	--Ø8--	--->	--CURR. (GROUP)-------	--CURR. CYL (HI)-
BYTE 14	--39--	--->	-MICROPROCESSOR LEDS--	---CURR. HEAD----
BYTE 15	--1A--	--->	-FRT.PANEL FAULT CODE-	---ERROR CODE----

NOTE: ALL CYLINDER REFERENCES IN THE ABOVE DRIVE CHARTS ARE TO PHYSICAL CYLINDERS.

Figure 11 Decoding VAX/VMS Error Report SDI Message

Figure 11 shows the information contained in each byte of the VAX/VMS error report SDI message. Each byte contains two hexadecimal characters that must be decoded further. In this example, there is no controller specific information available, so bytes 4 through 8 are all zeros. If there is controller specific information, as there is in a controller error format message, use the bit map on the right side of Figure 11 for interpretation. Then use Table A-4 to decode the meaning of each controller bit mnemonic.

Figure 11 also shows the drive-specific information contained in bytes 9 through 15. Determine which model drive unit is reporting this error message before you decode the extended status area information found in bytes 9 through 15.

RSTS/E ERROR LOGS

The RSTS/E ERRDIS error log report is not as sophisticated as the VMS error log report. Instead of giving separate error log messages with verbal descriptions, the RSTS/E error log prints out the contents of an MSCP packet that must be decoded.

In addition, octal MSCP message characters must be converted to hexadecimal before the information can be decoded.

This section shows how to decode the information in a RSTS/E ERRDIS error log report. A sample RSTS/E error log report is given with note numbers on the right-hand side. Refer to the numbered notes following the sample printout to interpret the error log message.

Sample Printout Of RSTS/E Error Log Report

```
DU RA80 Seq #44 Occurred on 17-Dec-83 at 00:15:42 |--[Note 1]

SOFTWARE INFORMATION EXCLUDED

MSCP Description:
-----------------
MSCP Envelope            000070  000020 |--[Note 2]

MSCP Packet              004000  140234  000002  000000 |
                         040403  000053  000000  000000 |
                         000000  000402  000002  000000 |
                         000035  000000  000000  001004 |-[Note 5]
                         107400  000000  000400  000004 |
                         000000  000000  002023  000000 |
                         013400  000005  001653  000000 |
                         000000  000000                 |


Status Code of Packet     Drive Error |---------[Note 3]
MSCP Intnl Ctrl Sttus Wd  000300 <--UNDEFINED
MSCP Intnl Unit Sttus Wd  100004 <--UNDEFINED
MSCP Error Code           000000 |--------------[Note 4]
BBR Flag Word             000000          |
LBN Being Replaced        000000  000000  |
Replacement Block Number  000000  000000  |<----UNDEFINED
RBN Being Replaced        000000  000000  |
```

Notes For RSTS/E Error Log Report

Note 1: This line of the sample error log printout reads RA8Ø for all RA8Ø, RA81, and RA6Ø drive errors.

Note 2: Note the last two digits of the second MSCP envelope word (ØØØØ2Ø). If they read 2Ø, as shown here, then the following MSCP packet contains error information. If the last two digits read Ø1, then the MSCP message is an end packet and contains limited useful information. Do not use this document when the envelope word indicates this is an end packet.

Note 3: The status code of the packet message is reporting the specific error or event that causes this error log report. If a coded message is given instead of a verbal description (for example, drive error), refer to Table A-8 to interpret the message.

Note 4: The MSCP error code, when present, reports conditions that cause a failure in MSCP communications. Refer to Table A-12 for the list of possible causes.

Note 5: If the second word of the MSCP envelope ends in 2Ø (note 2), the 3Ø octal words in the MSCP packet will contain useful error information. Figure 12 shows how the MSCP packet message is organized into words. Before decoding the error information, decode word 4 to determine the the error message format. The next paragraph shows you how to determine the message format.

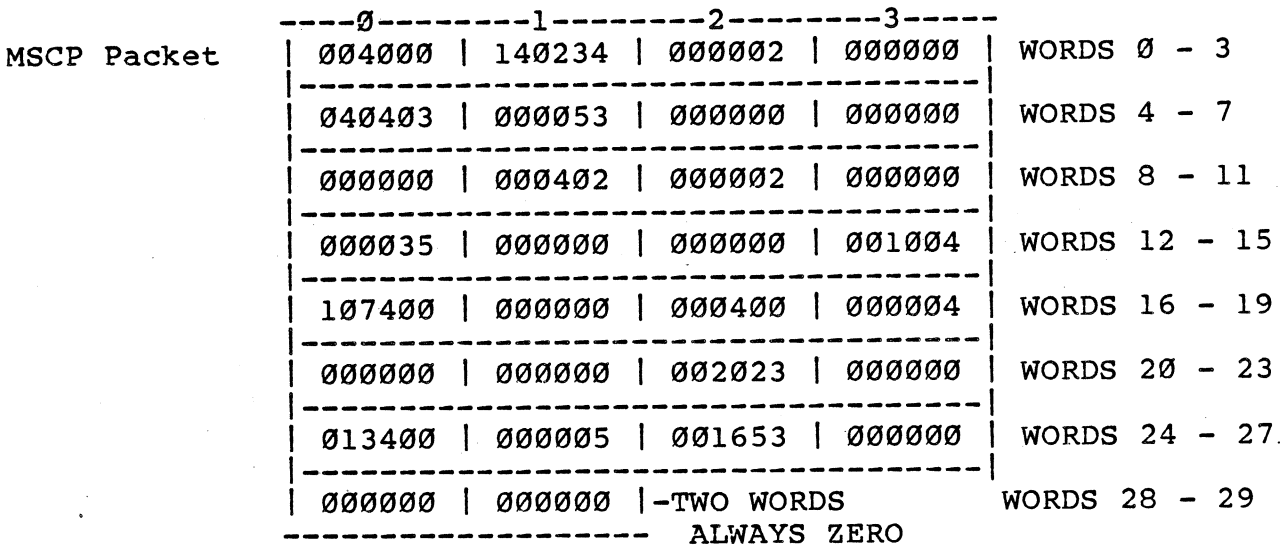


Figure 12 MSCP Packet Word Organization

DECODING MSCP PACKET MESSAGE FORMAT

The error information in the MSCP message packet may come in one of four kinds of formats. It is important, therefore, to determine the format of the message first. The four error message formats are:

- Controller error format (code Ø)
- Host memory access error format (code 1)
- Disk transfer error format (code 2)
- SDI error format (code 3)

The error message format codes are found in the low byte of word 4 of the MSCP packet. Figure 13 shows how to interpret the format code from word 4 in the sample RSTS/E error log printout given previously. This procedure involves converting the octal coded message into its hexadecimal equivalent. Remember that the message will only provide useful information if the second word of the MSCP envelope equals 20.

```
WORD 4 =  Ø 4 Ø 4 Ø 3      OCTAL
                 |
                 |
                \ /

 Ø   4    Ø    4      Ø    3     OCTAL

 Ø  1ØØ  ØØØ  1| ØØ  ØØØ  Ø11    BINARY CODED OCTAL
 --------------|-------------
  HIGH BYTE    |  LOW BYTE
               |
 Ø1ØØ   ØØØ1   | ØØØØ    ØØ11   BINARY CODED HEX
 --------------|-------------
   4      1    |   Ø       3     HEX

 LOW BYTE OF WORD 4   =  HEX Ø3 (ERROR FORMAT)
 HIGH BYTE OF WORD 4  =  HEX 41 (MESSAGE FLAG)

 THIS MSCP MESSAGE IS IN AN SDI ERROR FORMAT BECAUSE THE
 THE LOW BYTE OF WORD 4 CONTAINED A HEX CODE OF Ø3
```

Figure 13 Decoding MSCP Message Error Format

RECOVERING ERROR INFORMATION IN MSCP PACKET

Once you have determined the error format of the MSCP packet, use one of the following four error format charts to interpret the rest of the message. The contents of each word may be decoded and found in the appendix tables. If the tables do not give the octal code, convert the octal word to its hexadecimal equivalent.

