Model ODSS

Optical Disk Subsystem
(for GE Medical Systems)

Technical Manual

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REVISION HISTORY

ECO No.	Date	Description	Pages

PREFACE

This manual contains information regarding installation, testing, and operation of the ZETACO ODSS Optical Disk Subsystem. It has been written with the following assumptions in mind: 1) You have a working knowledge of Data General (DG) minicomputers, operating systems, and diagnostic and utility software; 2) you have access to full hardware and software documentation for your particular system; 3) you are familiar with standard installation, power, grounding, and peripheral cabling procedures; 4) you have access to full documentation for the magnetic and optical disks in the Optical Disk Subsystem.

The information in this manual is organized into four major sections:

SECTION 1.0 PRODUCT OVERVIEW - Describes the Optical Disk Subsystem features, capabilities, specifications, power, and interface requirements.

SECTION 2.0 INSTALLATION PROCEDURES - Describes and illustrates ;the procedures required to install the Optical Disk Subsystem.

SECTION 3.0 TROUBLE-SHOOTING - Contains information useful in analyzing subsystem problems, and how to get help.

SECTION 4.0 THEORY OF OPERATION - Describes how the subsystem works.

NOTE: For Programming Notes, please refer to the following DG document:

Programmer's Reference Series
Models 6236/6237 and 6239/6240 Disk Subsystems
DG Ordering Number: 014-701001

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1.0 PRODUCT OVERVIEW

1.1 GENERAL DESCRIPTION

The Optical Disk Subsystem (ODSS) is a digital data storage and retrieval system based on Write-Once Read-Many (WORM) optical disk technology. Data is stored on a removable, double-sided optical platter with an approximate capacity of one gigabyte per side.

The subsytem is composed of an Optical Disk Controller, a cached Optical Disk Drive that is both readable and writable, and up to three additional Optical Disk Drives that are read-only. The cached Optical Drive consists of an optical drive and a conventional Winchester magnetic disk drive, which is the cache itself.

The Controller pairs ZETACO's ARZ-1 emulation of the DG 6236/6239 disk subsystem with the SCSI peripheral interface on a single 15" x 15" 10-layer printed circuit board. Data transfers take place over the Burst Multiplexor Channel (BMC) on DG's Eclipse and MV Series computers.

ZETACO has designed a rack-mountable enclosure to house the magnetic drive and its power supply. The optical disk drives are also rack-mountable. All components are connected by a daisy-chain cabling system designed to meet FCC regulations.

1.2 FEATURES AND ADVANTAGES

* Single controller is compatible with DG's full range of BMC-equipped computers

* Simultaneous control of up to four optical disk drives, for a total of 4 gigabytes of accessible data

* Device code is easily selected, even after installation, via switches accessible at the board edge

* High speed dual-microprocessor design and BMC Ping-Pong buffering support maximum transfer rates with minimum controller latency

* On-board Self-test with error reporting and LED display

* Removable optical media, in the form of cartridges

* On-board Sector Scrub/Append allows data already stored on an optical disk to be "re-written"

* Magnetic disk cache minimizes need to scrub sectors

* Media management entirely resident on controller

* Disk-resident controller firmware for easy revision in the field

* User-friendly software configuration

1.3 SPECIFICATIONS

1.3.1 OPTICAL DISK CONTROLLER (ODC)

1.3.1.1 FUNCTIONAL -- GENERAL

Drives per Controller:	Up to 5 SCSI drives: 1 magnetic and up to 4 optical
Maximum Capacity:	4 Gigabytes: 1 GB Read/Write, 3 GB Read/Only
Transfer Rate:	Maximum SCSI burst rate of 1 MB/second
Indicator Lights:	Red (Left): Self-Test, SCSI Module Red (Right): Self-Test, HOST Module Yellow: CABLE Module Green (Left): SCSI Busy Green (Right): HOST Busy
Device Code Selection:	Switch-selectable

1.3.1.2 FUNCTIONAL - COMPUTER INTERFACE

DG Emulation:	6236/6239 Disk Subsystem
Bus Load:	1 unit load (any I/O slot)
Data Channel Interface:	Not supported

Burst Multiplexor Channel (BMC) Interface:

- less than 1 STTL load
- 64ma drive at 0.7v
- supports selectability of any of the 8 priority requests
- selectable burst rates of 1 to 256, 16-bit words/access
- selectable break between access of 1-256 sync clock periods
- Maximum allowable BMC latency is 30ms. To achieve maximum performance, system overhead (including BMC latency) should not exceed one disk sector time.
- supports transfer rates equal to the fastest available BMC computers (16.16 MB/sec)

1.3.1.3 FUNCTIONAL - DRIVE INTERFACE

Small Computer Systems Interface (SCSI):

- supports parity generation and checking
- supports disconnect/reconnect
- complies with "Common Command Set"

1.3.1.4 MECHANICAL

Dimensions:	15" x 15" x 1/2"
Shipping Weight:	10 pounds - includes controller, paddleboard, cables, Software Support Tape, and documentation

1.3.1.5 POWER REQUIREMENTS

+5 (+/- 5%) Volts DC @ 6.5 Amps typical

1.3.1.6 ENVIRONMENTAL

OPERATING ENVIRONMENT:

Temperature:	0 to +55 degrees C
Relative Humidity:	+10% to +90% (non-condensing)

NON-OPERATING ENVIRONMENT:

Temperature:	-45 to +115 degrees C
Relative Humidity	+10% to +90% (non-condensing)

Exceeds all Eclipse and Eclipse/MV temperature and humidity specifications.

1.3.2 MAGNETIC DISK DRIVE (MDD)

1.3.2.1 FUNCTIONAL

Control Data's WREN III SCSI Model 94161-156

For full product specifications, see CDC Product Specification #77738270.

1.3.2.2 MECHANICAL

Enclosure Dimensions:

Width:	19 inches
Height:	3.4 inches
Length:	15 inches

Shipping Weight: 32 pounds

1.3.2.3 POWER REQUIREMENTS

AC Input:	120 Volts +10%, -15%
Frequency:	47-63 Hz
Max. Operating Current:	1.3 Amps @ +5VDC 2.4 Amps @ +12VDC
Average Idle Current:	1.1 Amps @ +5VDC 1.5 Amps @ +12VDC
Max. Starting Current (Peak):	1.4 Amps @ +5VDC 4.5 Amps @ +12VDC
Fuse:	3 Amp Slo-Blo

1.3.2.4 ENVIRONMENTAL

OPERATING ENVIRONMENT:

Temperature:	+10 to +32 degrees C
Relative Humidity:	+10% to +90% (non-condensing)
Altitude:	-100 to +8000 ft

NON-OPERATING ENVIRONMENT:

Temperature:	-34 to +60 degrees C
Relative Humidity:	0% to +95% (non-condensing)
Altitude:	-100 to +10000 ft

1.3.3 OPTICAL DISK DRIVE (ODD)

Optical Storage International's LD 1200 Optical Disk Drive With SCSI

For full product specifications, see OSI Product Specification #Y075110023.

1.3.4 CABLING

1.3.4.1 INTERNAL

Paddleboard:	Passive backplane paddleboard with one 50-pin cable connector. ("A" backplane)
Cable:	50-conductor flat ribbon cable

1.3.4.2 EXTERNAL

Cables:

- 50-conductor shielded round cable connecting backpanel to ODD
- 50-conductor shielded round cable connecting ODD to MDD
- Optional 50-conductor shielded round cable(s) connecting additional ODDs.

The maximum cumulative cable length allowable for a fully populated subsystem is 6 meters (single-ended), or 19.68 feet.

2.0 INSTALLATION

2.1 BEFORE YOU BEGIN

This section contains the procedures necessary for proper installation of the ODSS. We recommend that you read through it once in its entirety before you begin.

The following sections, beginning with 2.2, are in order of execution. Sections 2.2 through 2.7 involve preparation and installation of the hardware components. Sections 2.8 through 2.11 describe the programs used to complete the installation. These programs are on the Software Support Tape, the 1/2" magnetic tape reel shipped with the ODSS.

You will need the following tools to install the ODSS:

1. A Phillips screwdriver
2. A set of nut drivers
3. A small straight-blade screwdriver
4. A large straight-blade screwdriver

You may also find a flashlight and needlenose pliers helpful for installing jumpers and the paddleboard in the computer backplane.

2.1.1 UNPACKING AND INSPECTION

The ODSS consists of the following parts:

QTY	DESCRIPTION	ZETACO P/N
1	Optical Disk Controller (ODC)	500-435-00
1	Magnetic Disk Drive Module (MDD)	850-007-00
1	Optical Disk Drive Module (ODD)	901-435-00
1	'A' Paddleboard	500-411-00
1	Internal Cable	300-148-00
1	External SCSI Cable 9'	300-152-03
1	External SCSI Cable 2'	300-152-04
2	BMC Bus Cables	300-038-00

In this procedure, we assume that you are installing an ODSS that has one optical drive.

Also shipped with the ODSS are:

1	Software Support Tape (9-track magnetic tape)	400-435-00
1	Technical Manual	600-435-00

Upon receipt of the ODSS from the carrier, inspect the shipping cartons immediately for any evidence of damage or mishandling in transit.

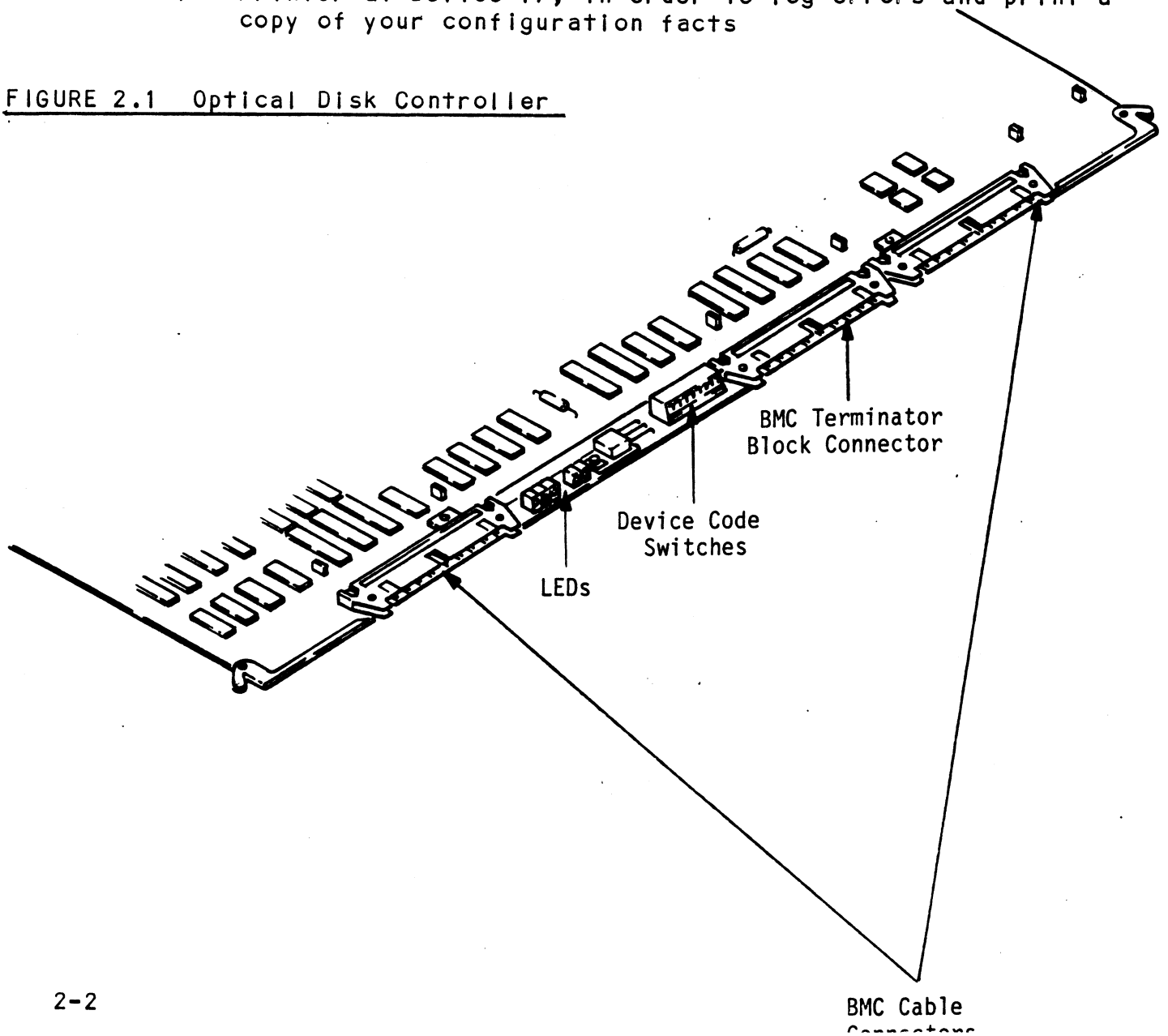
If the shipping cartons are water stained or damaged, contact the carrier and shipper immediately, specify the nature and extent of the damage and request that the carrier's agent be present when the cartons are opened.
ZETACO'S warranty does not cover shipping damage.

For repair or replacement of any ZETACO product damaged in shipment, call ZETACO to obtain return authorization instructions.

2.1.2 SYSTEM HARDWARE REQUIREMENTS

a) Eclipse or MV Family CPU with minimum 32K words memory
b) Magnetic Tape Subsystem
c) Magnetic Disk Subsystem with system disk(s)
d) Console on Device 10/11
e) Printer at Device 17, in order to log errors and print a copy of your configuration facts

FIGURE 2.1 Optical Disk Controller



2.1.3 THE SOFTWARE SUPPORT TAPE

The programs on the Software Support Tape have been written by ZETACO specifically for the ODSS. Use this tape to configure the Controller, format the magnetic disk, install Controller microcode onto the disk, and trouble-shoot the system.

NOTE: THIS TAPE CONTAINS YOUR ONLY PERMANENT COPY OF THE CURRENT REVISION OF THE ODSS MICROCODE.

The Software Support Tape is structured so that the programs on Files 2 through 5 can be loaded and executed directly from the tape. Each is a stand-alone program; this means that they do not need, and cannot have, an operating system running when they are executed.

Files 0 and 1 contain the software that enables you to boot from the tape and select the particular program you want to load into the system. The boot procedure is detailed in Section 2.8.

At several points in the installation procedure you will find sample dialogues for the programs. In these samples, the lines that the computer prints will be entirely in upper case letters. The sample user responses will be on the next line below, indented. The CARRIAGE RETURN response will be designated by "<cr>". Comments and suggestions, which do not appear in an actual session and are here provided for clarification, will be preceeded and followed by the characters "**".

