

SCSI Disk Controller

(For G.E. Medical Systems)

Technical Manual

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REVISION HISTORY

ECO No.	Date	Description	Pages
1029	12/08/87	FIX PER G.E. REQUEST	
1038	01/18/88	Added Error Code Definitions	Sec. 3
1088	07/20/88	FIX ERRORS	

PREFACE

This manual contains information regarding installation, testing, and operation of ZETACO's SCSI Disk Controller.

The technical contents have been written based on the assumptions that the reader 1) has a working knowledge of one of the applicable Data General mini-computers and associated operating systems; 2) is familiar with standard installation, power, grounding, and peripheral cabling procedures; and 3) has access to technical information describing the disk drive(s) to be installed with this controller.

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

- SECTION 1.0 PRODUCT OVERVIEW - Describes the SCSI Disk Controller features, capabilities, specifications, power and interface requirements.
- SECTION 2.0 INSTALLATION PROCEDURES - Describes and illustrates the procedures required to install the SCSI Disk Controller.
- SECTION 3.0 TROUBLE-SHOOTING - Contains information useful in analyzing subsystem problems, and how to get help.
- SECTION 4.0 USAGE GUIDELINES - Describes how various features and configuration are used and how they impact the performance of the controller.

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1.0 PRODUCT OVERVIEW

1.1 GENERAL DESCRIPTION

The SCSI Disk Controller is ZETACO's state-of-the-art bridge between DG's Eclipse and Eclipse/MV minicomputers, and high performance SCSI-interfaced disk drives. It fully emulates DG's Argus Disk Subsystem Controller.

The SCSI Disk Controller allows integration of 5.25 inch Magnetic SCSI Disk Drives into systems where large storage capacity, small footprint, and high reliability are demanded.

The SCSI Disk Controller has been implemented on a single 15" x 15" 10-layer printed circuit board, with a paddleboard to route signals to and from the disk drives. This Controller is compatible with FCC hardened chassis requirements, and interfaces DG's high speed bus, the Burst Multiplexor Channel (BMC).

1.2 SPECIFICATIONS

1.2.1 FUNCTIONAL

Drives per Controller:	Up to 7 SCSI targets.
Recording Format:	Media format is drive vendor unique.
Data Transfer Rate:	Up to 1.0 MB per second (Async.)
Maximum Capacity:	The theoretical maximum capacity supported by a single SCSI Disk Controller is 67 gigabytes.
Device Code:	Switch selectable.
Interrupt Priority Mask Bit:	Bit 7
Bus Load:	1 unit load (any I/O slot).
Data Channel Interface:	Not supported.
Burst Multiplexor Channel 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 count from 1 to 255 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).

Support BMC transfer rates equal to the fastest available BMC computers.

Sector Data Field: 256 - 16 bit words per sector

Data Buffering: Two 256-word BMC buffers in a ping-pong configuration

Memory Address: 21 bits

Indicator Lights:	RED	SCSI CPU Self-test
(Left to Right)	GREEN	SCSI Busy Busy
	YELLOW	NOT USED
	RED	Host Side CPU Self-test
	GREEN	Controller Busy

1.2.2 COMPUTER INTERFACE

The SCSI Disk Controller is designed to operate only with the BMC, in any I/O slot of an MV or Eclipse computer.

1.2.2.1 BMC BUS CABLES

Two 40-conductor flat ribbon cables, with a single socket on one end and multiple sockets (for multiple controllers), are required for BMC operation.

1.2.3 DISK DRIVE INTERFACE

Functional: - SCSI interface single-ended
Asynchronous

Cabling: CHASSIS WITH BULKHEAD

INTERNAL: 50-conductor flat ribbon cable with D connector on one end that mounts in the computer EMI/RFI backpanel. The other end plugs into the A paddleboard. See Figure 2.4.

NOTE: The maximum cumulative length allowable for SCSI single-ended cables is 18 feet.

1.2.4 MECHANICAL

Dimensions: 15" x 15" x 1/2"

Shipping Weight: 10 pounds - includes controller, paddleboards, cables (if ordered), software tape and documentation.