SDI ERROR FORMAT CHART

The SDI error format, as determined from the low byte of word 4, is used by the SDI-type disk controllers to report drive detected errors and SDI communication (drive bus) errors. Since the controller may retry a failed command, separate error log entries are recorded for each attempt. Each retry for the same command has the same command reference number (words Ø and 1). If recovery from the error condition is unsuccessful, the controller may declare the drive inoperative and mark it off line. The number of retries are different for each disk drive.

Use the chart in Figure 14 to interpret the MSCP packet for the SDI error format. Then refer to the tables in the appendix to decode the packet words.

MSCP PACKET FOR SDI ERROR FORMAT

				WORDS
Ø	1	2	3	
COMMAND REFERENCE NUMBER		DRIVE NUMBER (LOGICAL UNIT ADDRESS)	SEQUENCE NUMBER	Ø - 3
4 HI BYTE: MSG FLAG / LOW BYTE: FORMAT CODE	5 STATUS/EVENT CODE (GOOD INFO)	6 LOW WORD OF CONTROLLER SERIAL NUMBER	7 MID WORD OF CONTROLLER SERIAL NUMBER	4 - 7
8 HIGH WORD OF CONTROLLER SERIAL NUMBER	9 HI BYTE: CNTRL CLASS / LOW BYTE: UDA MODEL	1Ø HI BYTE: UDA HDWR VER. / LOW BYTE: UDA SOFTW REV.	11 RESERVED (N/A)	8 - 11
12 LOW WORD OF DRIVE SERIAL NUMBER	13 MID WORD OF DRIVE SERIAL NUMBER	14 HIGH WORD OF DRIVE SERIAL NUMBER	15 HI BYTE: DRIVE CLASS / LOW BYTE: DRIVE MODEL	12 - 15
16 HI BYTE: DRIVE HARDW VER. / LOW BYTE: DRIVE SOFTW REV.	17 RESERVED (N/A)	18 LOW WORD OF PACK/HDA SERIAL NUMBER	19 HIGH WORD OF PACK/HDA SERIAL NUMBER	16 - 19
2Ø LOW WORD OF LOGICAL BLOCK NUMBER	21 HIGH WORD OF LOGICAL BLOCK NUMBER	22 UDA STATUS/ERROR INFORMATION	23 UDA STATUS/ERROR INFORMATION	2Ø - 23
24 HI BYTE: DRIVE STATUS /ERROR / LOW BYTE: DRIVE RETRY COUNT	25 DRIVE STATUS/ERROR INFORMATION	26 DRIVE STATUS/ERROR INFORMATION	27 DRIVE STATUS/ERROR INFORMATION	24 - 27

Figure 14 MSCP Packet for SDI Error Format

DISK TRANSFER ERROR FORMAT CHART

The disk transfer error format, as determined from the low byte of word 4, is used by the SDI-type disk controllers to report errors that occur during a disk transfer. This format is generally used to report the results of a series of retries. Each retry is recorded by the error log program with the same command reference number. If the retries are unsuccessful, the controller may declare the drive inoperative and mark it off line.

Use the chart in Figure 15 to interpret the MSCP packet for the disk transfer error format. Then refer to the tables in the appendix to decode the packet words.

MSCP PACKET FOR DISK TRANSFER ERROR FORMAT

				WORDS
Ø COMMAND REFERENCE NUMBER	1	2 DRIVE NUMBER (LOGICAL UNIT ADDRESS)	3 SEQUENCE NUMBER	Ø - 3
4 HI BYTE MSG FLAG	LOW BYTE FORMAT CODE	5 STATUS/EVENT CODE (GOOD INFO)	6 LOW WORD OF CONTROLLER SERIAL NUMBER	7 MID WORD OF	4 - 7
8 HIGH WORD OF CONTROLLER SERIAL NUMBER	9 HI BYTE CNTRL CLASS	LOW BYTE UDA MODEL	10 HI BYTE UDA HDWR VER.	LOW BYTE UDA SOFTW REV.	11 RESERVED (N/A)	8 - 11
12 LOW WORD OF DRIVE SERIAL NUMBER	13 MID WORD OF	14 HIGH WORD OF	15 HI BYTE DRIVE CLASS	LOW BYTE DRIVE MODEL	12 - 15
16 HI BYTE DRIVE HARDW VER.	LOW BYTE DRIVE SOFTW REV.	17 HI BYTE ERROR RETRY COUNT	LOW BYTE ERROR RECOV-ERY LEVEL-	18 LOW WORD OF PACK/HDA SERIAL NUMBER	19 HIGH WORD OF	16 - 19
20 LOW WORD OF LOGICAL BLOCK NUMBER	21 HIGH WORD OF	A VARIABLE AMOUNT OF CONTROLLER OR DISK DEPENDENT INFORMATION. THE LENGTH OF THIS MESSAGE IS DEPENDENT ON THE LENGTH OF THE ERROR LOG MESSAGE SENT TO THE HOST SOFTWARE BY THE CONTROLLER SOFTWARE. OFTEN NO CONTROLLER OR DISK DEPENDENT INFORMATION IS PROVIDED. THIS INFORMATION WILL TYPICALLY NOT BE INTERPRETED BY ERROR LOG PROGRAMS, AND WILL THUS BE PRINTED AS A SERIES OF OCTAL VALUES.			20 - 23 24 - 27

Figure 15 MSCP Packet for Disk Transfer Error Format

CONTROLLER ERROR FORMAT CHART

The controller error format, as determined from the low byte of word 4, is used by the SDI-type disk controllers to report errors that occur within the controller. The failing operation may be retried. The number of retries is a function of the type of error, the type of drive, and the type of controller. The results of each retry will be logged by the error log program with the same command reference number (words Ø and 1).

Use the chart in Figure 16 to interpret the MSCP packet for the controller error format. Then refer to the tables in the appendix to decode the packet words.

MSCP PACKET FOR CONTROLLER ERROR FORMAT

				WORDS
Ø COMMAND REFERENCE NUMBER	1	2 RESERVED (N/A)	3 SEQUENCE NUMBER	Ø - 3
4 HI BYTE MSG FLAG	LOW BYTE FORMAT CODE	5 STATUS/EVENT CODE (GOOD INFO)	6 LOW WORD OF CONTROLLER SERIAL NUMBER	7 MID WORD OF	4 - 7
8 HIGH WORD OF CONTROLLER SERIAL NUMBER	9 HI BYTE CNTRL CLASS	LOW BYTE UDA MODEL	1Ø HI BYTE UDA HDWR VER.	LOW BYTE UDA SOFTW REV.	8 - 11
A VARIABLE AMOUNT OF CONTROLLER OR DISK DEPENDENT INFORMATION. THE LENGTH OF THIS MESSAGE IS DEPENDENT ON THE LENGTH OF THE ERROR LOG MESSAGE SENT TO THE HOST SOFTWARE BY THE CONTROLLER SOFTWARE. OFTEN NO CONTROLLER OR DISK DEPENDENT INFORMATION IS PROVIDED. THIS INFORMATION WILL TYPICALLY NOT BE INTERPRETED BY ERROR LOG PROGRAMS, AND WILL THUS BE PRINTED AS A SERIES OF OCTAL VALUES.				12 - 15 16 - 19 2Ø - 23 24 - 27

Figure 16 MSCP Packet for Controller Error Format

HOST MEMORY ACCESS ERROR FORMAT CHART

The host memory access error format, as determined from the low byte of word 4, is used by the SDI-type disk controllers to report errors that occur while attempting to access host memory. The failing operation may be retried. The number of retries is a function of the controller. The results of each retry are logged by the error log program with the same command sequence number (words Ø and 1).