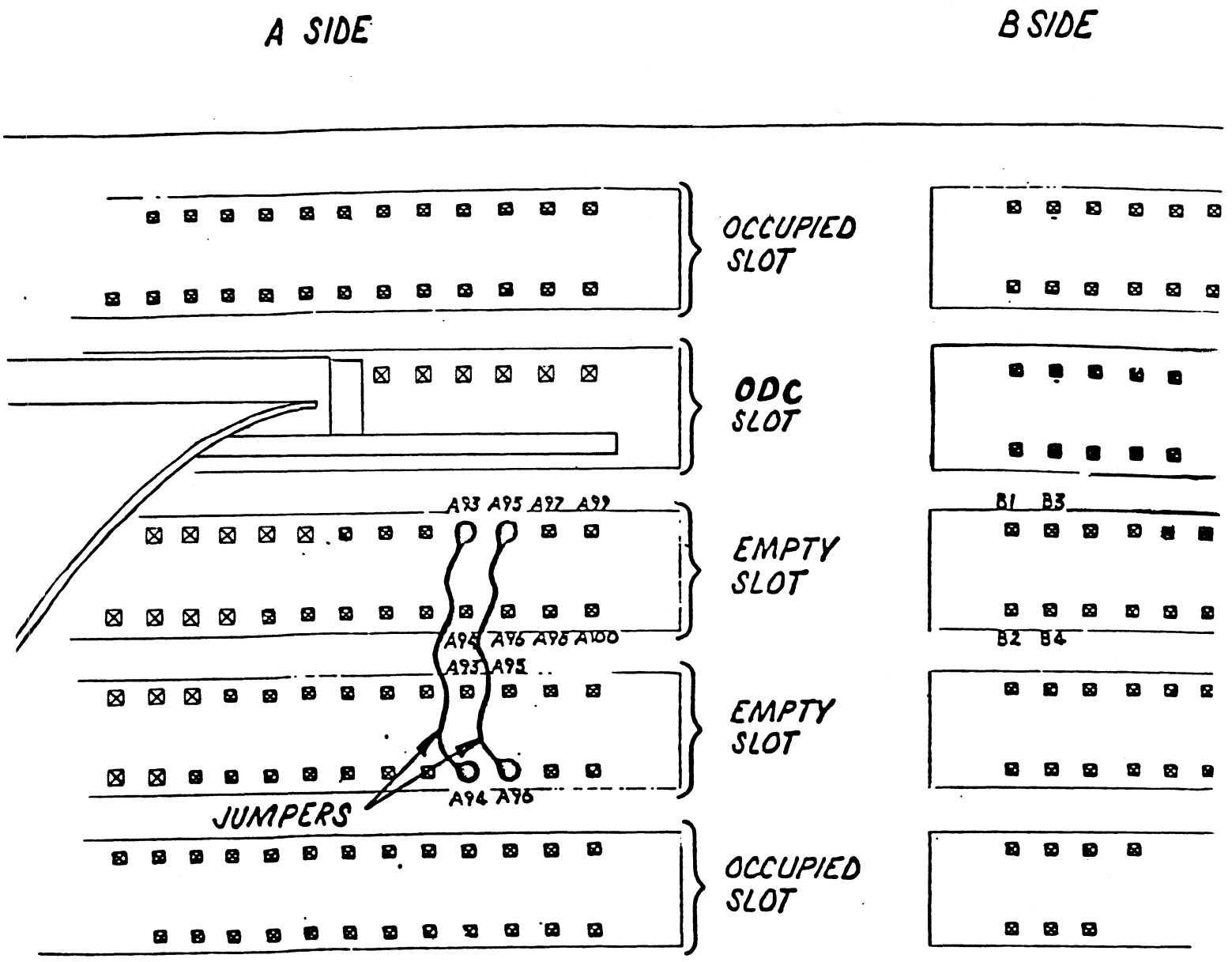
2.2 SELECT A SLOT FOR THE CONTROLLER

The ODC may be installed in any I/O slot. Consult the hardware manuals for your particular computer to identify the appropriate slots.

2.2.1 PRIORITY SELECTION

The Controller must receive two priority signals from the DG minicomputer backplane: DCH Priority In (Pin A94), and Interrupt Priority In (Pin A96). If there are vacant slots between the ODC and the processor, or between the ODC and another controller already installed in the chassis, jumper wires must be installed to obtain priority continuity. To "jumper across" unused slots, connect DCH Priority Out (Pin A93) to DCH Priority In (Pin A94) and Interrupt Priority Out (Pin A95) to Interrupt Priority (Pin A96). See Figure 2.2.

FIGURE 2.2 Backplane Priority Jumpers



2.3 INSTALL THE CONTROLLER

FIRST, BE SURE THE COMPUTER IS TURNED OFF. Pull the lock tabs on the two front corners of the board out as far as they will go. Next, carefully guide the Controller board into the I/O slot you selected in Section 2.2. When the board engages the backplane connectors, gently press the lock tabs in to provide insertion leverage. Use equal pressure on both lock tabs until the board seats firmly into the backplane connectors.

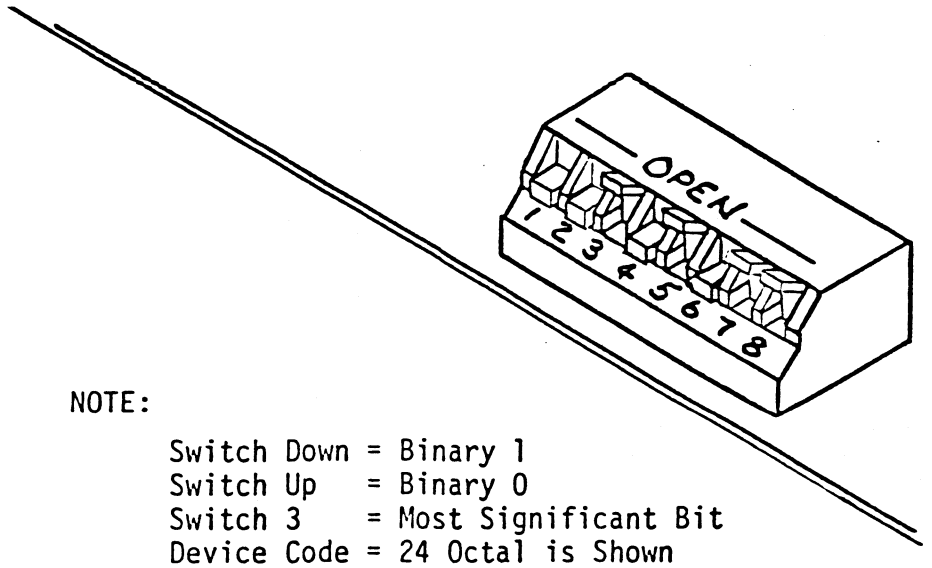
2.3.1 DEVICE CODE SELECTION

The recommended device code for the ODC is 24 (octal). However, any useable device code can be selected, as long as there is not already a controller in the system with that code.

There is a set of switches on the edge of the board that allows you to easily set the device code. Switches 3 through 8 specify device code. Switches 1 and 2 are reserved and should be placed in the "Down" position. Refer to Figure 2.1 and 2.3 for switch location and proper selection.

If, at a later date, you wish to change the device code for the Controller, you need not remove the board from the computer chassis. Simply set the switches accordingly and press RESET on the computer. The new device code will then be operative:

FIGURE 2.3 Device Code Switches



NOTE:

Switch Down = Binary 1
Switch Up = Binary 0
Switch 3 = Most Significant Bit
Device Code = 24 Octal is Shown

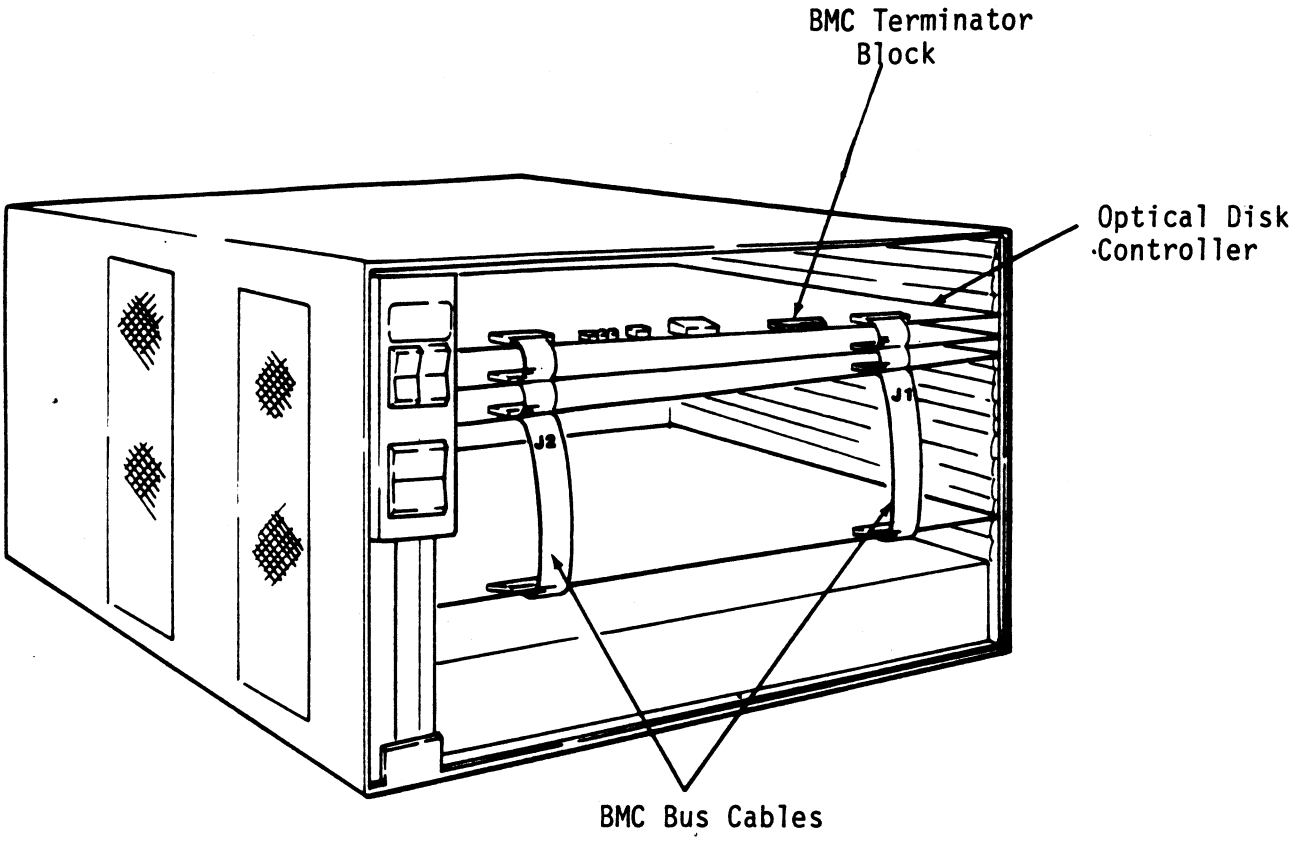
DEVICE CODE	S1 RESERVED	S2 RESERVED	S3 DS0	S4 DS1	S5 DS2	S6 DS3	S7 DS4	S8 DS5
0X			UP	UP	UP			
1X			UP	UP	DOWN			
2X			UP	DOWN	UP			
3X			UP	DOWN	DOWN			
4X			DOWN	UP	UP			
5X			DOWN	UP	DOWN			
6X			DOWN	DOWN	UP			
7X			DOWN	DOWN	DOWN			
X0						UP	UP	UP
X1						UP	UP	DOWN
X2						UP	DOWN	UP
X3						UP	DOWN	DOWN
X4						DOWN	UP	UP
X5						DOWN	UP	DOWN
X6						DOWN	DOWN	UP
X7						DOWN	DOWN	DOWN

2.3.2 BMC BUS CABLING AND TERMINATION

The two BMC bus cables daisy-chain from the computer's BMC interface board to the various BMC peripheral controllers, as shown in Figure 2.4. The controller at the end of the chain must have a BMC terminator block installed; the others must not. If the ODC is to be installed as the last (or only) BMC controller, then make sure the terminator block is installed in the appropriate header connector, located as shown in the figure. For another view of this connector, see Figure 2.1.

Install the BMC bus cables as shown in the figure by plugging the single-plug end of the cables into the DG BMC interface board, and the multiple-plug end of the cables into the ODC and other BMC peripheral controllers.

FIGURE 2.4 BMC Bus Cabling



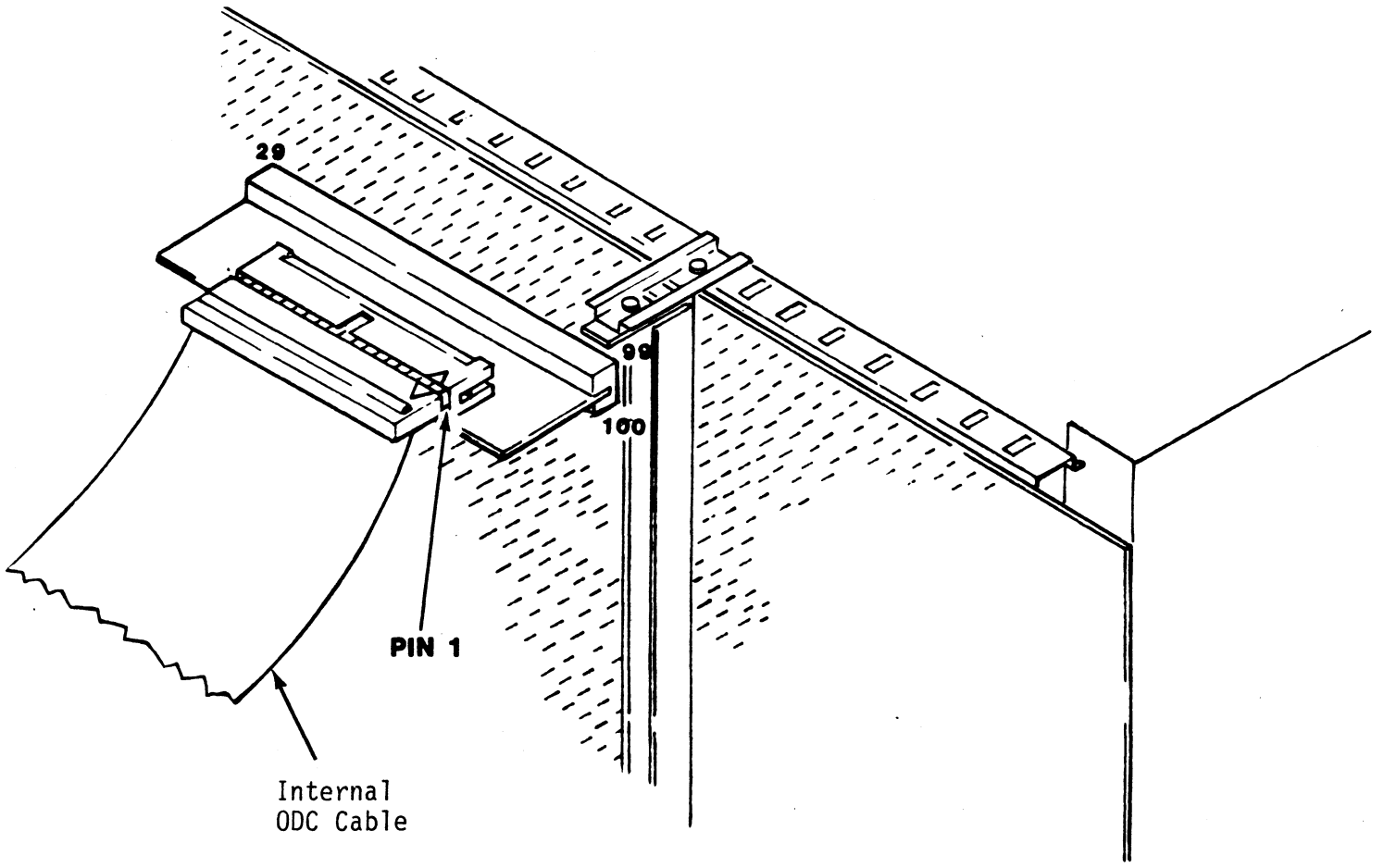
2.4 INSTALL THE PADDLEBOARD

The computer backplane, viewed from the rear, has the "A" side pins on the left. (On computers with vertically mounted circuit boards, the "A" side pins are on the top.)