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

1.2.5 POWER REQUIREMENTS

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

1.2.6 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/MV temperature and humidity specifications.

2.0 INSTALLATION

2.1 UNPACKING AND INSPECTION

The following items are shipped standard with each SCSI Disk Controller.

ITEM	P/N
A) SCSI Disk Controller with Cover	500-456-00
B) "A" Paddleboard	500-411-00
C) BMC Bus Cables (2)	300-038-00
D) Internal Cable Assembly (1)	300-148-01
E) BMC Bus Terminator (1)	300-156-00

Upon receipt of the SCSI Disk Controller from the carrier, inspect the shipping carton immediately for any evidence of damage or mishandling in transit.

If the shipping carton is 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 carton is opened.

ZETACO's warranty does not cover shipping damage. For repair or replacement of any ZETACO product damaged in shipment, call ZETACO, Inc. to obtain return authorization instructions.

2.2 BEFORE YOU BEGIN

This section contains the procedures necessary for proper installation of the SCSI Disk Controller. We recommend that you read through it once in its entirety before you start the actual installation process.

The following subsections, beginning with 2.3, are in order of execution. Subsections 2.3 through 2.8 involve preparation and installation of the hardware components. Subsections 2.9 through 2.12 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 SCSI Disk Controller.

2.2.1 SYSTEM HARDWARE REQUIREMENTS

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

You should have complete hardware documentation for your computer and disk drive available for reference during the installation.

2.2.2 THE SOFTWARE SUPPORT TAPE

Each of the programs on the Software Support Tape has been written by ZETACO specifically for the SCSI Disk Controller. Use this tape for configuring the controller, Media Formatting, Disk Diagnostic and Reliability, and installation of controller microcode onto the disk. DG's CORRESPONDING PROGRAMS MAY NOT WORK ON THIS CONTROLLER. Also note that the SCSI Disk Controller does NOT support MVSYSTEMX.

The Software Support Tape is structured so that the programs on Files 2 through 4 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 loaded 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 provided here for clarification, will be preceded and followed by the characters '***'.

2.3 PREPARE THE COMPUTER CHASSIS

Before installing the SCSI Disk Controller, the computer chassis must be prepared. To do so, choose an available I/O slot and establish the correct priority.

2.3.1 SLOT SELECTION

The SCSI Disk Controller may be installed in any "I/O" slot. Consult the hardware manual for your particular computer to identify the appropriate available slots.

2.3.2 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 SCSI Disk Controller and the processor, or between the SCSI Disk Controller 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 In (Pin A96). See Figure 2.2.

2.4 PREPARE THE CONTROLLER

To prepare the controller for installation you will need to establish proper BMC bus termination and select the Device Code.

2.4.1 BMC BUS TERMINATION

If there is more than one BMC device daisy-chained on the BMC bus, then the BMC controller at the end of the bus must have the bus terminators installed. If the SCSI Disk Controller is to be installed as the last (or only) BMC controller, then make sure the bus terminator is installed in the middle cable header on the front edge of the SCSI Disk Controller. Refer to Figure 2.1.

NOTE: The SCSI Disk Controller is shipped from the factory with the terminator installed unless otherwise specified.

2.4.2 DEVICE CODE SELECTION

The standard Primary device code for the SCSI Disk Controller is 24 octal; the Secondary is 64 octal. However, any DG device code can be selected, as long as there is not already a controller in the system with that device code.

There is a set of Device Code switches on the edge of the board that allow you to easily set the device code. Switches 3 through 8 specify device code. Switch 1 is reserved and should be placed in the "DOWN" position. Switch 2 is used for EEPROM Write Disable. Refer to Figures 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 SCSI Disk 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.

2.4.3 EEPROM WRITE DISABLE

Switch position 2 (see Figure 2.3) is used for disabling WRITES to the EEPROMs when in the DOWN position. If EEPROMs are to be re-configured, this switch must be placed in the UP position.

2.5 INSTALL THE CONTROLLER AND PADDLEBOARDS

First, 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 2.3. 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.