Use the chart in Figure 17 to interpret the MSCP packet for the host memory access error format. Refer to the tables in the appendix to decode the packet words.

MSCP PACKET FOR HOST MEMORY ACCESS ERROR FORMAT

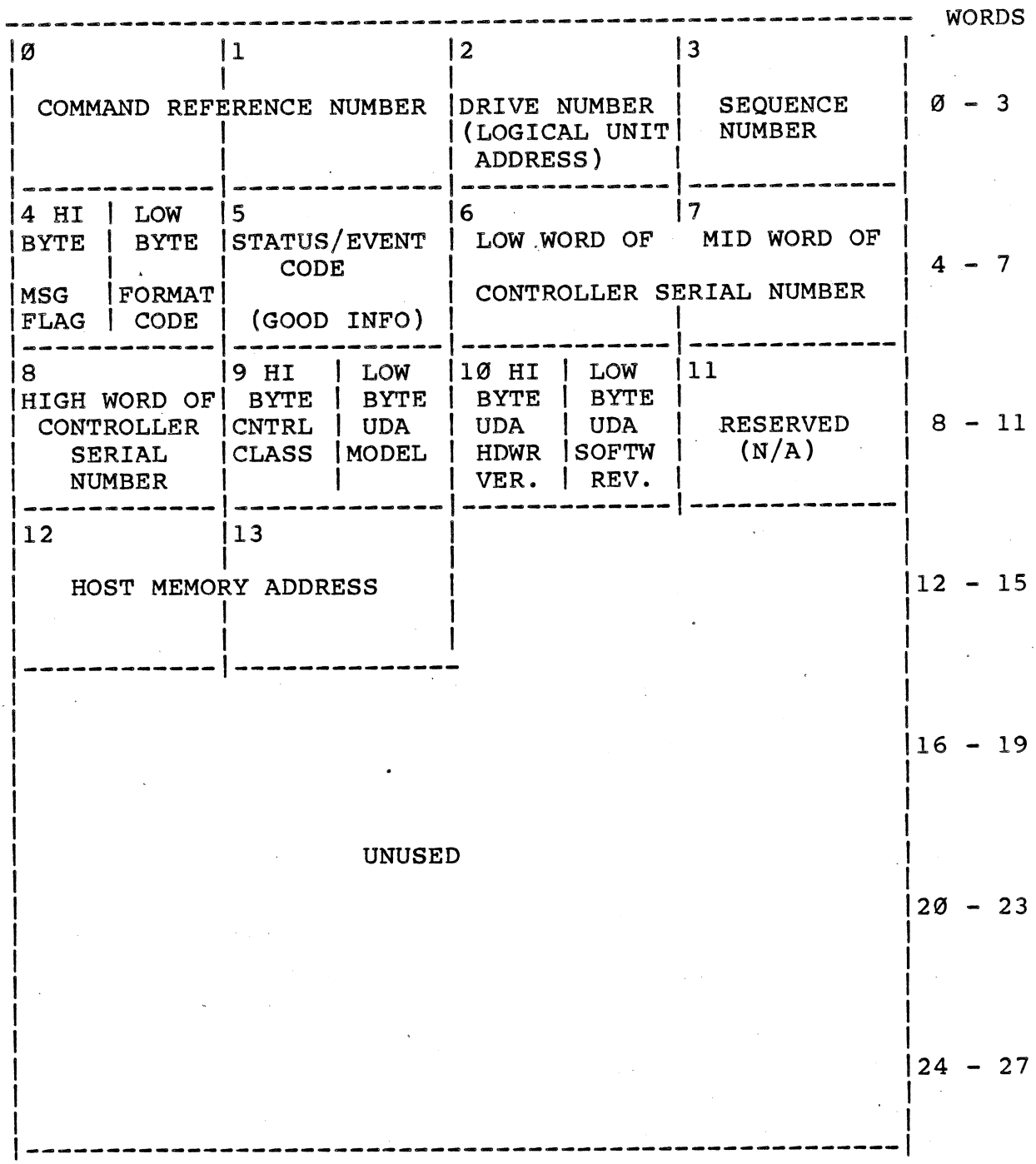


Figure 17 MSCP Packet for Host Memory Access Error Format

Status Word Availability

The status words contain important controller and drive status and error information. These status words are only available when the error log program is reporting an SDI error format message (format code Ø3). Determine if the status words are available by checking which error format code the error log event is reporting. In the VMS error log report, this is determined by reading the MLSG$B_FORMAT line. In a RSTS/E error log report, you must first decode word 4 of the MSCP packet as shown in Figure 14.

Decode Status Words

Decode the error log report as an SDI error format type (format code Ø3). SDI error format reports contain useful information on the UDA and disk drive in the SDI status message.

For VMS error log reports, the SDI status word information is found on the MSLG$Z_SDI line. It is reported as three lines of hexadecimal data and shown in decoded form in Figure 11.

For RSTS/E error log reports, the SDI status word information is given in words 22 through 27 of the MSCP packet. This information is given in an octal word format and is decoded as shown in Figures 12, 13, and 18.

After the SDI status information is decoded, find the table codes in the appendix to determine the failing FRU to replace.

	MODE BYTE								REQUEST BYTE							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
WORD 22	W4	W3	W2	W1	DD	FO	DB	S7	OA	RR	DR	SR	EL	ØØ	PS	RU

	CONTROLLER BYTE								ERROR BYTE							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
WORD 23	S4	S3	S2	S1	C1	C2	C3	C4	DE	RE	PE	DF	WE	ØØ	ØØ	ØØ

	HIGH BYTE	LOW BYTE
WORD 24	RA6Ø = PREV. CYL. (LO) RA8Ø/81 = LAST POSITION COMMAND ISSUED	RETRY COUNT FOR ALL DRIVES

	HIGH BYTE	LOW BYTE
WORD 25	RA6Ø = PREV. HEAD RA8Ø/81 = CURR CYL (LØ)	RA6Ø = PREV. CYL. (HI) RA8Ø/81 = SDI ERROR STATUS

	HIGH BYTE	LOW BYTE
WORD 26	RA6Ø = CURR CYL. (HI) RA8Ø/81 = CURRENT GROUP	RA6Ø = CURR CYL. (LO) RA8Ø/81 = CURR CYL (HI)

	HIGH BYTE	LOW BYTE
WORD 27	RA6Ø = DRIVE ERROR CODE RA8Ø/81 = FRONT PANEL FAULT CODES	RA6Ø= CURRENT HEAD RA8Ø/81 = MICRO-PROCESSOR LED CODES

Figure 18 UDA and Drive Status/Error Words 22 through 27

INTRODUCTION TO SPEAR

Run the SPEAR (Standard Package for Error Analysis and Reporting) program if it is available on your operating system. SPEAR goes beyond the typical error log capabilities. It not only accumulates data, but it has the capability of analyzing and predicting which FRU is at fault. SPEAR is a library of functions that sorts, evaluates, and reports on events recorded in the local system event file. SPEAR is currently used on TOPS-10, TOPS-20, and VMS operating systems. Plans are underway to incorporate RAnn drives under its diagnostic analysis.

You may order a SPEAR Reference Card from Printing and Circulation Services under part number (EK-SPEAR-RC). This reference card summarizes the SPEAR function codes, system event codes, and provides other useful information.