Locate the two rows of pins on the "A" side of the backplane for the slot containing the Controller. Ensure that no pins are bent. Position the "A" paddleboard connector block so that it covers the pins on the right-most end of the rows (pins 29 through 100). Be sure that the header connector on the paddleboard is facing up. Press the connector securely over the pins, making sure all pins insert and do not bend, until the connector block is flush with the backplane. See Figure 2.5.

CAUTION: COMPONENT DAMAGE MAY OCCUR IF THE PADDLEBOARD IS MISALIGNED. MAKE SURE THE BLOCK IS NOT SHIFTED RIGHT OR LEFT. ALSO, MAKE SURE THAT THE BLOCK IS POSITIONED OVER THE CORRECT TWO ROWS OF PINS, AND NOT BETWEEN SLOTS. IT MAY BE NECESSARY TO COUNT PAIRS OF ROWS TO DETERMINE CORRECT POSITIONING.

FIGURE 2.5 Paddleboard and Internal Cable Installation



2.5 INSTALL THE MODULES IN THE CABINET

ZETACO recommends that the ODSS modules be installed one directly above the other in the system cabinet, with the ODD on the top. You will need approximately eleven inches of vertical space for the two modules. You can position the pair anywhere in the cabinet according to the dictates of your present configuration.

2.5.1 ODD INSTALLATION

ZETACO has provided a system of extendable slides for mounting the ODD in the system cabinet. There are two slide assemblies; each slide assembly in turn consists of a part that attaches to the vertical mounting rails in the cabinet and a part that attaches to the module itself. Also, for each slide assembly there are two L-shaped slotted-hole brackets. Mounting hardware is included.

To mount the ODD in the cabinet, follow the directions given in Section 2.3 of the OSI LD 1200 Customer User Manual.

2.5.2 MDD INSTALLATION

Like the ODD, there are two slide assemblies for each MDD (see Figure 2.6a). Again, each slide assembly consists of a part that attaches to the vertical mounting rails in the cabinet (the CABINET MEMBER) and a part that attaches to the module itself (the MODULE MEMBER). For the MDD, each slide assembly requires one L-shaped slotted-hole bracket for attaching the CABINET MEMBER to the rear vertical rails. Again, mounting hardware is included.

The MDD is shipped from the factory with the slide assemblies attached. To complete the installation of the module:

1. Attach the L-bracket to the rear end of each CABINET MEMBER. On the inside of each L-bracket there is a quarter-turn fastener that mates with a receptacle in the rear of the module. Insert this fastener and turn it so that the L-bracket is locked to the module. Then attach the L-bracket to the CABINET MEMBER using the supplied hardware. See Figure 2.6b and c. At this point, the screws should only be "finger tight."

2. Unlock the fasteners at the rear of the module and disconnect the CABINET MEMBER from the MODULE MEMBER of each slide assembly by fully extending the slides and then pressing the release clips in the side channels of the slides.

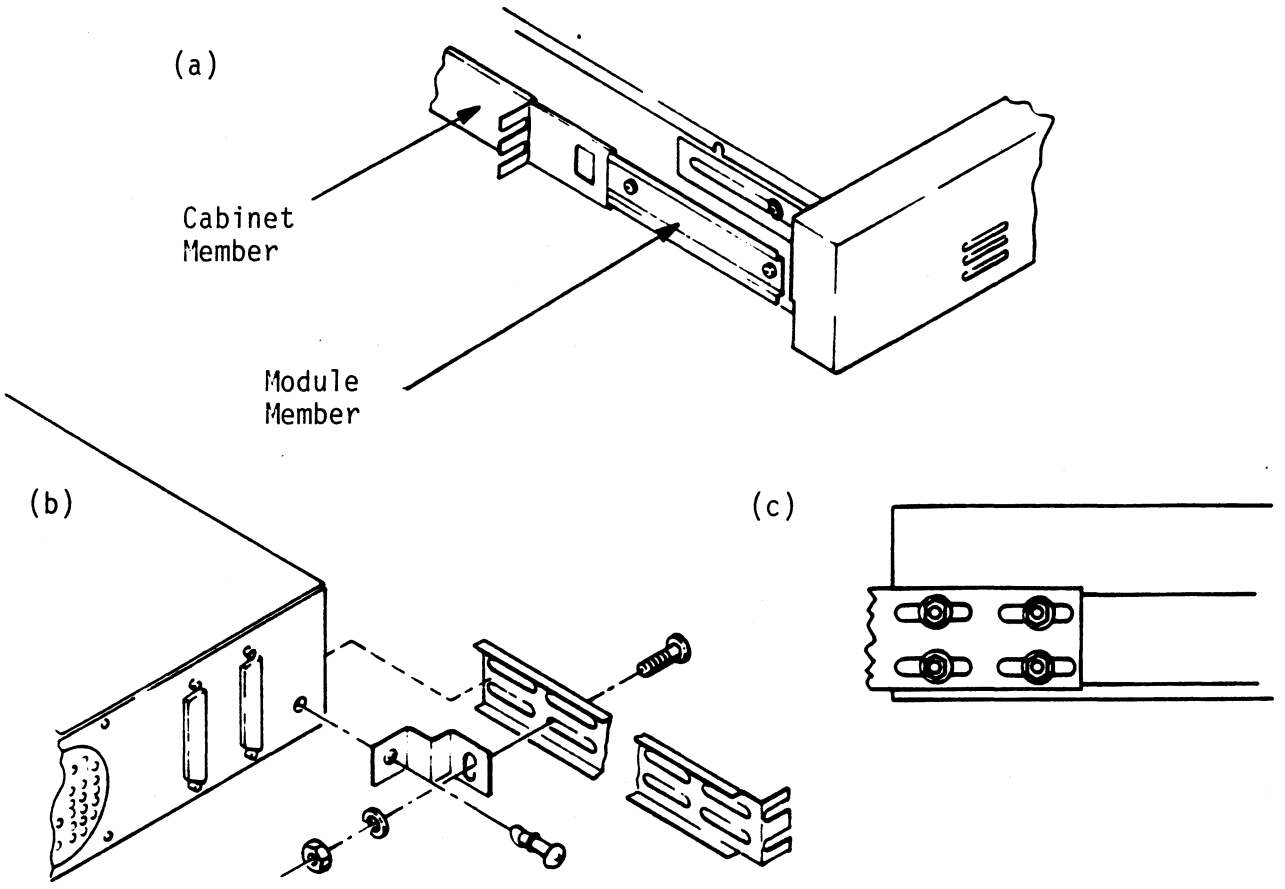
3. Mount the CABINET MEMBERS to the vertical rails on both sides of the cabinet, sliding the L-brackets forward or backward as necessary to span the distance between the front and rear rails. Leave the screws holding the CABINET MEMBERS to the vertical rails "finger tight," but at this time fully tighten the screws attaching the L-brackets to the CABINET MEMBERS.

4. Extend the slides of both CABINET MEMBERS until they have reached their maximum position. Lift the module and carefully guide the MODULE MEMBERS into the CABINET MEMBERS, adjusting the CABINET MEMBERS towards or away from the module as required to obtain accurate alignment. Slowly slide the module into the cabinet a few inches, taking care that the slides travel smoothly.

   When satisfied, and while CONTINUING TO SUPPORT MOST OF THE WEIGHT OF THE MODULE, fully tighten the CABINET MEMBERS to the vertical rails.

5. Slide the module fully into the cabinet and again be sure it travels smoothly. Finally, extend it fully, allowing its full weight to be supported by the slides. If all motion is free and easy, slide the module back into the cabinet and turn the fasteners in the back to lock the unit in place. The installation is now complete.

FIGURE 2.6 MDD Slide Assembly



2.6 CONNECT THE CABLES

The inter-module cabling scheme for the ODSS consists of two parts: an internal cable, and a set of external cables.

2.6.1 INTERNAL CABLING

The Internal Cable is a flat 50-conductor cable with a socket connector on one end and a "D" connector on the other. As shown in Figure 2.5, the socket connector plugs into the "A" paddleboard. The other end of this cable (the "D" connector) mounts on the computer bulkhead.

To mount the "D" connector on the bulkhead, first remove the cover from the desired mounting hole, and the hex bolts, washers, and nuts from the connector. Then, insert the connector into the hole in the bulkhead from the inside, insert the hex bolts from the outside, and secure the connector to the bulkhead.

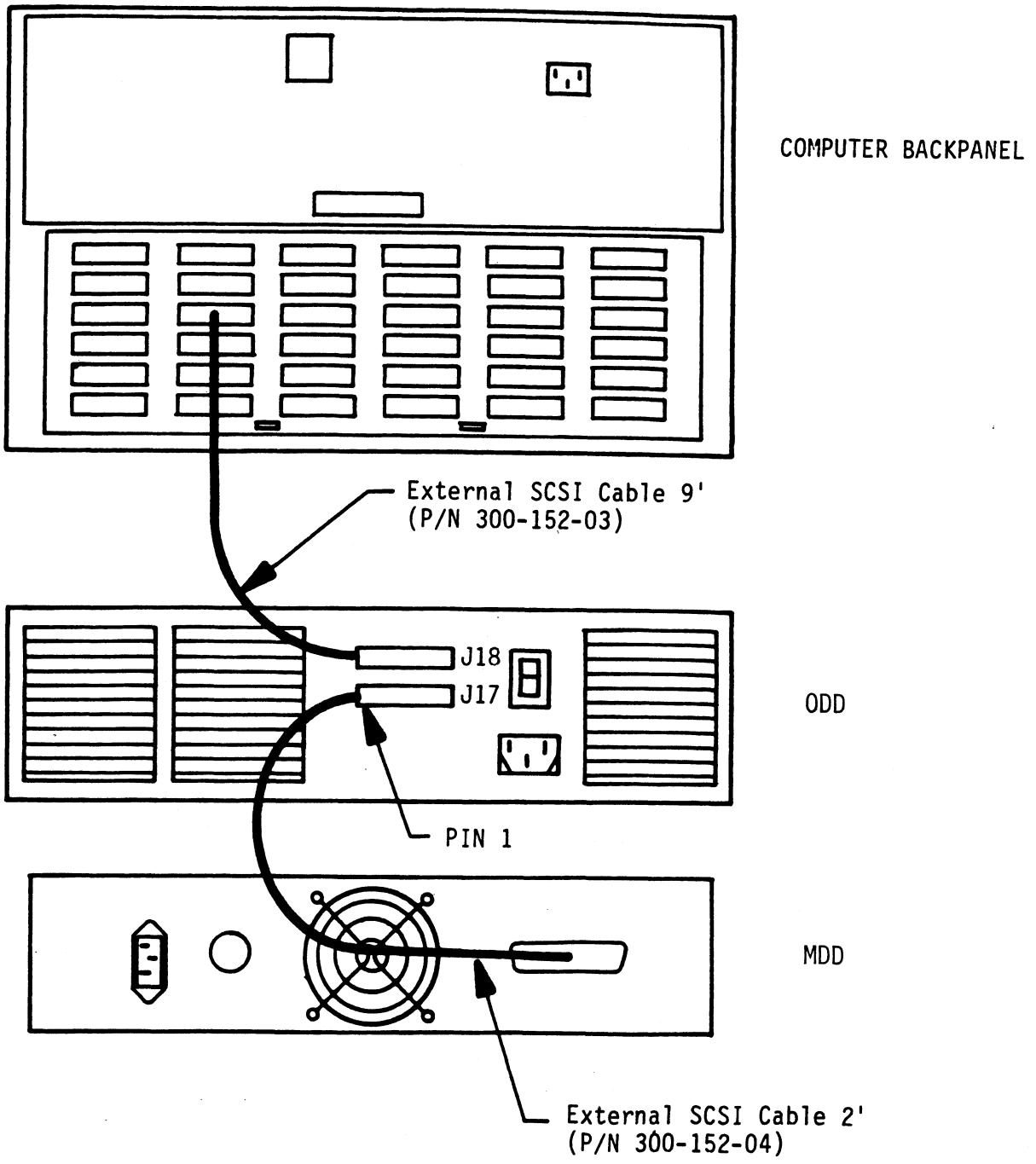
2.6.2 EXTERNAL CABLING

Two external cables, identical except for length, are required to operate the ODSS in its basic configuration. These cables, the External SCSI Cables, have at one end a 50-pin 'D' connector and at the other a 50-pin connector block. The 9' cable is connected from the computer bulkhead to the connector labelled "J18" on the rear panel of the ODD. The 2' cable is connected from "J17" on the rear panel of the ODD to the connector on the rear panel of the MDD.

Figure 2.7 illustrates this connection scheme. Be sure to observe the orientation of the connector block with respect to the location of pin 1.

If you are installing multiple ODDs at this time, see Appendix B for the expanded cabling scheme and additional drive preparations.

FIGURE 2.7 Cabling for ODSS with one ODD (Rear View)



2.7 POWER UP THE SUBSYSTEM

Begin the powerup sequence by turning on the drive modules. You will find ON/OFF rocker switches on the rear panel of the ODD and the front panel of the MDD; place both in the ON position. At this point, observe that 1) on the MDD, the switch itself is illuminated; 2) on the ODD, both the Device Address and Control Module lens caps are lit.

The MDD should now be spinning. It will take approximately 35 seconds for the disk to reach full rotational speed and become ready.

To spin up the ODD, insert a data cartridge and press the switch on the front panel labelled START/STOP. The unit will take approximately 3-4 minutes to reach operational speed and become ready. The LED imbedded in the START/STOP switch is the READY indicator; it will flash while the unit spins up, and remain steadily on when the unit becomes ready.

Once your drive modules have been turned on and are ready for operation, you can turn on the computer itself. After you press the computer's power switch, you will notice that the LEDs on the front edge of the ODC will be active. They are indicating the status of the board's automatic self-tests.

At the end of the sequence all LEDs should be off. This indicates that the ODC has successfully passed its self-tests and is ready to receive commands from the system.

If the LED sequence "hangs" with the yellow LED on, you may have forgotten to turn on your drive modules first. If so, turn them on in the manner described above. The ODC is actually waiting for a response from the drives; when the drives become ready, the LEDs will complete their sequence.

If any LEDs are still "hung", or if any are flashing, turn to Section 3, TROUBLE-SHOOTING.

2.8 BOOT THE SOFTWARE SUPPORT TAPE

The Bootstrap Procedure for the Software Support Tape is:

1. Mount the Software Support Tape on the drive and put it on-line. Be sure that the BPI setting matches that specified on the tape label.

2. Execute a "Program Load." The Program Load procedure is different for different computers. Consult the Operator's Manual for your computer to determine the correct one.

3. The Software Support Tape menu will be displayed:

```
FILE #          PROGRAM

 2              ODSS CONFIGURATOR
 3              ODSS DIAGNOSTIC
 4              ODSS UTILITY
 5              ODSS RELIABILITY
 6              ".SV" files in RDOS DUMP format

FILE NUMBER?

     2
```

** You should enter the number of the program you wish to execute. At this point in the installation procedure, we entered "2" to load the Configurator program. **

2.9 CONFIGURE THE ODC

The Configurator program has been given a "friendly" user interface. As the opening message of the program indicates, help is available on-screen for virtually all of the questions the program asks.

Once you have given the program the device code of your ODC (the octal number of the switch settings established in Section 2.3.1), the program will return with a request that you enter a command. This indicates that the system has successfully communicated with the Controller at that device code, and the Controller is ready to be configured.

If the system does not returned with a prompt, the system is unable to contact the Controller at that device code. If such is the case, turn everything off and double-check all of the preceeding installation steps. If, after doing so, you still have problems, contact ZETACO's Customer Support Hotline. See Section 3.7.