2.5.1 PADDLEBOARD INSTALLATION

The computer backplane, viewed from the rear, has the "A" side pins on the left. On computers with vertically mounted controller boards, think of the component side of the boards as up, then the "A" side pins are on the left.

Locate the two rows of pins on the "A" side of the backplane for the slot containing the SCSI Disk Controller. Ensure that no pins are bent. Position the "A" paddleboard block connector over the "A" backplane pins (29-100), with the header connectors facing up. Press the connector securely over the pins, making sure all pins insert and do not bend, until the guide block is flush with the backplane.

CAUTION: COMPONENT DAMAGE MAY OCCUR IF PADDLEBOARD IS MIS-
ALIGNED. MAKE SURE THE BLOCK IS NOT SHIFTED RIGHT
OR LEFT BY CHECKING FOR NON-INSERTED PINS ON BOTH
ENDS. DOUBLECHECK 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 2.2 Backplane Priority Jumpers

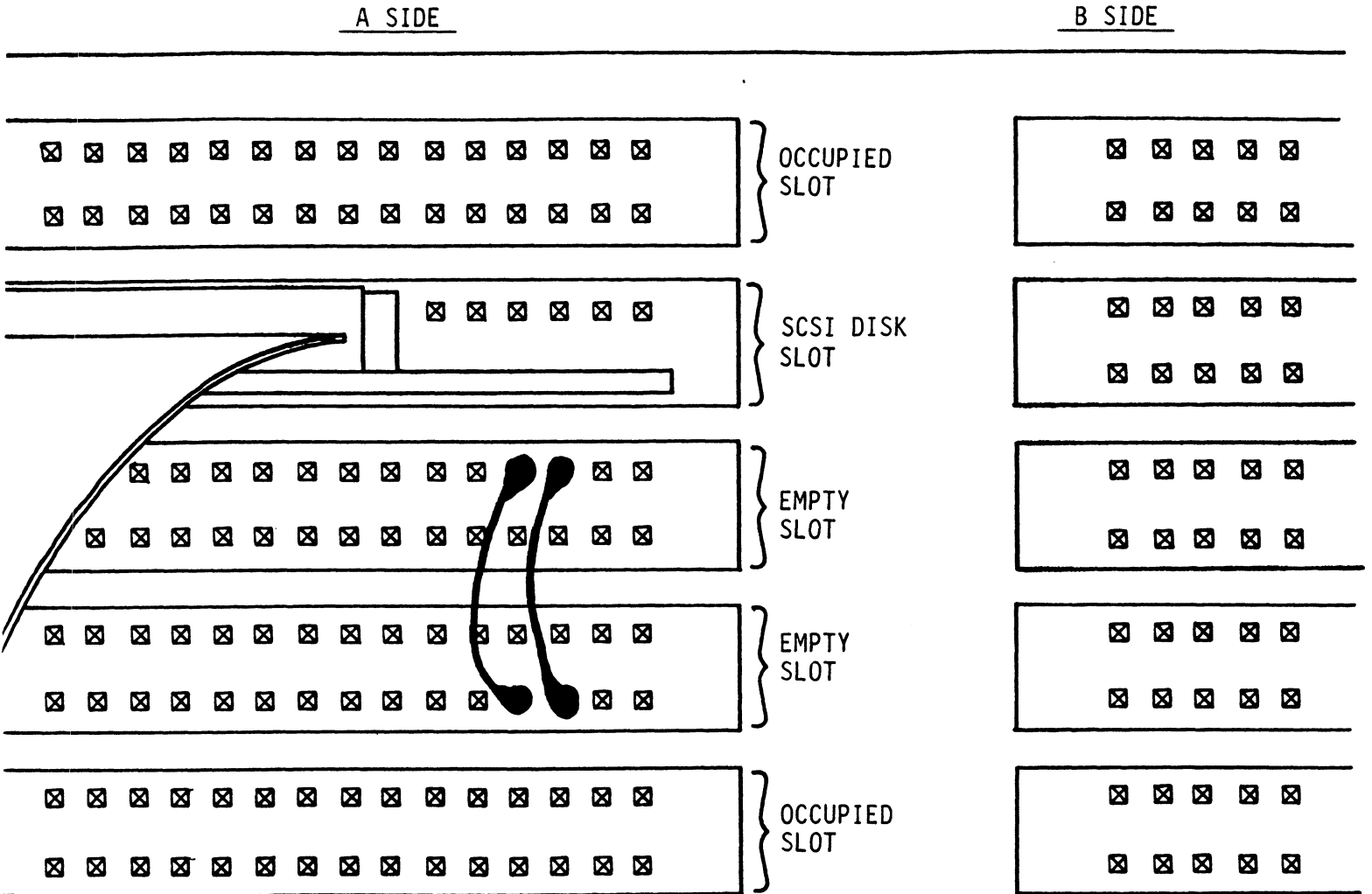
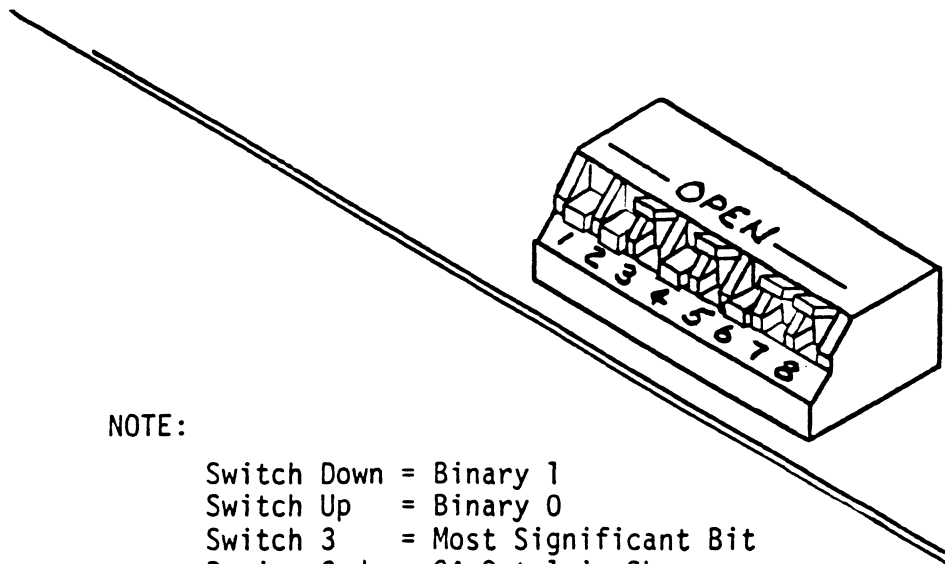