If SPEAR is not available to you, consult with the operating system manager for permission to run the subsystem diagnostics. This requires customers to give up their operating system temporarily.

Did SPEAR Select A Bad FRU?

If SPEAR did not pick out a bad FRU, then consult with the system manager to see if the suspect disk drive can be taken offline to run the drive-resident diagnostics with the hand-held terminal. It is important to consult with the system manager first since the operating system may depend on the disk pack for a system image or back-up file.

With the system manager's approval, place the suspect disk offline and run the drive-resident diagnostics.

Replace The FRU Suggested By SPEAR

Again, consult with the system manager before placing the disk drive offline. If the drive is already offline, then there is no danger of bringing down the customer's operating system. Use the appropriate drive service manual to see how to replace the FRU.

SUMMARY

As you have seen, UDA50 problems generally appear in diagnostic printouts as SA register codes. These codes can then be checked in one of the tables found in the maintenance guide to find the faulty FRU. Drive problems appear in the error report without SA register error codes. Instead, the error report will print the real-time drive state code and the general status. When this happens, the drive maintenance guide or service manual should be consulted. These manuals give instructions on how to run the drive-specific diagnostics to identify the drive failure.

APPENDIX A

Table A-1 LED Error and Symptom Codes

M7485 LEDs 8 4 2 1		M7486 LEDs 8 4 2 1	Error Symptoms	Most Likely Failure
o o o ●		x x x x	Hex 1; undefined	Undefined
o o ● o		o o o o	Hex 2; microcode stuck in init step 2	M7485 or software
o o ● ●		o o o o	Hex 3; microcode stuck in init step 3	M7485 or software
o ● o o		o o o o	Hex 4; microcode stuck in init step 4 or UNIBUS timeout error	M7485 or host inactive
o ● o	BLINK	o o o o	Hex 4/5; test complete	No prob.
o ● ● o x x x x		x x x x o o o o	Hex 6; undefined	Undefined
o ● ● ● x x x x		x x x x o o o o	Hex 7; undefined	Undefined
● o o o		o o o o	Hex 8; wrap bit 14 set in SA register	M7485 or software
● o o ● o o o o		o o o o ● o o ●	Hex 9; board one error	M7485
● o ● o ● o ● o		o o o o ● o o ●	Hex A; board two error	M7486

Table A-1 LED Error and Symptom Codes (Cont)

M7485 LEDs 8 4 2 1	M7486 LEDs 8 4 2 1	Error Symptoms	Most Likely Failure
● o ● ●	x x x x	Hex B; undefined	Undefined
x x x x	● o ● ●		
x x x x	● ● o o	Hex C; timeout error check error code in SA register	Many causes
● ● o ●	x x x x	Hex D; RAM parity error	M7486
x x x x	● ● o ●		
● ● ● o	x x x x	Hex E; ROM parity error	M7485
x x x x	● ● ● o		
● ● ● ●	● ● ● ●	Hex F; sequencer error	M7485
Cycling Pattern	Cycling Pattern	None	No problem *
		The cycling pattern continues beyond the start of the initialization process. The UDA5Ø is not responding to the host CPU.	M7485

* The LEDs normally cycle while the UDA5Ø is waiting for the host system 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.

Note: o = LED ON o = LED OFF x = May be ON or OFF

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

Table A-2 SA Register Error Codes

Error Code (Octal)	Error Description	Most Likely FRU Failure
100001	UNIBUS packet read error	M7485*
100002	UNIBUS packet write error	7485*
100003	UDA ROM and 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*
100017	Interrupt write error on UNIBUS	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 SI 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
106047	U processor constant PROM error with D processor running SI 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

Table A-2 SA Register Error Codes (Cont.)

Error Code (Octal)	Error Description	Most Likely FRU Failure
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.

Table A-3 Real-Time Drive State Code Interpretation

RTDS HEX CODE	DESCRIPTION
0000	The drive is either in initialization or in an offline state.
0001	The drive is online. An error state may have been cleared recently or the drive may have spun down with the RUN/STOP switch in the out position.
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.
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 spin up.
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.

Table A-3 Real-Time Drive State Code Interpretation (Cont.)

RTDS HEX CODE	DESCRIPTION
8003	The drive is online and one of two conditions exist: 1. One of the switches on the drive operator control panel changes state. 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.

Table A-4 Status Byte Description

Status Byte	Bit Description
Byte 1	Response code field -- Byte 1 is the response code to a controller command.
Byte 2	Unit number -- This byte consists of two hexadecimal digits representing the unit number (Ø-254 decimal) of the selected disk drive returning the status.
Byte 3	Subunit mask -- The subunit mask is a four-bit code representing the subunit that is returning the status message. The right-most bit position represents subunit zero. The left-most bit position represents subunit three. Only one bit can be set at a time. UDA5Ø subsystems can only handle drives that can contain up to two subunits. Therefore, the valid numbers in this status byte can only be a hexadecimal one or two. Figure A-1 shows the bit layout. For drives that contain no subunits (for example , the RA8Ø), the right-most bit position is always set indicating subunit zero.
Byte 3	High unit number -- Byte 3 contains the upper four bits to a 12-bit (three hexadecimal digits) unit number. For a UDA5Ø subsystem, these bits should be zeros.
Byte 4	OA -- A logical one in this position indicates that the drive is unavailable to the UDA5Ø. A logical zero indicates that the drive is available to the UDA5Ø.
Byte 4	RR -- A logical one in this position indicates that the drive requires an internal readjustment. Some drives do not use this bit.
Byte 4	DR -- A logical one in this position indicates that there is a request for a diagnostic to be loaded in the drive microprocessor memory. A logical zero indicates that no diagnostic is being requested of the host system.
Byte 4	SR -- A logical one in this position indicates that the drive spindle is up to speed. A logical zero indicates that the drive spindle is not up to speed.

Table A-4 Status Byte Description (Cont)

Status Byte	Bit Description
Byte 4	EL -- A logical one in this bit position indicates that there is host software loggable information in the extended status area (bytes 9-15). A logical zero indicates that no information is available in the extended status area.
Byte 4	PS -- A logical one in this bit position indicates that the drive port select switch for this controller is pushed in (selected). A logical zero indicates that the switch is out (not selected).
Byte 4	RU -- A logical one in this position indicates that the RUN/STOP switch is pushed in (RUN). A logical zero indicates the switch is out (STOP).
Byte 5	W4-W1 -- Logical ones in any of these four bit positions represent the write-protect status for the subunit represented (for example, a ØØØ1 indicates subunit zero within the selected drive is write protected).
Byte 5	DD -- A logical 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.
Byte 5	FO -- A logical one in this position indicates that the drive can be formatted.
Byte 5	DB -- A logical one in this position indicates that the diagnostic cylinders on the drive can be accessed.
Byte 5	S7 -- A logical one in this bit position indicates the 576 byte/sector format is selected. A logical zero indicates that the 512 byte/sector format is selected.
Byte 6	DE -- A logical one in this position indicates that a drive error has occurred and the drive FAULT lamp may be on.