You may now continue on through the Configurator, using the HELP command whenever you need help.

2.10 FORMAT THE MDD

The data cartridges for the ODD require no special preparation before they are used, but you will need to format the media in the MDD.

To do so, boot the Software Support Tape and load file #4, the Utility program. We will first use the "I" option (INQUIRY THE DRIVE) to verify that we can communicate with the MDD. Then we will select the "A" option (DO ALL) to load the ODC's operating microcode onto the board from the tape, format the MDD, install the microcode onto the MDD, and install some RDOS system parameters.

WARNING: INSTALLATION OF THE MICROCODE ONTO THE MDD IS ESSENTIAL TO PROPER OPERATION OF THE SUBSYSTEM. DO NOT CHOOSE THE "B" OPTION (FORMAT MAGNETIC DISK) ALONE AT THIS TIME. SEE APPENDIX A, THE SUBSYSTEM UTILITY PROGRAM, FOR A DISCUSSION OF THE OTHER PROGRAM OPTIONS.

Use the sample dialogue below to guide you.

```
ODSSU - UTILITY FUNCTIONS FOR OPTICAL SUBSYSTEM
        REV. LEVEL = X.XX
        PRODUCT OF ZETACO

THIS PROGRAM CONTAINS THE UTILITY FUNCTIONS FOR AN ODSS OPTICAL
SUBSYSTEM.  IT REPLACES ALL STANDARD PROGRAMS WHICH PREPARE A
DISK FOR USE IN AN RDOS SYSTEM.  THE NATURE OF AN OPTICAL
PLATTER IS SUCH THAT THE STANDARD PROGRAMS WILL DESTROY THE
PLATTER AND SHOULD NEVER BE RUN.  THIS PROGRAM ALSO ALLOWS YOU
TO INITIATE THE PLATTER COMPLETION COMMAND.
PLATTER COMPLETION IS NECESSARY WHENEVER A PLATTER HAS BEEN
FILLED AND PREVENTS FURTHER WRITING TO THE PLATTER.

ENTER C TO CONTINUE:
     C
```

```
AVAILABLE FUNCTIONS ARE:

A - DO ALL:  FORMAT, INSTALL MICROCODE, DKINIT
B - FORMAT MAGNETIC DISK
C - INSTALL ARZ MICROCODE ON MAGNETIC DISK
D - INSTALL SCSI MICROCODE ON MAGNETIC DISK
E - INITIALIZE (DKINIT) THE MAGNETIC DISK
I - INQUIRY THE DRIVE
R - (RE)INITIALIZE CONTROLLER
P - PLATTER COMPLETION (PURGE OF MAGNETIC)
H - HELP
L - LOGGING TO PRINTER
Q - QUIT

CHOICE?

     I

ENTER DEVICE CODE FOR DISK CONTROLLER [24]

     <cr>
```

** The characters in brackets are the default response. To enter the default response we pressed <cr>. If our Controller had been at another device code, we would have entered that number instead. **

```
--CONTROLLER INIT ROUTINE
--INQUIRY COMMAND
ENTER UNIT NUMBER:

     3

- VENDOR ID IS CDC
- PRODUCT ID IS 94161-155
- PRODUCT REVISION LEVEL IS
ENTER C TO CONTINUE:
```

** This response indicates successful communication with the drive. Note that a product revision level may or may not be given. If you receive any other response, TURN EVERYTHING OFF and review all of the preceeding installation steps. If the problem persists, call the ZETACO Hotline (See Section 3.7). Since, in our sample we received the correct response, we now enter a "C" to go on to the DO ALL option. **

```
     C
```

```
AVAILABLE FUNCTIONS ARE:

A - DO ALL:  FORMAT, INSTALL MICROCODE, DKINIT
B - FORMAT MAGNETIC DISK
C - INSTALL ARZ MICROCODE ON MAGNETIC DISK
D - INSTALL SCSI MICROCODE ON MAGNETIC DISK
E - INITIALIZE (DKINIT) THE MAGNETIC DISK
I - INQUIRY THE DRIVE
R - (RE)INITIALIZE CONTROLLER
P - PLATTER COMPLETION (PURGE OF MAGNETIC)
H - HELP
L - LOGGING TO PRINTER
Q - QUIT

CHOICE?

     A

THIS FUNCTION WILL ERASE THE DATA CURRENTLY ON THE MAGNETIC
DISK.  YOU SHOULD ONLY RUN IT IF YOU DO NOT HAVE AN ACTIVE
PLATTER ASSOCIATED WITH THE MAGNETIC DISK.  ANY PLATTERS WHICH
HAVE BEEN "COMPLETED" ARE NOT ACTIVE.

ENTER Y IF YOU WISH TO PROCEED WITH THIS FUNCTION.

     Y

-- INQUIRY COMMAND
-- FORMATTING
-- INSTALLING
-- INSTALLING
-- INITIALIZING
-- ALL FUNCTIONS COMPLETE

ENTER C TO CONTINUE:
```

** Once you have answered all the questions in the DO ALL option, the entire series of operations will take approximately 15 minutes to complete. You can verify that the program is indeed operating by observing the LEDs on the front of the ODC; the right-most green LED (Host Busy) should be on. To exit from the program at this point, enter a "C" and select the "Q" (QUIT) option from the menu. **

```
AVAILABLE FUNCTIONS ARE:

A - DO ALL:  FORMAT, INSTALL MICROCODE, DKINIT
B - FORMAT MAGNETIC DISK
C - INSTALL ARZ MICROCODE ON MAGNETIC DISK
D - INSTALL SCSI MICROCODE ON MAGNETIC DISK
E - INITIALIZE (DKINIT) THE MAGNETIC DISK
I - INQUIRY THE DRIVE
R - (RE)INITIALIZE CONTROLLER
P - PLATTER COMPLETION (PURGE OF MAGNETIC)
H - HELP
L - LOGGING TO PRINTER
Q - QUIT

CHOICE?

     Q

YOUR MAGNETIC DISK HAS BEEN INITIALIZED AND SHOULD NOT NEED TO
BE INITIALIZED AGAIN, EXCEPT IN SPECIAL CIRCUMSTANCES.  SOME
CIRCUMSTANCES MIGHT BE:
     -INSTALLING A NEW MAGNETIC DISK IN THE SUBSYSTEM.
     -IF THE FORMAT OR SUBSYSTEM DATA ON THE MAGNETIC IS LOST.
     -TO UPDATE THE MAGNETIC DISK WITH A NEW REVISION OF
      FIRMWARE.
ALL OPTICAL PLATTERS ARE PREFORMATTED WHEN SHIPPED.  WHENEVER A
NEW PLATTER IS USED IN YOUR SYSTEM; YOU MUST ISSUE THE RDOS CLI
COMMAND:  INIT/F ONCE.  SUBSEQUENT REFERENCES TO THE PLATTER
ARE INIT.  BE CAREFUL NOT TO ISSUE INIT/F MORE THAN ONCE AS
THIS WILL DESTROY THE PLATTER.

The MDD is now prepared for operation.

WARNING:  DO NOT RUN DG'S DKINIT OR ZETACO'S CSDKINIT PROGRAMS.
          THESE PROGRAMS WILL WRITE SEQUENTIAL PATTERNS TO THE
          OPTICAL SUBSYSTEM AND WILL THUS RENDER THE WRITE-ONCE
          MEDIA USELESS.

If you encounter any problems, see Section 3, TROUBLE-SHOOTING.
```

2.11 VERIFY THE INSTALLATION AND INTRODUCE THE NEW RDOS DEVICE

The best way to verify that the ODSS has been successfully installed is to run the Reliability program on the subsystem for one half hour or more. While this is not required to begin full operation, we strongly recommend it, since it is preferable to identify and trouble-shoot problems before going fully on-line.

To run the Reliability program, boot the Software Support Tape and load file #5.

WARNING: MAKE SURE THE OPTICAL DRIVE IS WRITE-PROTECTED AT THIS TIME, SINCE YOU DO NOT INTEND TO PERFORM ANY WRITE TESTING ON IT.

Although the Reliability program provides a number of options for exercising the subsystem, at this point you can take a simple path through the program questions in order to run basic tests. Use the sample dialogue below to guide you.

For more information on the other options available in the Reliability program, see Section 3, TROUBLE-SHOOTING.

THE DISPLAY MODES ARE:
0 - OCTAL
1 - DECIMAL
2 - HEXADECIMAL
ENTER THE NUMBER OF YOUR CHOICE [0] (OCT):

<cr>

** The choice in brackets is the default response. To select the default response -- in this case "0", or Octal -- we simply pressed CARRIAGE RETURN (<cr>).

TIMEOUT IF DEVICE DOES NOT RESPOND ([YES],NO):
<cr>

ENABLE MAPPING (YES,[NO]);

<cr>

EXECUTION MODE:
[R]ANDOM RELIABILITY [S]EQUENTIAL RELIABILITY

ENTER YOUR CHOICE [R]:

<cr>

THIS CONTROLLER CAN BE RUN IN ONE OF TWO MODES. THE FIRST IS RUNTIME MODE. IN THIS MODE THE CACHEING SCHEME IS USED AND THE MAGNETIC DRIVE CANNOT BE ACCESSED DIRECTLY. ALSO, THE MICROCODE WILL BE READ FROM THE DISK SO IT MUST HAVE BEEN INSTALLED ON THE DISK PREVIOUSLY.
THE SECOND MODE IS THE MAINTENANCE MODE. IN THIS MODE THE CACHEING SCHEME IS NOT USED AND THE MAGNETIC CAN BE ACCESSED DIRECTLY. ALSO, THE MICROCODE MUST HAVE ALREADY BEEN DOWNLOADED ONTO THE CONTROLLER BY RUNNING THE "R" SELECTION IN THE UTILITY PROGRAM.
SHOULD THE CONTROLLER BE RUN IN THE RUNTIME MODE (YES,[NO]):
<cr>

```
ODSS RELIABILITY UTILITY
REV. X:XX

COMMAND LIST

[E]NTER A DEVICE              [D]ELETE A DEVICE
[S]TART A PROGRAM             [H]ALT A DEVICE
[R]ESTART THE PROGRAM         [L]IST ERROR TOTALS
[C]OMMAND LIST                [P]RINTER CONTROL
[B]SOFTWARE DEBUGGER          [F]LAGS
[Q]UIT

ENTER A COMMAND SELECTION:

     E

** This command allows you to enter into the program's "memory"
information about the device or devices you want to run.

ENTER THE DEVICE CODE: (OCT):

     24

** In this case, the program is telling you that it requires
that your response be in octal.  For this sample, we chose
device code 24. **

START INITIALIZATION OF CONTROLLER.
END INITIALIZATION OF CONTROLLER.
UNIT   0000    IS READY; SELECT (YES,[NO]):

     cr

** In Maintenance Mode (which you are now in) the program
identifies the ODD as Unit 0.  We will not test the ODD now.**

UNIT   0001    IS READY; SELECT (YES,[NO]):

     <cr>

UNIT   0002    IS READY; SELECT (YES,[NO]):

     <cr>

UNIT   0003    IS READY; SELECT (YES,[NO]):

     yes

THE SELECTED DISK IS THE MAGNETIC DISK.  YOU MAY WRITE AND READ
TO THIS DISK, BUT IF YOU REDUCE THE LOWER BLOCK LIMIT YOU WILL
LOSE DATA THAT IS ON THIS DISK IF IT IS "ACTIVE" OR NOT
"COMPLETE":
```

```
THE MINIMUM LOGICAL DISK BLOCK IS [400642] (OCT):

     0
```

** The default value is the start of an area on the disk designated as a maintenance area. Logical blocks below this point are used in Runtime Mode for current data. Since we have not yet put any data on the disk, and want to test the whole disk, we specified '0' as the minimum block. See Section 3.6, TESTING A DISK WITH DATA ON IT, for a more detailed discussion of the maintenance area. **

```
THE MAXIMUM LOGICAL DISK BLOCK IS [456437] (OCT):

     <cr>

WRITE ONLY (YES,[NO]):

     <cr>

READ ONLY (YES,[NO]):

     <cr>

VERIFY DATA ([YES],NO):

     <cr>

DATA TYPES
0-LOGICAL BLOCK ADDRESS     1-FLOATING ZERO
2-FLOATING ONE              3-ALTERNATE ZEROES (52525)
4-ALTERNATE ONES (125252)   5-ALL ZEROS
6-ALL ONES                  7-RANDOM (ONLY IN RANDOM REL)
8-ROTATING (125252)         9-RUN ALL PATTERNS
SELECT DATA TYPE [9] (DEC):

     <cr>

              ODSS RELIABILITY UTILITY
                    REV. X.XX

                   COMMAND LIST

[E]NTER A DEVICE            [D]ELETE A DEVICE
[S]TART A PROGRAM           [H]ALT A DEVICE
[R]ESTART THE PROGRAM       [L]IST ERROR TOTALS
[C]OMMAND LIST              [P]RINTER CONTROL
[B]SOFTWARE DEBUGGER        [F]LAGS
[Q]UIT
```

```
ENTER A COMMAND SELECTION:

     S

START ALL ENTERED DEVICES ([YES],NO):

     <cr>
```

** When the test is running, the green LEDs on the front of the Controller will be flashing in random patterns. **

```
                ODSS RELIABILITY UTILITY
                     REV. X:XX

                     COMMAND LIST

[E]NTER A DEVICE              [D]ELETE A DEVICE
[S]TART A PROGRAM             [H]ALT A DEVICE
[R]ESTART THE PROGRAM         [L]IST ERROR TOTALS
[C]OMMAND LIST                [P]RINTER CONTROL
[B]SOFTWARE DEBUGGER          [F]LAGS
[Q]UIT
ENTER A COMMAND SELECTION:

     L


STATUS LIST: RUN TIME  0. HRS    0. MINS.
DEVICE CODE 24 UNIT NUMBER03 MAPPING NOT ENABLED STATE:ACTIVE
MODES: MAINTENANCE; RANDOM, READ/WRITE, DATA CHECK-DO ALL
PATTERNS
BLOCKS WT    xx  BLOCKS RD    xx    TOTAL ERRORS         x

ENTER A COMMAND SELECTION:
```

** At any time while the program is running you can request a list of errors that may have been logged. **

To stop the test, select the "H" command. If you wish to obtain a hard copy of the error log, select the "P" command, and then the "L" command.

If you encounter errors while running the program, turn to Section 3, TROUBLE-SHOOTING. If not, or if you have chosen to skip the Reliability program, installation is now complete and you are ready to bring the ODSS on-line.

2.11.1 STORING THE SOFTWARE SUPPORT PROGRAMS ON YOUR SYSTEM DISK

The Software Support Tape contains a file (#6) that in turn contains the Configurator, Utility, and Reliability programs in .SV file format. Since this file is in the standard system DUMP format for RDOS, you can load the programs onto your system disk for quick access.

To load File 6, use the standard CLI commands for loading from tape:

```
DIR %MDIR%
INIT MT0
LOAD/A/R/V MT0:6
RELEASE MT0
```

NOTE: ALTHOUGH YOU NOW HAVE YOUR UTILITY PROGRAMS SAVED ON DISK, IT IS IMPORTANT TO RETAIN THE SOFTWARE SUPPORT TAPE. IT CONTAINS YOUR ONLY COPY OF THE CURRENT REVISION OF THE CONTROLLER MICROCODE.