FIGURE 2.3 Device Code and EEPROM Write Disable Switches



NOTE:

- Switch Down = Binary 1
- Switch Up = Binary 0
- Switch 3 = Most Significant Bit
- Device Code = 24 Octal is Shown
- Switch 2 = EEPROM Write Disable when Switch is in DOWN Position

DEVICE CODE	S1 RESERVED	S2 EEPROM Write Disable	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

2.6 CONNECT ALL CABLES

Connect bulkhead cabling per the instructions in Section 2.6.1.

2.6.1 INTERNAL CABLING FOR FCC-COMPLIANT CHASSIS

The internal cable (P/N 300-148-00) is a flat 50-conductor cable terminated on one end with a socket connector and on the other with a "D" connector. As shown in Figure 2.4, the socket connector end plugs into the "A" paddleboard. The other end of this cable (D connector) mounts on the computer backpanel.

To mount the "D" connectors to the backpanel, first remove the covers from the desired mounting holes, and the hex bolts, washers, and nuts from the connectors. Then, insert the connector into the hole in the backpanel from the inside, insert the hex bolts from the outside, and secure the connector to the backpanel.

2.6.2 BMC BUS CABLING

The two BMC bus cables provided have a single 40-pin connector on one end and a group of connectors on the other end (4-connector P/N 300-038-00).