Table A-4 Status Byte Description (Cont)

Status Byte	Bit Description
Byte 6	RE -- A logical one in this position indicates that an error occurred in the transmission of a command between the drive and the UDA5Ø. The error could be a checksum error or an incorrectly formatted command string.
Byte 6	PE -- A logical one in this position indicates improper command codes or parameters were issued to the drive.
Byte 6	DF -- A logical one in this position indicates a failure in the initialization routine of the drive. Byte 8 of this status response now contains a drive-specific error code. Refer to the appropriate drive service manual for interpretation. A logical zero in this position indicates a successful completion of the initialization routine. Byte 8 then contains a number representing the amount of retries needed to successfully complete the previous operation.
Byte 6	WE -- A logical one in this position indicates a write-lock error has occurred.
Byte 7	S4-Sl -- This is a 4-bit code representing the subunits that have their attention available messages suppressed in the UDA5Ø. The right-most bit position represents subunit zero. The left-most bit position represents subunit three. A set S bit indicates that the UDA5Ø will not interrupt the system software whenever the subunit specified asserts the RTDS line. Normally, a drive asserting the RTDS line of the SDI bus causes an attention-available message to become asserted to the host CPU. The S4-Sl bits reflect the results of a change controller flags command in which attention-available messages are not desired for certain subunits.

Table A-4 Status Byte Description (Cont)

Status Byte	Bit Description
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. Code 0000 means a normal drive operation. Code 1000 means the drive is off line because it is under control of a diagnostic. Code 1001 means the drive is off line due to another drive having the same unit identifier (for example, serial number, drive type, class etc.).
Byte 8	RETRY COUNT/FAILURE CODE -- This eight-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; that is, a seek operation required fourteen retries to be successful. If a get status command is initiated, byte 8 contains the number 14. A set DF bit indicates that the drive initialization failed and, therefore, byte 8 now contains a specific drive error code. The meaning of this error code can be found in the appropriate drive service manual.

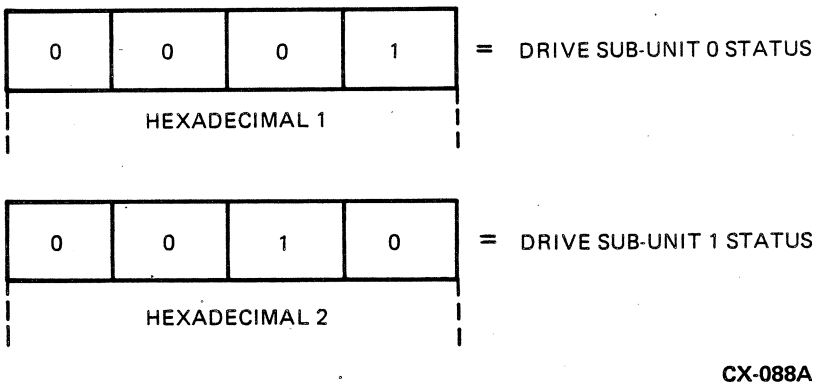


Figure A-1 Subunit Mask Bit Layout Examples

Table A-5 Subsystem Error Code List

Decimal Error Number	Description
EVRLA Host Error Messages	
	EVRLA Initialization Error Messages
1	Failed GETBUF routine
2	Error trying to read DM data file
3	Invalid program name found
4	Invalid DM program version
5	Failed RELBUF routine
6	Failed GETBUF routine
7	Error trying to read DM data file
8	Error trying to read DM data file
9	Failed to read P table
1Ø	Invalid controller encountered
11	Invalid controller encountered
12	Invalid UBA encountered
13	Selected devices are on multiple UNIBUS adapters
14	Duplicate controller address found
15	Duplicate controller vectors found
16	Failed to initialize channel adapter
17	Failed to clear UBA status
18	Failed to initialize device bus (UBA)
19	Failed to clear UNIBUS status
2Ø	Not enough memory to test units
21	Failed GETBUF routine
22	Failed SETMAP routine
	EVRLA Test 1 Host Error Messages
1	Failed to initialize device bus (UBA)
2	Failed to clear UBA status
3	Failed while checking UBA status
4	Error trying to address UDAIP
5	Failed while checking UBA status
6	Error trying to address UDASA
7	Failed to initialize device bus
8	Failed to clear UBA status

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
9	Step bit did not set UDASA register during initialization
1Ø	UDA resident diagnostic detected a failure
11	UDASA register failed to change during port loop diagnostic
12	Data comparison error during port loop test diagnostic
13	UDASA register failed to change during port loop diagnostic
14	Data comparison error during port loop test diagnostic
15	Failed to initialize device bus (UBA)
16	Failed to clear UBA status
17	Step bit did not set UDASA register during initialization
18	UDA resident diagnostic detected a failure
19	Channel services interrupt enable failure
2Ø	Channel services interrupt disable failure
21	UDA failed to interrupt
22	Unexpected interrupt encountered
23	Unknown interrupt encountered
24	Expected/received bus request (BR) levels do not match
25	Expected/received vectors do not match
26	Failed to initialize device bus (UBA)
27	Failed to clear UBA status
28	Failed to initialize device bus (UBA)
29	Failed to clear UBA status
3Ø	Failed to initialize device bus (UBA)
31	Failed to clear UBA status
32	Channel services interrupt enable failure
33	Channel services interrupt disable failure

EVRLA Test 2 Host Error Messages

1	Failed setmap routine
2	Failed to initialize device bus
3	Failed to clear UBA status
4	Channel services interrupt enable failure
5	Channel services interrupt disable failure

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
	EVRLA Test 3 Host Error Messages
1	Failed setmap routine
2	Failed to initialize device bus (UBA)
3	Failed to clear UBA status
4	Channel services interrupt enable failure
5	Channel services interrupt disable failure
	EVRLA Test 4 Host Error Messages
1	Failed setmap routine
2	Failed to initialize device bus (UBA)
3	Failed to clear UBA status
4	Channel services interrupt enable failure
5	Channel services interrupt disable failure
	EVRLA UDA Initialization Error Messages
100	Not enough free memory to test units selected
101	Step bit did not set in UDASA register during initialization
102	UDA resident diagnostics detected a failure
103	UDA did not return correct data in UDASA register during initialization
104	UDASA register did not go to zero after step 3 write of initialization
105	Step bit did not set in UDASA register during initialization
106	UDA resident diagnostics detected a failure
107	UDA did not return correct data in UDASA register during initialization
108	UDA did not clear ring structure in host memory

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
	EVRLA DUP Protocol Errors
200	Diagnostic machine (DM) program asked for data from unknown drive
300	Response packet from UDA does not contain expected data
401	Microcode reported M7485, M7486 that did not match get status response
402	Microcode reported unknown controller model
403	Response packet from UDA does not contain expected data
500	UDA reported a fatal error while loading DM program
501	UDA failed to interrupt
502	UDA reported a fatal error while waiting for get status response
503	UDA failed to interrupt
601	Unknown request received from DM program
602	DM program asked for data from unknown drive
603	Same as 602
604	Same as 602
605	Same as 602
606	Same as 602
607	Same as 602
608	Same as 602
609	Same as 602
610	No interrupt received from DM program
611	Fatal error while running DM program
612	Failed RELBUF routine
700	Failed GETBUF routine
701	Failed SETMAP routine
750	Failed GETBUF routine
	EVRLA Interrupt Handler Error Messages
800	Unknown interrupt encountered
801	Same as 800
802	Unexpected interrupt encountered

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
	CZUDC Host Error Messages
00001	I do not like the way you answered the hardware questions, UDA50 was given more than 1 vector, BR level, or burst rate
00002	I do not like the way you answered the hardware questions, two units select the same drive
00003	I do not like the way you answered the hardware question, more than eight drives selected on UDA
00004	Not enough room in memory to test the units selected
00005	Checksum error in DM program file
00006	Table inconsistency error, reload program
00007	Error in DM program file, DM program not found
00008	Two UDAs use the same vector
00009	Illegal configuration for test 4
00010	Wrong apt diagnostic is being used with this controller, use CIUDX
00013	Microcode reports controller model that did not match get status response
00020	Memory error trying to read UDA registers, check UNIBUS selection switches on UDA module M7485 or UNIBUS
00021	UDA resident diagnostic failure, replace M7486
00022	Step bit did not set in UDASA register, replace M7485
00023	UDA did not clear ring structure in host memory during initialization, replace M7485
00024	UDASA register did not go to zero after step 3 write of initialization, suspect either M7485 or the UNIBUS
00025	UDA did not return correct UDASA register information, replace M7485
00026	Data compare error port loop test, replace M7485
00027	Could not write to UDASA register, replace M7485
00028	UDA did not interrupt PDP-11, replace M7485
00029	UDA interrupted at different BR level, replace M7485