3.0 TROUBLE-SHOOTING

The ODSS is supported by ZETACO in the following ways:

- Microprocessor-based Self-test of over 90% of the Controller each time it is powered up, with an LED status report;
- Utility programs on 9-track tape for use during installation and trouble-shooting.
- Customer Support Hotline, manned from 8:00 a.m. to 5:00 p.m. (Central Time) to answer your questions.
- Quick turnaround on subsystem components returned to the factory for repair or replacement.
- Warranties on workmanship and materials

3.1 SELF-TEST

SELF-TEST checks out 90% of all the internal functions of the Controller board once every time power is applied. SELF-TEST is actually composed of three independent modules, each of which is associated with an LED on the front of the board. The LEDs are grouped (three on the left, two on the right) according to which "side" of the board they are reporting on. See Figure 2.1.

SCSI Module:	Red LED -- Left
HOST Module:	Red LED -- Right
CABLE Module:	Yellow LED -- Left

The entire set takes one second to execute. If SELF-TEST has passed, all LEDs will go out.

If a failure was detected in either the SCSI or HOST Module, one or both red LEDs will blink a specific number of times; this number corresponds to the specific subtest that failed. If the CABLE Module fails, the yellow LED will remain steadily lit. If both red LEDs remain steadily lit, this indicates that the +5v supplied from the backplane is below 4.75v.

If a SELF-TEST failure occurs during initial installation of the subsystem; your first corrective action should be to TURN OFF THE COMPUTER, pull out the Controller, and re-install it as in Section 2.3. Once it is in place, press firmly on the lock tabs to be sure it is fully seated in the connectors.

If the failure re-occurs, record the failing subtest(s) and call the ZETACO Hotline to obtain a Return Materials Authorization (RMA). See Sections 3.7, 3.8, and 3.9 for further information.

If the failure is in the CABLE Module (the yellow LED), be sure that the MDD and ODD are turned on (see Section 2.7). If one or both are not on, turning them on now will clear the error in a matter of moments. If they are on, TURN EVERYTHING OFF and, referring to Section 2.6, check that all cable connections are correct and secure. If the problem persists, call the ZETACO Hotline.

The following tables detail the subtests for the SCSI and HOST Modules.

TABLE 3.1 HOST Module Error Codes

CODE	TEST	POSSIBLE FAILURE
1	RAM TEST	Data read from RAM did not compare with data written. RAM chips, ADR bus, SD bus, RAM EN, READ or WRITE problem.
2	HI-SPEED BUFFER 1	Data read from buffer 1 did not compare with data written. Buffer RAM chips, HS BUF EN, HS address counter, ADR bus, SD bus or B0 bus.
3	HI-SPEED BUFFER 2	Data read from buffer 2 did not compare with data written. Buffer RAM chips, HS BUF EN, HS address counter, ADR bus, SD bus or B1 bus.
4	DONE	The DONE flip-flop did not set or did not clear when told to. Flip-flop, ADR bus, SD bus, I/O decode or board received a START or a RESET during the test.
5	BURST COUNTER	Burst counters did not count correctly. Burst counters, ADR bus, SD bus, BMC logic or Burst count latch.
6	BREAK COUNTER	Break counters did not count correctly. Break counters, ADR bus, SD bus, BMC logic or Break count latch.

7	BMC CB TEST	Data read back from the BMC did not compare with data written. BMC logic or BMC cables.
8	SECTOR TRANSFER SIMULATION	Data read back from the BMC did not compare with data written. BMC logic or BMC cables.
9	EEPROM CHECKSUM	The checksum at the end of the EEPROM did not compare with the calculated checksum. EEPROM is bad or has been written to.
10	DUAL PORT RAM	Data read from dual port RAM B did not compare with data written to dual port RAM A. Dual port RAM chips or 80186 not running.
11	RESERVED	
12	RESERVED	
13	RESERVED	
14	ERROR CONDITION	Data parity or ECC error not successfully cleared. Test condition logic, data parity logic, 9520, or FW bus.

TABLE 3.2 SCSI Module Error Codes

CODE	TEST	FAILURE
1	RESERVED	
2	DYNAMIC RAM TEST	Data read from dynamic RAM did not compare with data written.
3	BMC DATA BUFFER	Data read from the BMC data buffer did not compare with data written.
4	DUAL PORT RAM	Data read from dual port RAM did not compare with data written.
5	5380 SCSI IC	Data read from 5380 internal register did not compare with data written, or a forced 5380 interrupt was not detected.
6	DYNAMIC RAM PARITY	DRAM parity error interrupt not successfully forced or cleared.
7	NOT USED	
8	NOT USED	

3.2 OPERATIONAL ERRORS REPORTED ON THE LEDS

Some error conditions that may occur while the board is executing normal commands are serious enough to require a suspension of operation. These errors will be reported on the left red LED. They are listed in Table 3.3. You can clear the error and resume operation by pressing the reset switch on the front panel of the computer.

Note that while codes 9 through 11 are indicative of possible hardware problems on the ODC, code 12 can be caused by simply having the ODD turned off. If this is the case, turn it on and press the computer reset switch to clear the error.

TABLE 3.3 Operational Error Codes

CODE	ERROR
9	BMC DATA BUFFER PARITY ERROR
10	DYNAMIC RAM PARITY
11	ILLEGAL INTERRUPT FROM HOST SIDE
12	UNABLE TO ISSUE MODE SELECT TO OPTICAL DRIVE

3.3 TROUBLE-SHOOTING AND RELIABILITY SOFTWARE

In addition to the diagnostic functions provided by the ODC's SELF-TEST, ZETACO provides two utility programs, the Reliability and Diagnostic. They have been specifically designed to help you verify the reliability of the subsystem and trouble-shoot any problems that may arise. These are stand-alone programs, which means that they do not need, and cannot have, an operating system running when they are executed. They have been written by ZETACO specifically for the ODSS. DG RELIABILITY, DIAGNOSTIC, AND MVSYSTEMX PROGRAMS WILL NOT WORK ON THIS SUBSYSTEM.

The Software Support magnetic tape included with the ODSS contains these programs, as well as a Configurator and Subsystem Utility. For a detailed discussion of the Subsystem Utility see Appendix A.

The Software Support Tape is structured so that the programs on Files 2 through 5 can be loaded and run directly from the tape. Files 0 and 1 contain the software that enables you to boot from the tape and select the particular program you want. The boot procedure is described in Section 3.3.1 below.

All of ZETACO's software has been designed to be as "user-friendly" as possible. Messages about many of the options and program features are displayed on-line, expected or possible responses are suggested, commands are shortened for quick entry. The discussion of the programs that follows is intended as a companion to your on-screen display.

At several points you will find sample dialogues. In these samples, the lines that the computer prints will be entirely in upper case letters. The sample user responses will be on the next line below, indented. The CARRIAGE RETURN response will be designated by "<cr>". Comments and suggestions, which do not appear in an actual session and are here provided for clarification, will be preceeded and followed by the characters "**".

3.3.1 BOOTING THE SOFTWARE SUPPORT TAPE

The Bootstrap Procedure for the Software Support Tape is:

1. Mount the Software Support Tape on the drive and put it on-line. Be sure that the BPI setting matches that specified on the tape label.

2. Execute a "Program Load." The Program Load procedure is different for different computers. Consult the Operator's Manual for your computer to determine the correct one.

3. The Software Support Tape menu will be displayed. You should enter the number of the program you wish to execute.

3.4 THE RELIABILITY UTILITY

This program is useful both as a subsystem exerciser, and as a trouble-shooting program. In Section 2.11 we used it as an exerciser, to verify that the installation was successful. In this section we will discuss the program operation in more detail, some ways to use its various options in trouble-shooting, and the ways it reports errors.

In order to run the program, the MDD must have been previously formatted, and the controller microcode must have been loaded onto the board. In Runtime mode this will happen automatically if you have installed the microcode on the MDD. If you haven't installed the microcode on the disk, or if you will be running in Maintenance Mode, you will need to issue the "R" command in the Subsystem Utility program to load microcode onto the board. See Appendix A.

3.4.1 GLOBAL PARAMETERS

These are the over-all operating conditions of the program under which the specific tests for each device must run. They are the display mode, timeout enable, mapping enable, program execution mode, and controller mode.

1. The DISPLAY MODE option allows you to select the numbering system in which some of your on-screen information will be displayed. Decimal numbers will be followed by a "." (eg., 5.). Octal numbers will not. Hex numbers will be either 4 or 8 digits long, and will include any required leading zeroes. However, when entering any number, you need not enter leading zeroes; when entering decimal numbers, you need not enter the ".".

   Note that whenever the program asks for a numeric response, the required numbering system is displayed in parentheses.

   Wherever the program asks for an input, it displays a possible response in brackets []. This is the default response, and is selected simply by entering a carriage-return or new-line.

2. The MAPPING features are defined in the DG Programmer's Reference Series: Models 6236/6237 and 6239/6240 Disk Subsystems.

3. The two PROGRAM EXECUTION MODES are Random and Sequential. Note that you cannot run random data patterns in your tests if you choose Sequential Mode.

Random Mode is primarily intended for exercising the subsystem. It is difficult to trouble-shoot with because it involves many variables. For example, CB commands are stacked and continue to execute even after the program halts to report an error. Therefore, if you were to enter the Debugger and examine the register contents, the reported values might not reflect the current state of the Controller.

Sequential Mode, on the other hand, offers a more tightly controlled environment.

4. The two CONTROLLER MODES are Maintenance and Runtime.

In Maintenance Mode:
Unit 0 = read/write optical disk
Unit 1 = read/write optical disk
Unit 2 = read/write optical disk
Unit 3 = magnetic disk

In Runtime Mode:
Unit 0 = cached read/write optical disk
Unit 1 = read/only optical disk
Unit 2 = read/only optical disk
Unit 3 = read/only optical disk

See Section 4, THEORY OF OPERATION, for more details.

3.4.2 THE COMMAND LIST

Basically, when you run the program, you:

1. select some global program parameters,
2. enter the devices you want to test and the test specifics for each of them,
3. run the tests, and
4. examine the status of each device.

The following is a complete list of available program commands, with comments where they are pertinent.

1. ENTER A DEVICE.

For each device the program will ask you to specify minimum and maximum logical block limits within which you want the program to operate. The default value reported for the maximum block will always be the highest useable logical block for that device. The default value for the minimum block is variable:

- In Runtime Mode it will be zero, or whatever you previously set it to.

- In Maintenance Mode, if your device is Unit 3 (the magnetic disk), it will always be the first block of the maintenance area of the magnetic disk. IF YOU HAVE DATA ON THE MAGNETIC DISK THAT YOU WANT TO PRESERVE, DO NOT CHANGE THE MINIMUM BLOCK TO SOMETHING LESS THAN THE DEFAULT. You can, of course, set it higher.

- In Maintenance Mode, if your device is any other unit (ie., an optical disk), it will be zero, or whatever you previously set it to.

The program will ask you if you want to read and/or write, and verify data. In Maintenance Mode, you can only write to your optical disk if you select Sequential testing. You can always read, but if you elect to verify, you must know what data pattern you'll be reading. If you want to test your optical disk in Maintenance Mode, see Section 3.4.3 on creating and using a Maintenance Platter.

In Maintenance Mode, the program reports each of the four allowable units (units 0-3) as ready and asks you to select, even though some of those units may not actually exist. In Runtime Mode, if a device does not exist, the program reflects this state of affairs by simply reporting the unit not ready.

If you try to select a device that isn't there, the program accepts the entry. However, when you try to run that device, the program will report errors. You will notice that the left-hand red LED (SCSI Module) is flashing Error Code 12 (see Table 3.3) and/or the right-hand Green LED (Host Busy) is solid on. To get out of this error condition you will have to press the CPU reset switch. When the monitor prompt appears, you can restart the program at 500.

If, after running for awhile, you want to enter another device, you will have to re-enter the devices you currently have along with the new one.

2. START A DEVICE

This command gives you the option of starting the test on all entered devices, or on any combination of them. The program does not verify that the tests are running, but simply returns to the command list. You can verify that they are running by 1) monitoring the drives and the Green LEDs on the Controller, and 2) doing a List command. This command will return a status report for each entered device (see below).

3. LIST ERROR TOTALS

The resulting display actually gives status information on the device as well as error totals. You can list a device at any time, whether it is running or not. This is useful if you wish to be sure you've entered only what you want entered. However, if you list a newly entered device before it has been run, the mode information displayed will be valid, but the run time, blocks written and read, and number of errors will not.

4. COMMAND LIST

5. HALT A DEVICE

You can halt any device or combination of devices without affecting testing on the other ones.

6. DELETE A DEVICE

Once a device is halted, you can delete it, even while other devices are running. Deleting one device does not affect testing on the other entered devices.

7. PRINTER CONTROL

8. RESTART THE PROGRAM

The important point to note about this command is that it completely re-initializes the program. You will have to select your operating mode, enter devices, and, if you want a printout, re-enable your printer.

9. FLAGS

Flags are, in effect, "switches" that allow you to alter the flow of the program depending on specific conditions encountered during execution.

The flag available in the Reliability program gives you the choice of whether to halt the program when an error is encountered, or simply log the error and continue with the test. If you choose the default response you will have chosen to log the error and continue. If you choose to halt, the program will do so, log the error, and jump to the Debugger.

The flag can be changed while the program is running.

10. SOFTWARE DEBUGGER

This is a useful tool for trouble-shooting software and hardware problems. You should have some familiarity with this type of program in order to use it effectively. A list of commands is available on request once you enter the Debugger. Besides entering through the command, you can also enter automatically when a program error occurs, if you set the Halt-on-Error Flag.

One useful command is the "IO" command, which allows you to issue individual PIO or CB commands to the Controller and observe the results. For details on the commands themselves, consult the DG Programmer's Reference Series Models 6236/6237 and 6239/6240 Disk Subsystems.

For PIO commands that do not transfer data to or from memory (eg., Unit Status or Reset) you do not need to do any more than issue the command. For ones that do, you must first be sure the board has been initialized, and then determine where in memory you will be working.

The board is initialized by doing 1) a Reset command, 2) a Begin command, and 3) a Set Mapping command. If you have been running for awhile, you have already initialized the controller. If you entered the Debugger right after loading the program, you must first go back and do an "Enter" command. Answer "no" to every unit. The board will now be initialized.

To find available memory workspace, exit the "IO" command and type "MM" (Examine-modify Memory). The program will now wait for you to enter a specific memory location. Enter "BUFF". This response takes you to the area set aside by the program as a data buffer. The address reported back is the first address of the buffer area. The last address is 71777 (oct). Use this address space for your data transfers.

For CB commands, you must first create the CB or CBs in your buffer area. Also, if you will be returning data to memory, be sure to designate addresses after your CB list or the list may be overwritten.

11. QUIT

3.4.3 THE MAINTENANCE PLATTER

Since optical platters are write-once media it is impractical to use them for random write testing. Furthermore, unless you know the data previously written to a platter, even read testing is limited. Nevertheless, it is desirable to be able to test the read and write functionality of your drives.

The solution is to dedicate a platter to read/write testing and manage it in such a way as to maintain strict control over its usage. We will call such a platter the Maintenance Platter.

The key to proper management of the Maintenance Platter is the Platter Log. This is actually a map of how the available space on the platter is used. We will allocate a certain portion to write testing and another portion to read testing. Each time we write data to the write area we will update the log to show the remaining space available for future writes. Precise segments of the read space will be further allocated to specific data patterns.

Table 3.4 shows a sample Platter Log. The maximum number of usable logical disk blocks on this optical platter is 1958271 (dec). We chose to allocate approximately 50% to write space, 1% to small blocks of a variety of data patterns, and another 49% to larger blocks of the same patterns.