This cable daisy-chains from the computer's BMC interface to the multiple BMC peripheral controllers. The controller at the end of the chain must have its BMC terminators installed, the others must have them removed. Refer to Section 2.4.1 for BMC terminator installation.

Install the BMC bus cables as shown in Figure 2.4 by plugging the single-plug end of the cables into the DG BMC board, and the multiple-plug end of the cables into the SCSI Disk Controller and other BMC peripheral controllers.

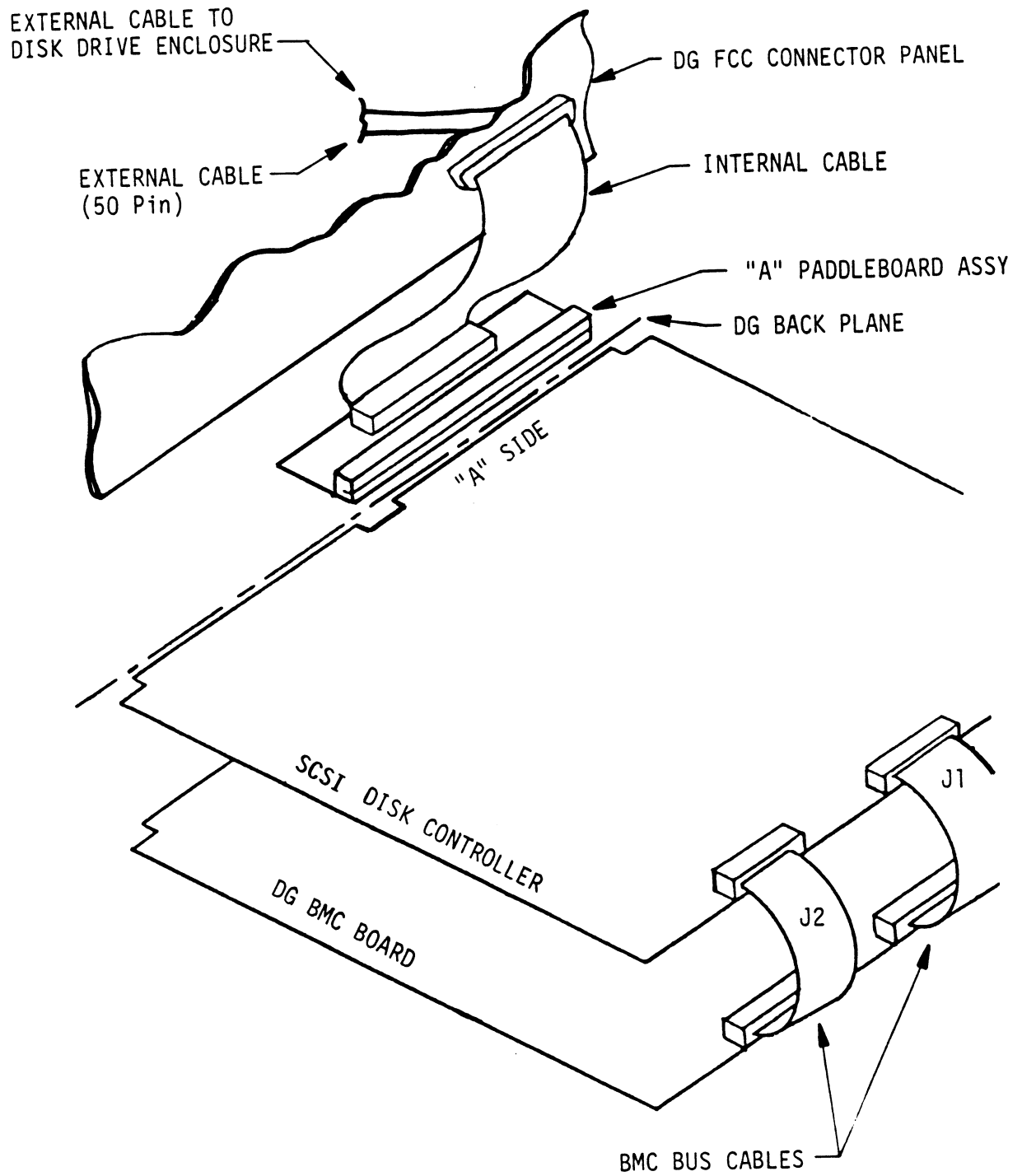
2.7 TURN THE SYSTEM ON

To find out the basic status of the controller upon power-up, observe the LEDs at the front edge of the board. Their meanings are described in section 1.2.1.