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
00030	UDA reported error in UDASA register list of UDASA codes
00031	Assume DM program hung
00032	Unknown request number in DM message buffer, suspect UNIBUS UDA or corrupted DM program
00033	Response packet from UDA does not contain expected data
00036	No interrupt received from UDA for 30 seconds
00037	UDA reports error in UDASA register
00038	Memory error trying to read UDASA register, check UNIBUS select switches on M7486, or UNIBUS, or replace M7485

Common Evrla and Czudc DM Program Error Messages

TEST 1 DM Error Messages

01000	A nonexistent host memory error
01001	Parity error on read from UNIBUS
01002	Memory location did not contain own address
01003	Nonexistent memory error trying to read from UNIBUS buffer
01004	Parity error on read from UNIBUS within buffer
01005	Data compare failed after read then write from UNIBUS
01006	UNIBUS addressing error

Test 2 DM Error Messages

02000	Host specified unit number can not be found
02001	Cannot receive valid drive state, check drive power
02002	Drive state received with bad parity
02003	Drive not asserting receiver ready
02004	Time-out on send of echo command to drive
02005	Echo during receive of echo response from drive
02006	Echo command responded with different data
02007	Error bit set in get status response after drive clear
02008	Time-out on send of online command to drive
02009	Error during receive of online response from drive
02010	Online command was unsuccessful

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
Ø2Ø11	Online command did not return expected response code
Ø2Ø12	Time-out on send of get unit characteristics command to drive
Ø2Ø13	Error during receive of get unit characteristics command
Ø2Ø14	Get unit characteristics was unsuccessful
Ø2Ø15	Get unit characteristics command did not return expected response code
Ø2Ø16	Host program gave DM code improper data
Ø2Ø17	Time-out on send of diagnose command to drive
Ø2Ø18	Error during receive of diagnose command response from drive
Ø2Ø19	Diagnose command was unsuccessful
Ø2Ø2Ø	Diagnose command did not return expected response code
Ø2Ø21	Drive diagnostic reports a hard error
Ø2Ø22	Host program downline loaded a diagnostic with zero byte count
Ø2Ø23	Diagnostic requested by drive could not be supplied by host
Ø2Ø24	Time-out on send of memory read command to drive
Ø2Ø25	Error during receive of memory read response from drive
Ø2Ø26	Memory read command was unsuccessful
Ø2Ø27	Memory read command did not return expected response code
Ø2Ø28	Time-out on send of memory write command to drive
Ø2Ø29	Error during receive of memory write command response from drive
Ø2Ø3Ø	Memory write command was unsuccessful
Ø2Ø31	Memory write command did not return expected response code
Ø2Ø32	Time-out on send of run command to drive
Ø2Ø33	Error during receive of run command response from drive
Ø2Ø34	Run command was unsuccessful
Ø2Ø35	Run command did not return expected response code
Ø2Ø36	Time-out on send of recalibrate command to drive
Ø2Ø37	Error during receive of recalibrate response from drive
Ø2Ø38	Recalibrate command was unsuccessful
Ø2Ø39	Recalibrate command did not return expected response code
Ø2Ø4Ø	Time-out on send of get status command to drive
Ø2Ø41	Error during receive of get status response from drive
Ø2Ø42	Get status command was unsuccessful
Ø2Ø43	Get status command did not return expected response code

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
Ø2Ø44	Time-out on send of drive clear command to drive
Ø2Ø45	Error during receive of drive clear command from drive
Ø2Ø46	Drive clear command was unsuccessful
Ø2Ø47	Drive clear command did not return expected response code
Ø5ØØØ	Unable to find requested drive for testing.

Test 3 DM Error Messages

Ø3ØØ1	Time-out on send of a level 2 command
Ø3ØØ2	Time-out of receive on get common characteristics command
Ø3ØØ3	First word received was not a start frame
Ø3ØØ4	Framing error on level Ø response
Ø3ØØ5	Checksum error on level Ø response
Ø3ØØ6	Response longer than expected
Ø3ØØ7	Code received from subsystem unintelligible
Ø3ØØ8	Command did not return expected response code
Ø3ØØ9	Drive not asserting receiver ready in drive state
Ø3Ø1Ø	Failed to receive valid drive state
Ø3Ø11	Can not receive drive state from drive check power
Ø3Ø12	Drive state received with bad parity
Ø3Ø13	No valid state from drive
Ø3Ø14	Subunit characteristics say there are zero read only groups in diagnostic area
Ø3Ø15	Subunit characteristics say less than 1 read/write groups in diagnostic area
Ø3Ø16	Neither read/write ready nor attention set after recalibration command
Ø3Ø17	Subunit characteristics say less than 1 diagnostic cylinder
Ø3Ø18	Read/write ready dropped before format operation
Ø3Ø19	Format operation reported time-out failure
Ø3Ø2Ø	After recalibration, error bits were set
Ø3Ø22	Read/write ready dropped before write operation
Ø3Ø23	Could not read or write any block on this track, write operation failure

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
Ø3Ø24	Read/write ready dropped before read operation
Ø3Ø25	Could not read or write any block on track, read operation failure
Ø3Ø26	Could not read or write any block on track, data compare word failure
Ø3Ø27	Seek complete time-out, read/write ready did not set
Ø3Ø28	No block on this track can be read, last block tried
Ø3Ø29	Available was not asserted after disconnect
Ø3Ø3Ø	Invalid command [aaaa] was successful
Ø3Ø31	Command with type length = A was successful
Ø3Ø32	Unit did not report transmission error
Ø3Ø33	Unit accepted an invalid group number from group select level 1
Ø3Ø34	Unable to correctly read overlay
Ø3Ø35	Successfully wrote in DBN area while drive was write protected
Ø5ØØØ	Unable to find requested drive for testing

Test 4 DM Error Messages

Ø4ØØ1	Attention asserted during seek error or loggable information
Ø4ØØ2	Attention asserted unexpectedly, asynchronous drive error or log
Ø4ØØ3	Seek did not complete, neither attention nor read/write ready asserted
Ø4ØØ4	RCT area corrupted, could not find replacement for RCT LBN
Ø4ØØ5	Header not found during write
Ø4ØØ6	Select track and write level 1 command not executed
Ø4ØØ7	ECC detected error
Ø4ØØ8	ECC detected error, but correction failed
Ø4ØØ9	ECC corrections exceeded threshold
Ø4Ø1Ø	ECC correction succeeded, but EDC detects error
Ø4Ø11	Error recovery tried all levels without success
Ø4Ø12	Data comparison failed, whether detected by ECC or EDC or not
Ø4Ø13	Drive not on line to UDA and not spinable
Ø4Ø14	Unable to complete seek, tried three times
Ø4Ø15	Seek required [retries] retries before completing

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
04016	Errors during drive initialization and setup
04017	No valid states from drive, no drive clocks
04018	Attempt to write on write protected drive error code from UDA
04019	Header not found during read
04020	Select track and read level 1 command not executed
04021	Drive not formatted in 512 byte mode
04023	Unable to continue testing, port switch out, or run/stop switch out, or spindle dropped ready
04024	EDC detected error, but ECC did not
04025	Write attempted maximum times
04026	Read attempted maximum times
04028	Both read only and write only bits set-host error
04033	Unable to correctly read overlay
04034	SERDES overrun error during read
04035	Data or state clock time-out during read
04036	Data synchronization time-out during read
04037	Read/write ready dropped during read
04038	Receiver ready dropped during read
04040	All copies of rct read with errors, LBN with header not found
04041	Could not find replacement for LBN that was revectored
04042	Time-out waiting for sector or index pulse
04044	Seek or head select error detected during write
04045	Seek or head select error detected during read
04047	Data or state clock timeout during write
04048	Read/write ready dropped during write
04049	Receiver ready dropped during write
04050	Operator error-beginning block number greater than ending number
04051	Operator error, the begin/end sets overlap
04052	Operator error, begin/end block number exceeds maximum
04053	Operator error, duplicate bad blocks
04054	Operator error, bad block number exceeds maximum
04055	Operator error, start cylinder greater than ending cylinder
04056	Operator error, random and sequential seek cannot be mixed

Table A-5 Subsystem Error Code List (Cont.)