TABLE 3.4 Sample Platter Log

```
------------------------------ USED-------------
WRITE SPACE:  0-979135         0 - 120203
-----------------------------------------------
-----------------------------------------------
SMALL READ PATTERNS:  SIZE 2392 EACH
-----------------------------------------------
0 LOGICAL BLOCKS                 979136 - 981527
1 FLOATING ZERO                  981528 - 983919
2 FLOATING ONE                   983920 - 986311
3 ALTERNATE ZEROS (52525 OCT)    986312 - 988703
4 ALTERNATE ONES (125252 OCT)    988704 - 991095
5 ALL ZEROS                      991096 - 993487
6 ALL ONES                       993488 - 995879
7 ROTATING (125252 OCT)          995880 - 998271
-----------------------------------------------
-----------------------------------------------
LARGE READ PATTERNS:  SIZE 120000 EACH
-----------------------------------------------
0 LOGICAL BLOCKS                 998272  - 1118271
1 FLOATING ZERO                  1118272 - 1238271
2 FLOATING ONE                   1238272 - 1358271
3 ALTERNATE ZEROS (52525 OCT)    1358272 - 1478271
4 ALTERNATE ONES (125252 OCT)    1478272 - 1598271
5 ALL ZEROS                      1598272 - 1718271
6 ALL ONES                       1718272 - 1838271
7 ROTATING (125252 OCT)          1838272 - 1958271
```

To create a Maintenance Platter, you MUST be in the Sequential execution mode, and the Controller must be in Maintenance Mode. The sample dialogue below will guide you in beginning to set up your platter.

```
THE DISPLAY MODES ARE:
          0 - OCTAL
          1 - DECIMAL
          2 - HEXADECIMAL

ENTER THE NUMBER OF YOUR CHOICE [0] (OCT):

          1

**  We chose decimal because the Platter Log in Table 3.4 is in
decimal.  **

TIMEOUT IF DEVICE DOES NOT RESPOND ([YES],NO):

          <cr>
ENABLE MAPPING (YES,[NO]);

          <cr>
```

```
EXECUTION MODE:
        [R]ANDOM RELIABILITY
        [S]EQUENTIAL RELIABILITY

ENTER YOUR CHOICE [R]:

        S

    THIS CONTROLLER CAN BE RUN IN ONE OF TWO MODES.  THE FIRST
IS RUNTIME MODE.  IN THIS MODE THE CACHEING SCHEME IS USED AND
THE MAGNETIC DRIVE CANNOT BE ACCESSED DIRECTLY.  ALSO, THE
MICROCODE WILL BE READ FROM THE DISK SO IT MUST HAVE BEEN
INSTALLED ON THE DISK PREVIOUSLY.
    THE SECOND MODE IS THE MAINTENANCE MODE.  IN THIS MODE THE
CACHEING SCHEME IS NOT USED AND THE MAGNETIC CAN BE ACCESSED
DIRECTLY.  ALSO, THE MICROCODE MUST HAVE ALREADY BEEN
DOWNLOADED ONTO THE CONTROLLER BY RUNNING THE "R" SELECTION IN
THE UTILITY PROGRAM.
SHOULD THE CONTROLLER BE RUN IN THE RUNTIME MODE (YES,[NO]):

        <cr>

            ODSS RELIABILITY UTILITY
                  REV. X.XX

                  COMMAND LIST

[E]NTER A DEVICE                [D]ELETE A DEVICE
[S]TART A PROGRAM               [H]ALT A DEVICE
[R]ESTART THE PROGRAM           [L]IST ERROR TOTALS
[C]OMMAND LIST                  [P]RINTER CONTROL
[B]SOFTWARE DEBUGGER            [F]LAGS
[Q]UIT

ENTER A COMMAND SELECTION:

        E

ENTER THE DEVICE CODE [24] (OCT):

        <cr>

START INITIALIZATION OF CONTROLLER.

END INITIALIZATION OF CONTROLLER.
UNIT   0000    IS READY; SELECT (YES,[NO]):

        yes

THE SELECTED DISK IS AN OPTICAL DISK.  YOU MAY WRITE (SEQ.
RELI) AND READ TO THIS DISK, BUT YOU SHOULD NOT ATTEMPT TO
WRITE TO THE SAME AREA ON THE DISK MORE THAN ONCE.
```

```
THE MINIMUM LOGICAL DISK BLOCK IS [0000] (OCT):

          979136

** Refer to Table 3.4. We are going to leave blocks 0-979135
blank for future writing, so at this point we designate the
start of our first small read pattern. **

THE MAXIMUM LOGICAL DISK BLOCK IS [617577] (OCT):

          981528

ON THE OPTICAL DISK IN MAINTENANCE MODE THE UPPER BLOCK ADDRESS
MUST BE AN ODD NUMBER

THE MAXIMUM LOGICAL DISK BLOCK IS [617577] (OCT):

          981527

** Since we previously decided each of these pattern spaces
would be 2392 blocks, we first added 2392 to 979136 to get our
maximum block. However, because of the way disk blocks are
organized on the platter, the upper block MUST be an odd
number. Therefore, we must add the number of blocks we want
MINUS 1 (2392 - 1 = 2391). Now, 979136 + 2391 = 981527. The
resulting number matches what is in our Platter Log. Note also
that the lower block MUST be even. **

WRITE ONLY (YES, [NO]):

          <cr>

** Since we are primarily concerned at this point with getting
our data patterns out on the disk, we could have answered yes.
If we had, the next question would have been the verify
question. **

READ ONLY (YES, [NO]):

          <cr>

VERIFY DATA (YES,[NO]):

          yes

** We do this to be sure that we are writing good data onto
the platter. **
```

```
DATA TYPES
0-LOGICAL BLOCK ADDRESS          1-FLOATING ZERO
2-FLOATING ONE                   3-ALTERNATE ZEROES (52525)
4-ALTERNATE ONES (125252)        5-ALL ZEROS
6-ALL ONES                       7-RANDOM (ONLY IN RANDOM REL I)
8-ROTATING (125252)              9-RUN ALL PATTERNS
SELECT DATA TYPE [0.] (DEC):

          <cr>

**  This is the first data pattern, according to our log.  **

UNIT 0 IS SELECTED
UNIT   0001    IS READY; SELECT (YES,[NO]):

          <cr>

UNIT   0002    IS READY; SELECT (YES,[NO]):

          <cr>

UNIT   0003    IS READY; SELECT (YES,[NO]):

          <cr>


              ODSS RELIABILITY UTILITY
                    REV. X.XX

                   COMMAND LIST

[E]NTER A DEVICE                 [D]ELETE A DEVICE
[S]TART A PROGRAM                [H]ALT A DEVICE
[R]ESTART THE PROGRAM            [L]IST ERROR TOTALS
[C]OMMAND LIST                   [P]RINTER CONTROL
[B]SOFTWARE DEBUGGER             [F]LAGS
[Q]UIT
ENTER A COMMAND SELECTION:

          S
START ALL ENTERED DEVICES ([YES],NO):

          <cr>

STATUS LIST: RUN TIME  0. HRS    0. MINS.
DEVICE CODE 24 UNIT NUMBER00 MAPPING NOT ENABLED STATE:HALTED
MODES: MAINTENANCE, SEQUENTIAL, READ/WRITE, DATA CHECK-LOGICAL
BLOCKS
BLOCKS WT  2392  BLOCKS RD  2392    TOTAL ERRORS          0
SEQUENTIAL RELIABILITY FINISHED ON THIS UNIT.
ENTER A COMMAND SELECTION:
```

** At this point we would presumably select the "E" command again and write our next block of data onto the platter. Note that if for some reason you cannot write to a particular area of the disk (ie., you get disk errors), write the boundaries of the bad area down in your log, go on to write your patterns to a different area, and record its boundaries.

After you have finished writing all your patterns, you may wish to try writing to the write space. Consider the following example. **

```
ENTER A COMMAND SELECTION:

     E

ENTER THE DEVICE CODE [24] (OCT):

     <cr>

START INITIALIZATION OF CONTROLLER.

END INITIALIZATION OF CONTROLLER.

UNIT   0000    IS READY; SELECT (YES,[NO]):

     yes

THE SELECTED DISK IS AN OPTICAL DISK.  YOU MAY WRITE (SEQ.
REL!) AND READ TO THIS DISK, BUT YOU SHOULD NOT ATTEMPT TO
WRITE TO THE SAME AREA ON THE DISK MORE THAN ONCE.

THE MINIMUM LOGICAL DISK BLOCK IS [0000] (OCT):

     120204
```

** Since we have already used blocks 0 - 120203, we specified the NEXT unused block. If we had inadvertantly entered 120203, we would have gotten an error when we tried to run the program. ON AN OPTICAL PLATTER YOU CANNOT WRITE TO A BLOCK THAT HAS ALREADY BEEN WRITTEN TO. **

```
THE MAXIMUM LOGICAL DISK BLOCK IS [617577] (OCT):

     120303
```

** We decided to write 100 blocks. 100 - 1 = 99, which we added to our minimum block of 120204. **

```
WRITE ONLY (YES, [NO]):

     <cr>
```

```
READ ONLY (YES, [NO]):

     <cr>

VERIFY DATA (YES,[NO]):

     yes

DATA TYPES
0-LOGICAL BLOCK ADDRESS     1-FLOATING ZERO
2-FLOATING ONE              3-ALTERNATE ZEROES (52525)
4-ALTERNATE ONES (125252)   5-ALL ZEROS
6-ALL ONES                  7-RANDOM (ONLY IN RANDOM REL I)
8-ROTATING (125252)         9-RUN ALL PATTERNS
SELECT DATA TYPE [0.] (DEC):

     <cr>
```

** You can choose any pattern except 7 or 9. In Sequential Mode you cannot run random patterns. Do not run ALL patterns because this option will automatically go back and try to write the next pattern over the previous one. On an optical drive this will cause an error.

```
UNIT 0 IS SELECTED
UNIT   0001   IS READY; SELECT (YES,[NO]):

     <cr>

UNIT   0002   IS READY; SELECT (YES,[NO]):

     <cr>

UNIT   0003   IS READY; SELECT (YES,[NO]):

     <cr>

              ODSS RELIABILITY UTILITY
                    REV. X.XX

                   COMMAND LIST

[E]NTER A DEVICE            [D]ELETE A DEVICE
[S]TART A PROGRAM           [H]ALT A DEVICE
[R]ESTART THE PROGRAM       [L]IST ERROR TOTALS
[C]OMMAND LIST              [P]RINTER CONTROL
[B]SOFTWARE DEBUGGER        [F]LAGS
[Q]UIT

ENTER A COMMAND SELECTION:

     S
```

```
START ALL ENTERED DEVICES ([YES],NO):

     <cr>

STATUS LIST: RUN TIME  0. HRS    0. MINS.
DEVICE CODE 24 UNIT NUMBER00 MAPPING NOT ENABLED STATE:HALTED
MODES: MAINTENANCE; SEQUENTIAL, READ/WRITE, DATA CHECK-LOGICAL
BLOCKS
BLOCKS WT   100  BLOCKS RD   100    TOTAL ERRORS          0
SEQUENTIAL RELIABILITY FINISHED ON THIS UNIT.
ENTER A COMMAND SELECTION:
```

Once you've completed your writing, be sure to update the write space portion of your log.

```
----------------------------------USED-------------
WRITE SPACE:  0-9791350 -        0 - 120303
---------------------------------------------------
```

3.4.4 EXAMPLES OF ERRORS REPORTED BY THE PROGRAM

The program will display PIO errors, CB errors, and Data Compare errors.

1. A sample PIO error:

```
**** ERROR **** AT RUN TIME  0. : 1.
DEVICE CODE 24 UNIT NUMBER03 MAPPING NOT ENABLED STATE:ACTIVE
MODES :MAINTENANCE; RANDOM, READ ONLY, DATA CHECK-ROT
            REG A     REG B     REG C
OPERATION     0         0         5
STATUS        0         0     14005
STATUS ERROR ON PIO COMMAND!
```

The display mode is octal.

2. A sample CB error:

```
**** ERROR **** : RUN TIME 0. HRS.    0. MINS.
DEVICE CODE 24 UNIT NUMBER03 MAPPING NOT ENABLED STATE:ACTIVE
MODES :MAINTENANCE; RANDOM, READ/WRITE, DATA CHECK-ROT
LOGICAL BLOCK        038A6993     SECTOR COUNT       0004
MEMORY ADDRESS       00005E17     COMMAND            WRITE
PAGE TABLE ADDRESS   00000000     RETURNED XFER COUNT 0000
ASYNC STATUS :            0003
    CB EXECUTION ERROR: HARD ERRORS
CB STATUS    :            8001
    ANY CB HARD EXECUTION ERROR
    CB DONE BIT
CB ERROR     :            0400
    DRIVE ERROR
CB UNIT STATUS:           2000
    READY
```

The display mode is hexadecimal.

3. A sample Data Compare error:

```
***** DATA COMPARE ERROR *****
DEVICE CODE 24 UNIT NUMBER03 MAPPING NOT ENABLED STATE:ACTIVE
MODES :MAINTENANCE; RANDOM, READ/WRITE, DATA CHECK-ROT
DISK BLOCK           038A6993     SECTOR COUNT       0004
PAGE TABLE ADDRESS   00000000     LOGICAL XFER ADDRESS 00000
PHYSICAL XFERS ADDRESS  00006417
EXPECTED   RECEIVED   OFFSET
  AAAA       8000       0000
  5555       4000       0001
  AAAA       2000       0002
TOTAL ERROR COUNT:    0600
```

The display mode is hexadecimal.

For a detailed description of the error statuses refer to the DG Programmer's Reference Series: Models 6236/6237 and 6239/6240 Disk Subsystems.

3.5 THE DIAGNOSTIC PROGRAM

The Diagnostic program is actually a master control program that automatically runs a set of smaller test programs. Since each test is directed at a specific function of the Controller, this program is useful as a component-level trouble-shooting tool. The program has a loop-on-error feature that allows you to pinpoint the problem.

In order to run the program, the MDD must have been previously formatted, and the controller microcode must have been loaded onto the board. If you have not installed the microcode on the MDD, you will need to issue the R command in the ODSS Utility program to load microcode onto the board. See Appendix A.

3.5.1 GLOBAL PARAMETERS

These are the over-all operating conditions of the program under which the test set will run. They are the display mode, timeout enable, test loop count, and pass count.

1. In this program, unlike the Reliability, the CONTROLLER MODE is fixed as Maintenance Mode; you can only run the Diagnostic on the magnetic disk, which is Unit 3.

2. The DISPLAY MODE option allows you to select the numbering system in which some of your on-screen information will be displayed. Decimal numbers will be followed by a "." (eg., 5.). Octal numbers will not. Hex numbers will be either 4 or 8 digits long, and will include any required leading zeroes. However, when entering any number, you need not enter leading zeroes, and when entering decimal numbers, you need not enter the ".".

   Note that whenever the program asks for a numeric response, the required numbering system is displayed in parentheses.

   Wherever the program asks for an input, it displays a possible response in brackets []. This is the default response, and is selected simply by entering a carriage-return or new-line.

3. The TEST LOOP COUNT and PASS LOOP COUNT are selected when you enter your device (see the ENTER command below). "Test" here refers to the individual tests run under control of the program. "Pass" refers to a complete run of the test set. For example, one pass could consist of each test in the set running 10 times.

3.5.2 THE COMMAND LIST

Basically, when you run the program, you:

1. select some global program parameters,
2. modify the test set if desired,
3. enter your device,
3. run the tests, and
4. examine the results.