Self-test takes one second to complete. At that point the red LEDs should turn OFF and remain off. If either does not, or if either blinks, this indicates a Self-test failure. See Section 3.0 for assistance.

The green LEDs should be OFF, since no READ/WRITE activity will have been initiated immediately after power-up.

FIGURE 2.4 SCSI Disk Controller Cabling Diagram



SOFTWARE SUPPORT PACKAGE

In addition to the diagnostic functions provided by the SCSI Disk Controller via on-board Self-test, ZETACO provides Reliability and Utility software. The Software Support Package on a magnetic tape included with the controller contains these programs.

Each of the programs on the Software Support Tape has been written by ZETACO specifically for the SCSI Disk Controller. You should use this tape for loading controller Microcode, Media Formatting, Disk Diagnostic and Reliability, and Configuration of the Controller. DG's CORRESPONDING PROGRAMS MAY NOT WORK ON THIS CONTROLLER. Also note that the SCSI Disk Controller does not support MVSYSTEMX.

The Software Support Package tape is structured so that the programs on Files 2 through 7 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 loaded into the system.

At several points during the installation procedure, you will find sample dialogue 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 that do not appear in an actual session, and are here provided for clarification, will be preceded and followed by the characters "***".

If you are using an MV class machine, you must load the MV's microcode before 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 in on-line. Be sure that the BPI setting matches that specified on the tape label.
2. Boot the tape in your normal fashion.

It is unnecessary to set the switch register on the S/140.

3. The Software Support Package menu will be displayed:

FILE #	PROGRAM
2	GE SCSI CONFIGURATOR
3	GE SCSI DIAGNOSTIC
4	GE SCSI FORMATTER
5	GE SCSI INITIALIZER
6	GE SCSI RELIABILITY
7	GE SCSI COMMAND STRING
8	".SV & .LS" Files in RDOS DUMP Format
9	".SV & .LS" Files in AOS DUMP Format

File Number?

You should enter the number of the program you wish to execute.
At this point of the installation procedure, enter:

2 <cr>

to load the Configurator Program.

2.9 CONFIGURE THE SCSI DISK CONTROLLER

After the Configurator Program has loaded, the following message will appear on your computer screen:

```
CFGESCSI-CONFIGURATOR FOR GESCSI CONTROLLER
Revision Level = n.nn
Copyright 1987, ZETACO, Inc.
```

THE PURPOSE OF THE CONFIGURATOR PROGRAM IS TO ALLOW YOU TO TAILOR THE GESCSI DISK CONTROLLER TO YOUR PARTICULAR ENVIRONMENT. THE SCSI DISK CONTROLLER INCLUDES AN ELECTRICALLY ERASABLE PROM (EEPROM) THAT CONTAINS CERTAIN FACTS. THIS PROGRAM LETS YOU LIST THE CURRENT FACTS, MODIFY THOSE THAT YOU WANT CHANGED, AND RECORD THE NEW FACTS ONTO THE EEPROM.

THE HELP COMMAND ON THE MAIN MENU PROVIDES INFORMATION BOTH ON WHAT TO DO AND HOW TO DO IT. IF THIS IS THE FIRST TIME YOU HAVE RUN THIS PROGRAM, YOU MIGHT WANT TO START BY SELECTING HELP.

YOU CAN GET AN EXPLANATION OF ANY QUESTION THE PROGRAM ASKS BY RESPONDING TO THAT QUESTION WITH AN "H".

WHAT IS THE PRESENT SETTING OF THE DEVICE CODE (IN OCTAL)?