Decimal Error Number	Description
Ø4Ø57	Operator error, overflow calculating the L/DBN from cylinder
Ø4Ø58	Operator error, track exceeds maximum for device, or group exceeds maximum for device.
Ø4Ø59	Operator error, two identical tracks or groups
Ø4Ø62	Operator error, cylinder too large dbn/lbn exceeds maximum
Ø4Ø63	Real time state received error during write
Ø4Ø64	Real time state received error during read
Ø4Ø68	Unknown error code during write
Ø4Ø69	Unknown error code during read
Ø4Ø7Ø	Timeout of send
Ø4Ø71	Timeout of receive
Ø4Ø72	First word received was not a start frame
Ø4Ø73	Framing error on level Ø receive
Ø4Ø74	Checksum error on level Ø receive
Ø4Ø75	Buffer size smaller than receive
Ø4Ø76	Response level 2 command not as expected
Ø4Ø77	Drive never deasserted receiver ready after send
Ø4Ø78	Unknown error code returned from level 2 receive
Ø5ØØØ	Unable to find requested drive for testing

Table A-6 Error Log Event Format Codes

Format Code			Format Description
Dec.	Octal	Hex	
Ø	Ø	Ø	Controller errors
1	1	1	Host memory access errors
2	2	2	Disk transfer errors
3	3	3	SDI errors

Table A-7 Error Log Message Flags

Bit set in high byte of word 4	Octal	Hex	Error Message Flag Description
7	2ØØ	8Ø	Operation successful flag
6	1ØØ	4Ø	Operation continuing flag
Ø	1	1	Sequence number reset flag

Table A-8 Error Log Status Event Codes

Hex Code	Octal Code	Description
Ø	Ø	Success
1	1	Invalid command
2	2	Command aborted
3	3	Unit off-line
4	4	Unit available
5	5	Media format error
6	6	Write protected
7	7	Compare error
8	1Ø	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 Ø)

2Ø	4Ø	Spin-down ignored
4Ø	1ØØ	Still connected
8Ø	2ØØ	Duplicate unit number
1ØØ	4ØØ	Already online
2ØØ	1ØØØ	Still online

Invalid Command Subcode (Hex 1)

1	1	Invalid message length

Command Aborted Subcode (Hex 2)

2	2	Not used

Unit Off-line Subcode (Hex 3)

Hex Code	Octal Code	Description
3	3	Unit unknown or online to another controller
23	43	No volume mounted or drive disabled via RUN/STOP switch

Table A-8 Error Log Status Event Codes (Cont.)

Hex Code	Octal Code	Description
43	1Ø3	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	2Ø3	Duplicate unit number
1Ø3	4Ø3	Unit disabled by field service or diagnostic. For SDI drives, the DD bit is set.
Unit Available Subcode (Hex 4)		
4	4	Not used
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	3Ø5	FCT corrupted Disk is not formatted or the FCT is corrupted.
1Ø5	4Ø5	RCT corrupted The RCT search algorithm encounters an invalid RCT entry.
125	445	No replacement block available
Write-Protected Subcode (Hex 6)		
1ØØ6	1ØØØ6	Unit is software write protected.
2ØØ6	2ØØØ6	Unit is hardware write protected.

Table A-8 Error Log Status Event Codes (Cont.)

Hex Code	Octal Code	Description
Compare Error Subcode (Hex 7)		
7	7	Not used
Data Error Subcode (Hex 8)		
8	1Ø	Sector written with "Force Error" modifier.
48	11Ø	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	15Ø	Data sync time-out Data sync is not found.
88	21Ø	Correctable error in ECC field A transfer encounters a correctable error in which only the ECC field is affected.
E8	35Ø	Uncorrectable ECC error A transfer encounters an ECC error that exceeds the correction capability of the subsystem's error correction algorithm.

Table A-8 Error Log Status Event Codes (Cont.)

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.
29	51	Odd transfer address
49	111	Odd byte count
69	151	Nonexistent memory error
89	211	Host memory parity error

Table A-8 Error Log Status Event Codes (Cont.)

Hex Code	Octal Code	Description
Controller Error Subcode (Hex A)		
A	12	Reserved for host command time-out 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.
6A	152	Inconsistent internal control structure Some high level check detects an inconsistent data structure. For example, a reserved field contains a non-zero 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.
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.

Table A-8 Error Log Status Event Codes (Cont.)

Hex Code	Octal Code	Description
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 that are 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 only is 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.
14A	512	PLI reception buffer parity error
16A	552	PLI transmission buffer parity error
		Drive Error Subcode (Hex B)
2B	53	Drive command time-out For SDI drives, the controller's time-out 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 (mis-seek) The drive reports that a seek operation is successful, but the controller has determined that the drive has positioned itself to an incorrect cylinder.

Table A-8 Error Log Status Event Codes (Cont.)

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 time-out.
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.

Table A-8 Error Log Status Event Codes (Cont.)

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, has 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 A-9 Controller Class Values

Class Byte (Decimal)	Subsystem Type
Ø	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 A-1Ø Controller Model Values

Model Byte (Decimal)	Controller Type
Ø	Reserved
1	HSC5Ø
2	UDA5Ø

Table A-11 Drive Model Number Values

Model Byte (Decimal)	Device	Model
1	RA8Ø	fixed disk drive
4	RA6Ø	removable disk drive
5	RA81	fixed disk drive

Table A-12 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 that the unit is hung
5	Disk unit size is too big (over pack cluster size 16)
6	Controller is off-line
7	Unit is not functional
10	Command timed out
12	Data error during read/write command