The following is a complete list of available program commands, with comments where they are pertinent.

1. LIST TESTS

2. TEST ENTRY

   Unless you FIRST use this command to define your own test set, the Diagnostic will automatically run the complete set of tests.

   The program prints a message warning you that some tests must be run in the order they appear on the list. These tests are:

#1	RESET COMMAND TEST
#4	RESTART COMMAND TEST
#7	SET MAPPING OPTIONS TEST
#10	READ DISK SIZE TEST

You must run test #1 before any other tests. You must run test #4 before any of the tests that follow it; the same is true for tests 7 and 10. For example, if we wanted to run tests 2, 3, 8 and 9, we would have to also run tests 1, 4, and 7 in proper numeric sequence. Our final test set would be 1, 2, 3, 4, 7, 8, 9.

3. ENTER A DEVICE

4. START DIAGNOSTIC

5. DELETE A DEVICE

6. HALT THE DIAGNOSTIC

If you have chosen a very large pass count but want to halt the program, use this command.

7. COMMAND LIST

8. PRINTER CONTROL

9. FLAGS MODIFICATION

If you select the FLAGS MODIFICATION command (F) you can set up some additional controls over the program execution. The following flags are available:

DISPLAY TEST TITLES (YES,[NO])?
PROCEED FROM ERROR (YES,[NO])?

The default response allows the program to loop on an error, although the error will be reported only once. If you answer "yes", the error will be printed once and will roll off the screen as testing continues. If you choose to proceed from error you may wish to enable your printer in order to record errors.

DISPLAY PERCENTAGE OF ERROR (YES,[NO])?
DISPLAY RUN TIME OF EACH TEST [N]?

10. BRANCH TO DEBUG

This is a useful tool for trouble-shooting software and hardware problems. You should have some familiarity with this type of program in order to use it effectively. A list of commands is available on request once you enter the Debugger.

One useful command is the "IO" command, which allows you to issue individual PIO or CB commands to the controller and observe the results. For details on the commands themselves, consult the DG Programmer's Reference Series Models 6236/6237 and 6239/6240 Disk Subsystems.

For PIO commands which do not transfer data to or from memory (eg., Unit Status or Reset) you do not need to do any more than issue the command. For ones that do, you must first be sure the board has been initialized, and then determine where in memory you will be working.

The board is initialized by doing 1) a Reset command, 2) a Begin command, and 3) a Set Mapping command. If you have been running for awhile, you have already initialized the controller. If you entered the Debugger right after loading the program, you must first go back and do an Enter command. Answer "no" to every unit. The board will now be initialized.

To find available memory workspace, exit the "IO" command and type "MM" (Examine-modify Memory). The program will now wait for you to enter a specific memory location. Enter "BUFF". This response takes you to the area set aside by the program as a data buffer. The address reported back is the first address of the buffer area. The last address is 71777 (oct). Use this address space for your data transfer PIOs.

For CB commands, you must first create the CB or CBs in your buffer area. Also, if you will be returning data to memory, be sure to designate addresses after your CB list or the list may be overwritten.

8. QUIT

3.5.3 EXAMPLES OF ERRORS REPORTED BY THE PROGRAM

The program will display PIO errors, CB errors, Data Compare errors, and miscellaneous functional errors.

1. A sample PIO error:

```
**** ERROR **** AT RUN TIME  0. : 1.
DEV1CE CODE 24 UNIT NUMBER03 MAPPING NOT ENABLED STATE:ACTIVE
MODES :MAINTENANCE; RANDOM, READ ONLY, DATA CHECK-ROT
            REG A     REG B     REG C
OPERATION     0         0         5
STATUS        0         0     14005
STATUS ERROR ON PIO COMMAND!
```

2. A sample CB error:

```
THESE ARE THE PHYSICAL PARAMETERS REPORTED BY THIS UNIT
CYLINDERS: 1467      HEADS: 12      SECTORS: 103
PC    :  7711    LISTING PC:    47
TEST #:    16.   TEST NAME : RECAL COMMAND TEST
LINK ADDRESS      :     0  COMMAND:                 : 200
PAGE TABLE ADDRESS: 000000  MEMORY ADDRESS          :   0
DISK ADDRESS      :     0  UNIT NUMBER             :   0
RETURNED XFER COUNT:    0  CB STATUS               :   0
ERROR STATUS      :  2000  UNIT STATUS             :22000
RETRIES           :     0  SOFT RETURN XFER COUNT  :   0
PHYSICAL CYLINDER :     0  PHYSICAL HEAD+SECTOR    :   0
DISK ERROR CODE   :     0
STATUS ERROR ON CB
LOOPING ON ERROR
```

3. A sample Data Compare error:

```
PC    :    5612              LISTING PC:    10
TEST #:      4.              TEST NAME : READ ONE SECTOR
EXPECTED   RECEIVED   OFFSET
165346     165347        1
165346     165347        3
165346     165347        5
TOTAL ERROR COUNT:    0600
```

4. Miscellaneous functional errors are those in which the test performed some operation and expected to get a particular status back. Here is a sample of an error of this type:

```
PC    :    56xx              LISTING PC:    10
TEST #:      x.              TEST NAME : RECAL COMMAND TEST
AC0: 125252  AC1: 000000  AC2: 123456  AC3: 005612
AC1 SHOULD EQUAL AC0
LOOPING ON ERROR
```

For a more complete description of the error statuses refer to the DG Programmer's Reference Series: Models 6236/6237 and 6239/6240 Disk Subsystems.

3.6 TESTING A DISK WITH DATA ON IT

Occasionally you may wish to run off-line tests on your magnetic disk, even though you have current data stored on it. In this section we will briefly describe two ways you can do this, using the Reliability program.

The first way tests the whole disk, but in a READ-ONLY mode. Although it does not test write capability, it can be useful for testing the Controller's ability to seek, read data from the disk, and transfer data on the BMC.

Boot the program and respond to its questions as outlined in Section 2.12, with two exceptions: 1) When it asks, "READ ONLY (YES/[NO]):", answer YES. 2) When it asks, "VERIFY DATA ([YES]/NO):", answer NO. Now start RELI with the "S" command.

The second method allows writing as well as reading, but only tests a portion of the disk. This portion is called the "maintenance area". It is a collection of disk blocks that lies "above" the area on the MDD used for current data and cache overhead. It is an unused portion of the MDD that can essentially be used as a "scratch" area for testing. The starting block of this area is always given as the default minimum logical block when you are in Maintenance Mode. The ending block is the last useable block on the MDD, given as the default maximum logical block.

To use the maintenance area you MUST be in Maintenance Mode. Enter ("E" command) unit 3. Select the defaults for the minimum and maximum logical blocks by entering <cr>. Of course, you can enter a disk block GREATER THAN the minimum block default, but DO NOT ENTER ONE LESS THAN THE DEFAULT OR YOU WILL DESTROY SYSTEM DATA. You can now run the program as you normally would.

3.7 CUSTOMER SUPPORT HOTLINE

ZETACO, Inc. provides a Customer Support Hotline (612-941-9480) to answer technical questions and to assist with installation and trouble-shooting problems. The Hotline is manned by a technical team from 8:00 a.m. to 5:00 p.m. (Central Time) Monday through Friday.

3.8 WARRANTY INFORMATION

The MDD and ODD are warranted free from manufacturing and material defects, when used in a normal and proper manner, for a period of six months from date of shipment.

The ODC is warranted free from manufacturing and material defects, when used in a normal and proper manner, for a period of two years from date of shipment.

Except for the express warranties stated above, ZETACO disclaims all warranties including all implied waranties of merchantability and fitness. The stated express warranties are in lieu of all obligations of liabilities on the part of ZETACO for damages, including but not limited to, special, indirect or consequential arising out of or in connection with the use or performance of ZETACO's products.

If a part is no longer under warranty, or if the problem is not warranted (as set forth above), then repair will be on a time-and-material basis.

3.9 PRODUCT RETURN AUTHORIZATION

All possible effort to test a suspected malfunctioning subsystem should be made before returning any of the components to ZETACO for repair. However, if Controller or module malfunction has been confirmed using the tests outlined in Sections 3.1 through 3.6, you should return the part to ZETACO. A Return Material Authorization (RMA) number is required before shipment and should be referenced on all packaging and correspondence.

To ensure prompt response, the information outlined in the Material Return Information form on the following page should be gathered before calling the ZETACO Hotline for the RMA number. Please include a completed copy of the Material Return Information form with the product. Each product to be returned requires a separate RMA number and Material Return Information Form.

To safeguard the product during shipment, please use packaging that is adequate to protect it from damage. Mark the box "Delicate Instrument" and indicate the RMA number(s) on the shipping label.

MATERIAL RETURN INFORMATION

The speed and accuracy of a product's repair is often dependent upon a complete understanding of the user's checkout test results, problem characteristics, and the user system configuration. Use the form below to record the results of your trouble-shooting procedures. If more space is needed, use additional sheets.

TEST	RESULT
Power-up Self-test	_____

Other tests performed (system operation, errors, etc.)

Please allow our service department to do the best job possible by answering the following questions thoroughly and returning this information with the malfunctioning component.

1. Does the problem appear to be intermittent or heat sensitive? (If yes, explain.)

2. What revision number of RDOS are you running?

3. Describe the system configuration (i.e.; peripherals, controllers, model of computer, etc.)

4. Has the unit been returned before? Same problem?

To be filled out by CUSTOMER:

Model # :_____
Serial #:_____
RMA # :_____(Call ZETACO to obtain an RMA number.)

Returned by:

Your name:_____
Firm: _____
Address: _____
_____
Phone: _____

4.0 THEORY OF OPERATION

The system is composed of an Optical Disk Controller, a Cached Optical Disk (READ/WRITE), and up to three additional Optical Disks (READ ONLY). The Cached Optical Disk is composed of an optical disk drive and a conventional Winchester-type magnetic disk drive.

In operation, writing is actually done to specific areas in cache until an area becomes filled. At that point, the least frequently written entry in that area is "rolled-out" onto the optical disk to make room for a new one. If a sector that has already been rolled-out to the optical needs to be re-written, it is "scrubbed" and the data is written to a new location. When an optical platter becomes filled, it is "COMPLETED" by writing all of the data from the magnetic disk onto it, along with the Scrub Directory.

4.1 ARCHITECTURAL OVERVIEW OF THE ODC

The Controller has, in effect, two "sides", the HOST INTERFACE and the SCSI INTERFACE. The operations of each side are controlled independently by 80186 microprocessors. The two sides communicate through a Dual Port Ram.

The HOST side is ZETACO's emulation of DG's 6236/6239 Disk Subsystem (Argus). Because of the WRITE ONCE drive technology, the emulation does not support Dual Porting, Mirroring, Sector Slip, and Modified Sector Copy.

The DG PIO commands are passed through two sets of register files. CB commands are transmitted on the BMC Bus. The host-side microprocessor interprets the DG commands and passes the results through the Dual Port Ram to the SCSI side.

Data is also transmitted on the BMC Bus to and from the drives through a two-sector "Ping-Pong" buffer on the Controller. Data transfers require no microprocessor intervention.

The SCSI side has a 512Kbyte bank of Dynamic RAM that holds the microcode for the SCSI side, some data buffers, one Scrub Directory for each drive, and the Cache Table. It is the Cache Table that couples the cache drive to the primary optical drive. A copy of it and the directories is kept on the magnetic drive and any changes are backed up there.

The microprocessor on the SCSI side receives the processed commands from the HOST side and in turn issues the required SCSI commands to the 5380 SCSI Controller. The two devices together handle all arbitration on the SCSI bus, pass the commands along to the drives, receive statuses, and report these back to the HOST side through the Dual Port Ram.

Each port of the Dual Port Ram is divided into 8 bytes of command space and 8 bytes of status space. The command areas can only be written to by the HOST side; the status areas can only be written to by the SCSI side. The dual port arrangement allows "pipelining" of information, whereby one port can be loaded while the other port is being executed.

4.2 FUNCTIONAL OVERVIEW OF THE ODC

4.2.1 CONTROLLER OPERATING MODES

There are two controller operating modes: Runtime, and Maintenance. In Runtime Mode the cache and scrubbing are enabled and the disk units are mapped such that the magnetic and primary optical drive are seen as one unit, Unit 0 -- the Cached Optical Drive. The other three optical drives are units 1, 2, and 3, respectively, and are READ ONLY.

In Maintenance Mode the cache and scrubbing are disabled and the disk units are remapped to allow separate access to the magnetic drive as Unit 3.

4.2.2 THE CACHING SCHEME

The Cache Table and the cache space on the magnetic drive are both divided logically into 256 records, with each record containing 16 entries. There is a one-to-one correspondence between both sets of records. In the cache space an "entry" is a pointer to the actual data; in the Cache Table, it is four bytes of information containing the upper 13 bits of the RDOS disk address, a Valid Entry Flag, and a Last Modified Record counter.

The optical disk is divided into a number of sections with 256 1Kbyte sectors per section. Each record in the Cache Table is associated with it's corresponding sector. For example, Record 76 is associated with Sector 76 of all of the sections. In which section the sector belongs is determined by the upper 13 bits of the 22-bit RDOS disk address saved in its entry. The lower bits (1-8) select the record.

4.2.3 THE SCRUBBING SCHEME

Once a sector has been written to on the optical, it cannot be re-written , as is routinely done on a magnetic disk. The purpose of the cache, of course, is to cut sector rewrites to a minimum, but there will still be instances where the system will need to write new data to an already-written sector.

When this occurs, we say that the original sector is "scrubbed." What this amounts to is a re-mapping of that sector to a different, unused sector on the optical disk. A portion of the optical platter has been reserved for this purpose. The new address is kept in a "Scrub Directory" on the magnetic disk and is referenced whenever the system asks for the original location.

Anytime data in the cache space is rolled-out to an address on the optical platter, the firmware looks for that address in the Scrub Directory. If it does not find it, it concludes that that address can be written to and goes ahead. Now, the next time a WRITE to that address is attempted, three operations will take place: 1) the drive will report an error (can't write to a previously written sector); 2) the firmware will enter the original address and the new address in the Scrub Directory; 3) the data is written to the next available sector in the area reserved for scrubbed sectors. Anytime an error is reported during a WRITE to the optical drive, the sector will be scrubbed.

Sectors can be re-scrubbed several times. If the address is already in the directory, the data is simply written to the next available sector in the scrub area, and the directory is updated on the magnetic to reflect the new location.

4.2.4 SAMPLE OPERATIONS

In order to see how the caching scheme works we will describe three basic operations: a WRITE, a READ, and a COMPLETE. First we will consider a simple WRITE; that is, one that does not require a roll-out.

Initially, the RDOS disk address is divided up and the firmware looks at the record in the Cache Table pointed to by bits 1-8. There it searches the entries in the record for one that contains the same value as the upper 13 bits of the disk address. From now on we will call these bits the "Cache Table data", as distinct from the disk data.

If it finds a match we have a cache "hit." The disk data is then written out to the appropriate address in the cache space on the magnetic drive. Next, the firmware adjusts the LMR counter of the new entry and updates the LMRs of all other entries in the record.

If no match is found and an empty entry exists, the microprogram writes the new Cache Table data into it. The disk data is written to the cache space; and the LMRs are all adjusted.

Following WRITE operations, the ODC scans the affected cache records and transfers data from the magnetic disk to the optical platter, as a background task, as required to maintain at least one empty entry per record. When a record is detected with no open entries, the ODC creates one by "rolling-out" the oldest (i.e., the least written) entry's data from magnetic to optical. If the optical drive returns an OVERWRITE Error (the sector has been rolled-out previously), the ODC performs a "SCRUB" operation.