24

ENTER COMMAND (? TO SEE CHOICES):

**We have responded to the question about the device code of the controller with the primary device code. The program returned with a prompt for a Configurator 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 had not returned with any prompt, that would have indicated that the system was unable to contact the controller at that device code. In such cases, turn the computer off and double-check all of the preceding 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 UNIT NUMBER AND MISCELLANEOUS PREPARATION

Set the drive(s) to the desired unit number(s). This is usually done via jumpers in the drive. For two or more drives, unit numbers assigned are usually consecutive, with unit "0" being the primary unit.

2.11 USAGE OF FORMATTER, INITIALIZER & RELIABILITY

There are two general procedures with which these programs are used; the first installation of the product and the occasional preventive maintenance.

The first installation should follow the steps listed below.

1. Configure the Controller
2. Run FORMATTER Utility (use default path [A])
3. Run RELIABILITY (use physical mode)
4. Run INITIALIZER (use default path [Z])
5. Optionally run RELIABILITY (use logical mode)
(If this step is selected, you must run step 4 again before building RDOS.)

Follow the following steps for preventive maintenance.

1. Run INITIALIZER; use [A] path and select READ ONLY if you do not want to destroy your data.

NOTE: IT IS ALWAYS RECOMMENDED THAT YOU HAVE A CURRENT BACK-UP IN CASE SOME FATAL ERROR SHOULD OCCUR.

2. Run RELIABILITY in logical mode. Be sure to select READ ONLY and NO DATA VERIFICATION if you do not want to destroy your data.

The following sections will describe each of the programs as used during the first installation process.

2.12 ANALYZE THE DISK

The Formatter Program (File #4) consists of three modules:

1. ANALYZE DISK
2. RELOCATE BLOCKS
3. FORMAT ONLY

In the opening menu there are selections to enter and start the devices. You will need to select the [E]nter device selection and then you will be given the menu listing the above choices.

We recommend at this point that you run the Analyze module. This will format the disk and analyze the surface in order to relocate any bad blocks.

The following sample dialogue will guide you through this procedure.

To format the disk, boot the software support tape and load File #4. The sample dialogue below will guide you through the Analyze module of the Formatter Program.

GESCSI DISK FORMATTER
REV. X.XX

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COMMAND LIST

[E]NTER A DEVICE	[D]ELETE A DEVICE
[S]TART A DEVICE	[H]ALT A DEVICE
[R]ESTART THE PROGRAM	[L]IST ERROR TOTALS
[C]OMMAND LIST	[P]RINTER CONTROL
[F]LAGS	[M]ODE OF DISPLAY
[X]EQ AND ERROR LOG	[Q]UIT

ENTER A COMMAND SELECTION (C=CMD LIST):

We wish to enter the device that we want to format, so we type E.

E
ENTER THE DEVICE CODE [24]:
<cr>

24 is the primary device code. If you have your controller set up for the secondary device code of 64, you would enter that number here.

START INITIALIZATION OF CONTROLLER
CONTROLLER MICROCODE REV: X.XX
END INITIALIZATION OF CONTROLLER

This is just telling you that the program is loading microcode onto the SCSI Disk Controller, and what the revision number is.

SCSI DEV. 0. UNIT 0. IS READY; SELECT (YES, [NO]):
YES

The Formatter Program has looked at the SCSI Disk Controller and found that SCSI DEV. 0, Unit 0 is ready. It then asks you if you want to use this unit. If you do then you would type YES. If not, then type <cr> and the Formatter Program would go on to the next ready unit.

COMMAND CHOICES

[A]NALYZE DISK
[R]ELOCATE BLOCKS
[F]ORMAT ONLY

ENTER YOUR SELECTION [A]:
A

At this time we want to Analyze the disk so we can run the Reliability Program and verify that the subsystem is operational.

FORMAT ([YES] NO):
YES

You should select to Format.

RETAIN ANY PREVIOUSLY RELOCATED SECTORS? IF YOU DO NOT
RETAIN THE PREVIOUSLY RELOCATED SECTORS, IT IS RECOMMENDED
THAT A FULL FIVE PATTERN ANALYSIS BE DONE IN ORDER TO
RELOCATE ALL THE BAD SECTORS THAT WERE PREVIOUSLY BEING
HANDLED ([YES] NO):

YES

You'll usually want to retain previous lists on formatting.