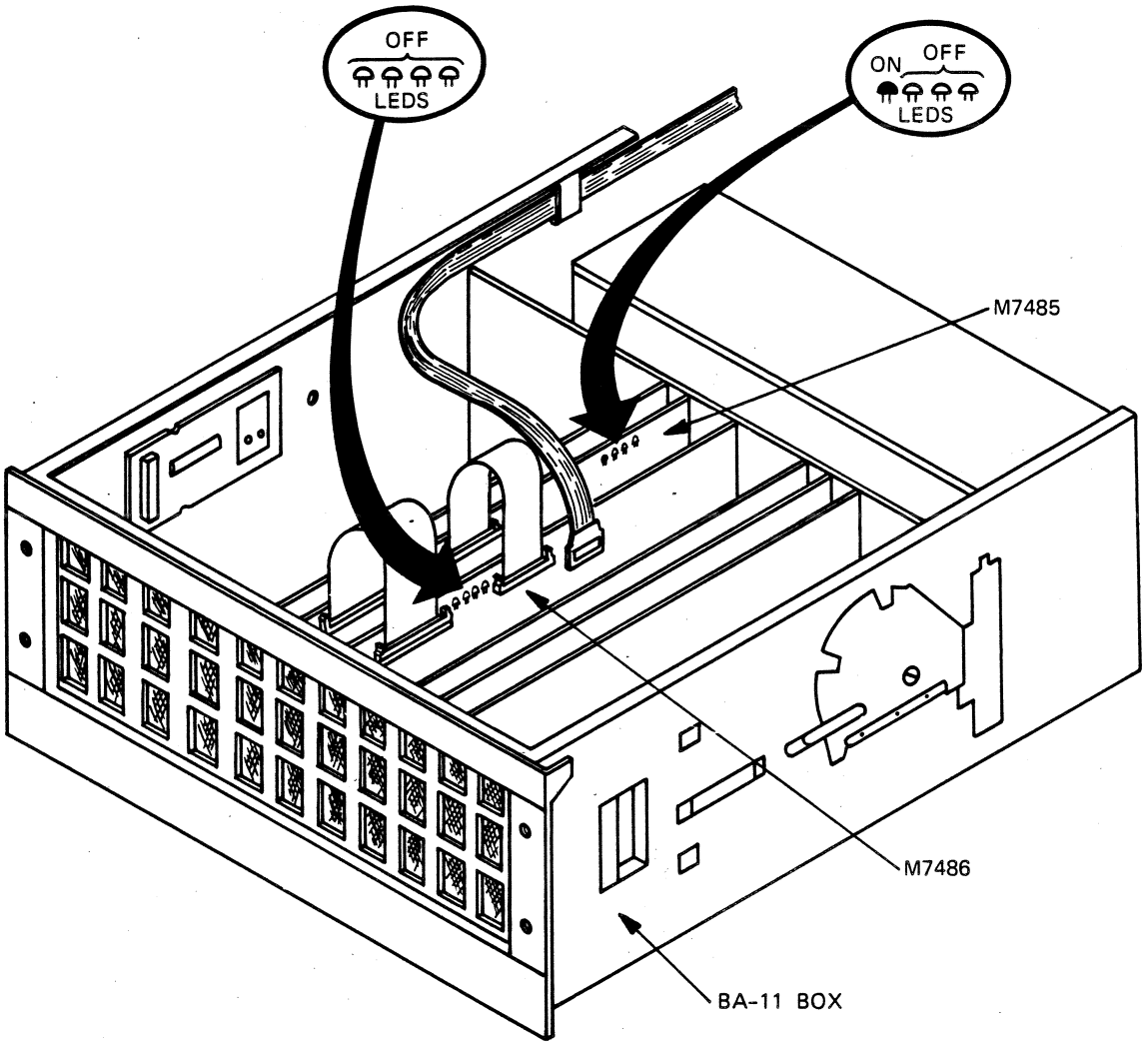
Table A-13 Status Code of the MSCP Packet

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 Øff-line	The unit identified in the "unit number" field is in the off-line 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.
Host buffer access buffer	The controller encounters an error, like UNIBUS time-out, 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".

UDA5Ø MAINTENANCE COURSE

The following questions pertain to interpreting error printouts and LED displays from the UDA5Ø. Answer the questions by checking the error code types in the appropriate table supplied in the course material.

1. The branch supervisor assigns you a UDA5Ø subsystem service call. At the site, open up the cabinet in which the UDA5Ø is mounted and note the following display.



CX-089A

What is the probable failure?

A. Hex 1; undefined error

B. Hex A; board 2 (M7486) error

C. Hex 8; SA register bit stuck. Replace M7485 module

D. Hex 1; normal indication. No problem exists.

2. After running diagnostics on a UDA50 subsystem, an error report is printed out that resembles the following:

```
CZUDCA0 DVC FTL ERR 00005 ON UNIT 01 TST 006 SUB 010 PC:
     067410
UDA INITIALIZE ERROR
UDA RESIDENT DIAGNOSTICS DETECTED FAILURE
UDA SA REGISTER = 100004
```

What is the probable FRU failure?

A. The error code of 0005 indicates a UDA ROM parity error; replace the M7485 module.

B. The SA register code of 100004 indicates a UDA RAM parity error; replace the M7486 module.

C. The microprocessor ALU failed; replace the M7486 module.

D. The UDA50-resident diagnostics detected a step two error.

3. On another service call, the diagnostics called out an error report that looks like the following:

```
CZUDCA0 DVC FTL 00160 ON UNIT 01 TST 004 SUB 003 PC:
061112
DATA COMPARISON ERROR DURING DIAGNOSTIC PORT LOOP TEST
                DATA SENT     : 140000
                DATA RECEIVED : 106200
```

What is the probable FRU failure?

A. The data received indicates a microprocessor ALU failure; replace the M7486 module.

B. Device fatal error 00160 indicates a microprocessor RAM buffer error.

C. A step 1 data error was called out; replace the M7485 module.

D. The read mode SERDES failed; replace the M7486 module.

4. Your fourth service call gives you no LED code nor are the UDA50 SA register contents indicated. You will only see the following:

```
CZUDCA0 HRD ERR 00062 ON UNIT 01 TST 004 SUB 010 PC:
061024
DISK EXERCISER DM PC: 2210 UDA AT 177510 DRIVE 020
RUNTIME
     0:00:16
ENTIRE RCT AREA SEARCHED, COULD NOT FIND RBN TO REPLACE
LBN WITH HEADER COMPARE ERROR
SEARCHING FOR LBN:  065

CZUDCA0 SFT ERR 00027 ON UNIT 01 TST 004 SUB 000 PC:
052055
DISK EXERCISER DM PC: 6100 UDA AT 177510 DRIVE 020
RUNTIME
     0:00:31
TIMEOUT OF DRIVE DURING WRITE ATTEMPT
WRITE ATTEMPT RETRIES:  0
L/DBN NUMBER  7000
ACTUAL L/R/DBN  0
TRK 3 GRP 1 CYL 14
ORIGIN OF LAST SEEK BY CYL 200 GROUP 1
REAL TIME DRIVE STATE 8000
STATUS:  0001  1100  0000  0A00  0010  0813  1014
```

What is the status of the drive as indicated by the real- time drive state code?

A. The drive is presently being initialized or is in an offline state.

B. The drive is in a drive available state and is not spinning.

C. The controller is unable to get a valid drive state.

D. The drive is in an invalid drive state.

5. Refer to the error printout in question 4. Which of the below answers correctly indicate the status of the subsystem as indicated by error printout bytes 4, 5 and 6?

A.
- Drive 14 has the RUN switch depressed.
- Drive 14 is up to speed.
- Drive 14 is disabled by the UDA50.

- Drive 14 has failed the initialization routine.

B. o Drive 14 has the RUN switch depressed.

o Drive 14 is not up to speed.

o Drive 14 has a write-lock error.

o Drive 14 FAULT light is on due to a drive error.

C. o The drive is up to speed.

o The drive is write-protected.

o The drive is not being formatted.

o The drive is in 512 byte/sector mode.

D. o The drive has a write-lock error asserted.

o The drive is not being formatted.

o The drive has the RUN switch depressed.

o The drive has its port select switch depressed.

6. After diagnosing the problem in question 4, what is the next step to be taken in troubleshooting the drive?

A. Run the drive-resident diagnostics to locate the problem. A bad drive is indicated.

B. Examine the SA register contents from the CPU front panel to determine a specific fault.

C. Replace the M7485 module.

D. Replace the M7486 module.

7. How many signal lines does each SDI cable contain?

A. Four

B. Five

C. Six

D. Seven

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