A READ operation is nearly identical to a WRITE. The most important difference between the two is that when there is a Cache Table or Scrub Directory hit during a READ, none of the entries are changed. The program simply goes to where the entry points. If the platter has been "completed", the cache is bypassed entirely.

A COMPLETE operation is a special procedure designed to finalize a filled platter. When the COMPLETE OPTICAL PLATTER command is issued, the Controller will roll-out all data from the magnetic to the optical drive, scrubbing when necessary. If no errors occur, then the final Scrub Directory is written onto the optical platter, and it becomes READ ONLY.

APPENDIX A

A.0 THE SUBSYSTEM UTILITY PROGRAM

The Subsystem Utility program will allow you to manage some of the tasks associated with operating and maintaining the ODSS. It is a stand-alone program, which means that you cannot run it under the control of the operating system. Instead, from the system monitor you must load it, either from the Software Support Tape or, if you previously stored your utility programs on your system disk, from the system disk.

Like all of ZETACO's software, the Subsystem Utility program is "user-friendly". On-screen help is available, and important facts about some of the options are provided. This brief description of the program is intended as a companion to your on-screen display.

A.1 THE PROGRAM OPTIONS

The following is a complete list of available program options, with comments where they are pertinent.

1. HELP

2. DO ALL: FORMAT, INSTALL FIRMWARE, DKINIT

   This option automates the basic initialization of the Controller and magnetic disk. The individual options are covered below.

3. (RE)INITIALIZE CONTROLLER

   This option transfers the ARZ-1 firmware from the tape onto the Controller. If you do not run it before any of the other options, then the first time you run another option it will run automatically.

   You may wish to run this option if for some reason you cannot load the ARZ-1 microcode from the magnetic disk, as is normally the case.

4. FORMAT MAGNETIC DISK

   Of course, you must format the disk before you can either install the firmware on it or run DKINIT. It takes about 15 minutes to complete the formatting operation.

If you have not previously run the INITIALIZE CONTROLLER option, it will be run for you before the formatting operation begins. If you later run the format option again, the initialize routine will NOT run again, unless the Controller has been powered down.

5. INSTALL ARZ FIRMWARE ON MAGNETIC DISK

6. INSTALL SCSI FIRMWARE ON MAGNETIC DISK

In normal operating mode (Runtime Mode -- see Section 4, THEORY OF OPERATION), the Controller automatically loads its microcode from the magnetic disk. Therefore, in Runtime Mode, THE FIRMWARE MUST BE ON THE MAGNETIC DISK OR THE SYSTEM WILL NOT WORK. If you choose to do a format alone, you must run both of the INSTALL options before you return to normal system operation.

7. INITIALIZE (DKINIT) THE MAGNETIC DISK

This option prepares the disk to run under the RDOS operating system. It was written by ZETACO especially for the ODSS. If you choose to do a format alone, you must run this option before you return to normal system operation.

WARNING: DG'S DKINIT PROGRAM WILL NOT WORK ON THE ODSS.

8. INQUIRY THE DRIVE

The INQUIRY command belongs to the Common Command Set of of the SCSI Interface. When issued, it returns information about the vendor and product for the specified unit. If a vendor has chosen not to provide any information, a program message will report that no data is available.

For more information on the SCSI Inquiry command, see the SCSI Specification ANSI X3T9.2/82-2

9. PLATTER COMPLETION (PURGE OF THE MAGNETIC)

Select this option when you have determined that your active optical platter is nearly full. After you run this option, the platter will be read-only. For a description of the platter completion process, see Section 4, THEORY OF OPERATION.

10. LOGGING TO PRINTER

11. QUIT

APPENDIX B

B.0 ADDING ADDITIONAL OPTICAL DRIVES

Since the ODC is capable of controlling up to 4 optical drives, you may at some point wish to add additional drives to your subsystem. This Appendix will provide you with the details to do so.

B.1 SET UP THE SCSI ADDRESS OF THE NEW UNIT

The SCSI Address of an ODD is determined by a switch cap labelled "Control Module Address x", where 'x' is a number from 0 to 3. This switch cap is located on the front panel of the drive. With the new unit you will have received a set of four caps (0-3). Control Module Address 0 will have been installed at the factory.

To change caps, simply pull out the presently installed one and gently push the new one into place. The caps have been designed so that they only fit one way. The following table shows which cap to use.

TABLE B.1 SCSI Unit Addressing

LOGICAL UNIT	CONTROL MODULE ADDRESS
First	0
Second	1
Third	2
Fourth	3

NOTE: The SCSI Address of the MDD has been set to 4 at the factory.

B.2 CONNECT THE CABLES

1. Disconnect the two-foot External SCSI Cable (300-152-04) from both the MDD and J17 of the primary (or previous) ODD.

2. Locate the new drive between the primary (or previous) ODD and the MDD. Since the MDD has the SCSI bus terminators installed, it must be at "the end of the line" in the daisy-chain cabling scheme described here.

3. Connect the SCSI Daisy-Chain Cable (P/N 300-151-00) shipped with the new unit from J17 on the rear panel of the previous unit to J18 on the rear panel of the new unit. This FCC-compliant cable has a 50-pin connector block on both ends.

4. Re-connect the two-foot External SCSI Cable between J17 of your new ODD and the MDD.

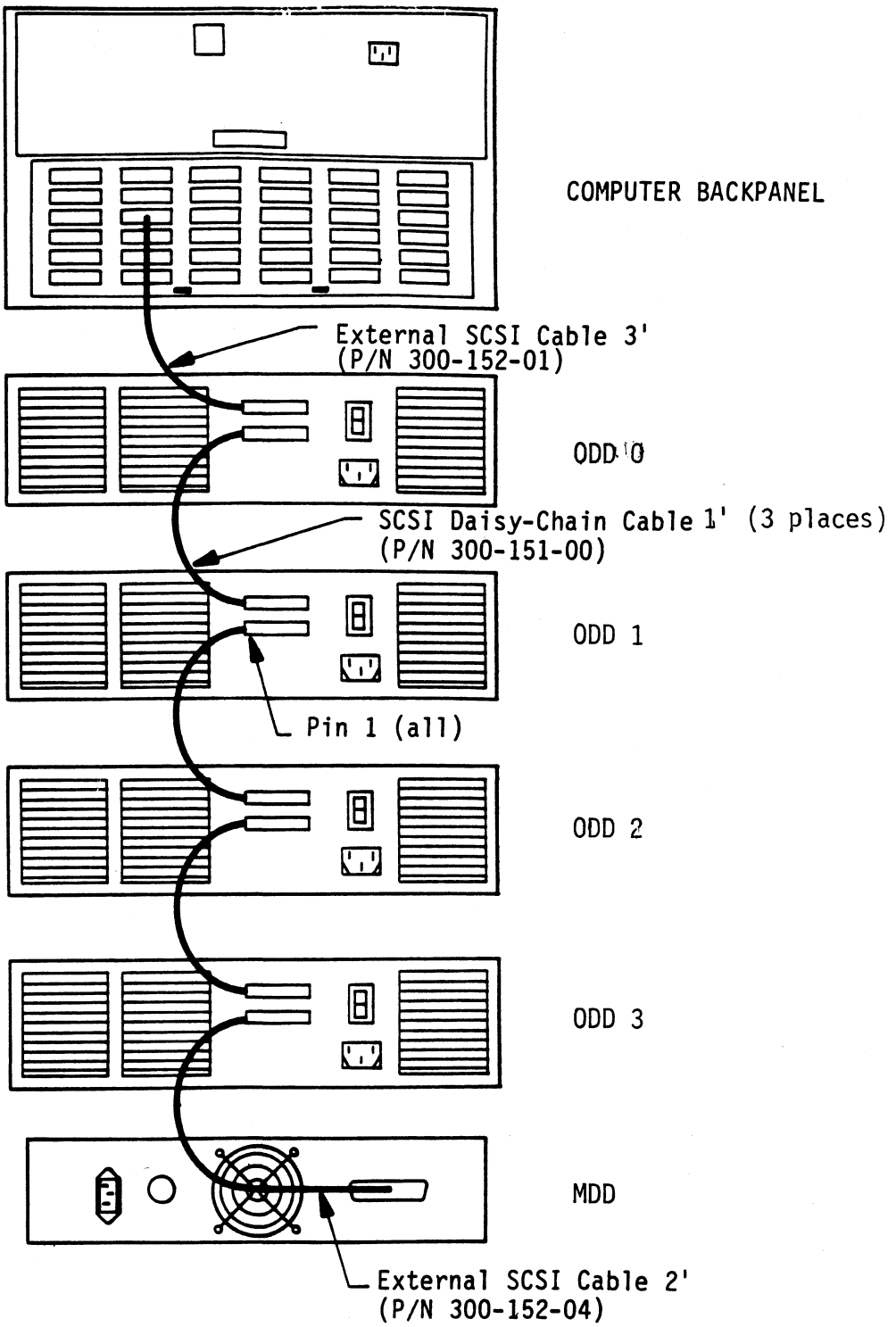
5. If you are only adding a second drive, you can leave the 9-foot cable from the computer bulkhead to the primary ODD (P/N 300-152-03) in place. However, if you are adding a third drive, this cable MUST BE REPLACED by the 3-foot External SCSI Cable (P/N 300-152-01) shipped with the new unit. This is done to ensure that a three- or four-drive subsystem will adhere to the maximum cumulative cable length of 6 meters (19.68 feet) specified for the SCSI Interface.

Figure B.1 illustrates the daisy-chain arrangement of a fully populated ODSS.

B.3 CHECK CURRENT CONTROLLER CONFIGURATION

Unless, during original installation you configured for a number of optical drives equal to or greater than the number you now have, you will need to change that configuration fact to reflect your new drives.

FIGURE B.1 Fully Populated ODSS (Rear View)



APPENDIX C

C.0 PREVENTIVE MAINTENANCE

The main preventive maintenance procedure that is required for your Optical Disk Subsystem is the cleaning of the MDD and ODD air filters. This should be done AT LEAST every six months, but, depending on site conditions, may be required more frequently.

For a complete description of preventive maintenance procedures for the ODD, see Section 3.5 of the OSI Laserdrive 1200 Customer User Manual. The following procedure is for the MDD.

1. Loosen the screws on both sides of the MDD which hold the front panel in place. Gently slide the front panel forward.

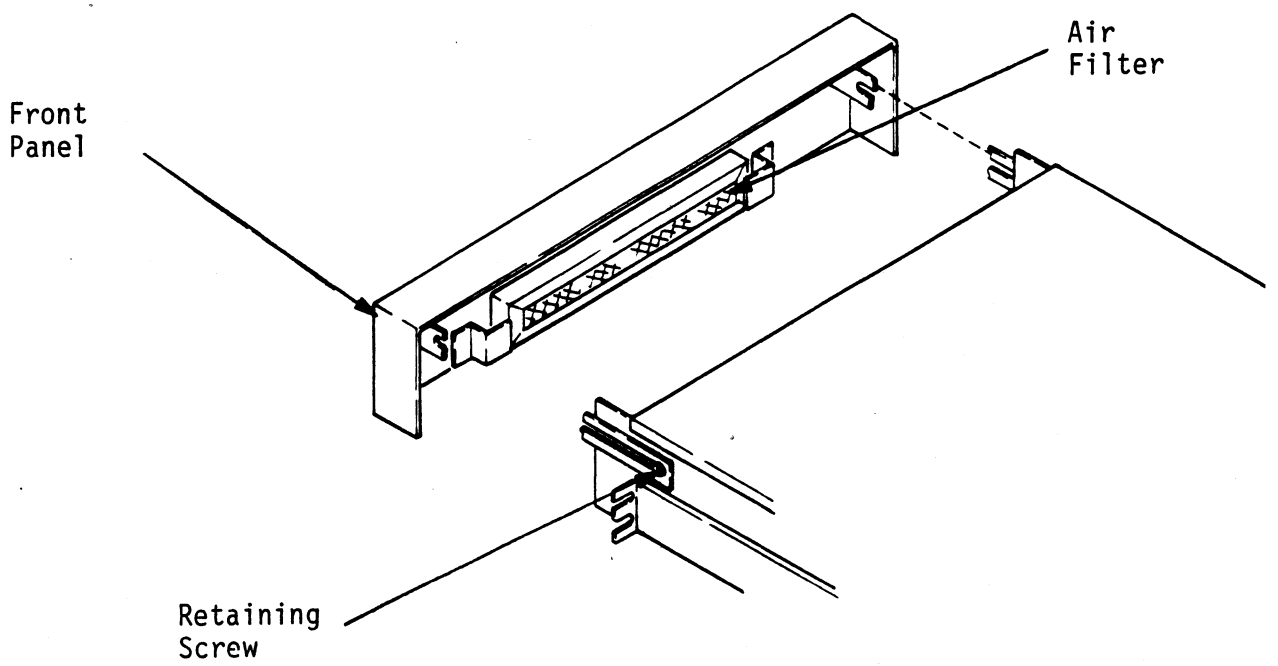
2. The air filter is located inside the front panel. See Figure C.1. Remove it by sliding it out from the top of the panel.

3. Clean the filter in lukewarm water, using a mild detergent.

4. Rinse the filter well and allow it to dry thoroughly.

5. Replace the filter in the front panel and re-attach the panel to the unit.

FIGURE C.1 Location of MDD Air Filter



APPENDIX D

D.0 .IDEF PROGRAMMING PROCEDURE

The .IDEF system call allows the system to recognize interrupts from a device that was not originally SYSGEN'd. The procedure below must be strictly adhered to in order to successfully use it. The procedure is written based on the assumption that the reader is thoroughly familiar with DG I/O programming practice.

Note that none of the I/O instructions issued by the programmer actually invoke the secondary device. Instead, they are issued to the device code of the Optical Disk Controller. In the instructions below, "DSKP" stands for the Controller device code.

1. In the RDOS CLI, do INIT DA0, then RELEASE DA0.

2. In your working accumulator, place the following:

```
BIT:      0 1 2 3 4 5! 6 7 8 9 10 11 12 13 14 15
                     !
VALUE:    Alt Dev Cd ! 1 0 1 0  0  0  1  1  1  1

OCTAL:    xx1217
```

3. Issue: DOCS ACC, DSKP

4. Issue: DIC ACC, DSKP

5. Loop on the instruction in Step 4 until the value 65656 (oct) appears in the accumulator. When it does, the Busy flip-flop will set.

6. Issue the command you want to send, in the following sequence:

```
DOA ACC, DSKP
DOB ACC, DSKP
DOC ACC, DSKP
```

   The DOC must come last, and must NOT contain a START. The command will begin executing immediately after the DOC is sent.

7. When execution is complete, the Done flip-flop will set, Busy will clear, and the CPU will receive an interrupt from the alternate device.

8. In your interrupt handler, when you issue a CLEAR to clear the interrupt it must be to DSKP.

You can issue as many commands as you wish to the alternate device, but FOR EACH COMMAND, YOU MUST DO THE ENTIRE SEQUENCE AGAIN, STARTING WITH STEP 2.

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Please give us your comments.

Please use this form to send us your comments regarding this technical manual. Your input is greatly appreciated! Problems will be promptly addressed and action taken as necessary. If you wish a written reply, please furnish your name and mailing address. Thank you.

Date_____

Name_____ Title_____

Firm_____

Address_____

City/State/Zip_____

TECHNICAL MANUAL TITLE_____

DOCUMENT NUMBER_____REVISION_____

ERRORS IN MANUAL:

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SUGGESTIONS FOR IMPROVING EITHER THE MANUAL OR THE PRODUCT:

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