THE DATA PATTERNS LISTED BELOW ARE USED IN THE ORDER LISTED.

AAAA	2525	5555	1F1F	FFFF
0000	FGFG	5252	F1F1	GFGF

ENTER THE NUMBER OF PATTERNS TO RUN [5]:
<cr>

Use the default.

SCSI DEV. 0. UNIT 0. IS SELECTED

** NOTE **

YOU MUST ENTER [S]TART IN ORDER TO HAVE THE SELECTED OPERATIONS ACTUALLY TAKE PLACE.

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COMMAND LIST

[E]NTER A DEVICE	[D]ELETE A DEVICE
[S]TART A DEVICE	[H]ALT A DEVICE
[R]ESTART THE PROGRAM	[L]IST ERROR TOTALS
[C]OMMAND LIST	[P]RINTER CONTROL
[F]LAGS	[M]ODE OF DISPLAY
[X]EQ AND ERROR LOG	[Q]UIT

ENTER A COMMAND SELECTION (C=CMD LIST):
S

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

This will start the program Analyzing. Now you may enter other commands such as [L]IST.

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COMMAND LIST

[E]NTER A DEVICE	[D]ELETE A DEVICE
[S]TART A DEVICE	[H]ALT A DEVICE
[R]ESTART THE PROGRAM	[L]IST ERROR TOTALS
[C]OMMAND LIST	[P]RINTER CONTROL
[F]LAGS	[M]ODE OF DISPLAY
[X]EQ AND ERROR LOG	[Q]UIT

ENTER A COMMAND SELECTION (C=CMD LIST):
L

****As the Analyzing moves along, you may want to see if it is still active. Use of the L command will show you the current state of each of the devices being Analyzed.****

```
RUN TIME 0. HRS. 20. MINS. 3. SECS.  
DEVICE CODE 24 SCSI DEV. NUMBER 0. UNIT NUMBER 0.  
STATE: **ACTIVE**  
MODES: FORMAT - ANALYZE  
FORMATTING IN PROGRESS # OF BLOCKS ANALYZED: 0.  
# OF HARD ERRORS REPORTED: 0.  
# OF SOFT ERRORS REPORTED: 0.
```

****This tells us that we are Formatting and Analyzing.****

```
RUN TIME 0. HRS. 40. MINS. 3. SECS.  
DEVICE CODE 24 SCSI DEV. NUMBER 0. UNIT NUMBER 0.  
DEVICE STATE: **ACTIVE**  
MODES: - FORMAT - ANALYZE  
THIS UNIT IS COMPLETE WITH ITS ASSIGNED TASKS.
```

****When this message is printed, the program has finished with the unit, and you may now enter the [Q]UIT key.****

At this point, before going on to Section 2.13, you should press the "E" key and enter the device code of the controller. This will initialize the controller microcode. DO NOT answer "yes" to any of the select questions. Now go on to Section 2.13.

2.13 RUN RELIABILITY TO VERIFY THE INSTALLATION

At this point, run Reliability for several minutes, just to verify that the subsystem is operating after the initial format. To do so, boot the software support tape and load File #6.

The Reliability Program consists of two basic modules. The first is the Random RELI. In this module, the disk transfer addresses and size are selected at random. The data type will be selected by the user, but if ALL PATTERNS is selected, the pattern will be selected at random as well. In random RELI sixteen device control blocks will be active and distributed randomly between the devices that are currently active.

The second module is the Sequential RELI. In this module, the disk is first written sequentially and then is read sequentially. After the READ is finished, the device halts and is finished. If ALL PATTERNS is selected, each of these patterns is completed in the order that they are listed. In both of these modules, device control blocks will be stacked on the controller for multiple units. Multiple controllers will also be active simultaneously. The sample dialogue below will guide you in getting the program started.

RELIABILITY PROGRAM

PHYSICAL MODE: RUNS THE ACTUAL DISK DRIVES THAT ARE
CONNECTED AND REQUIRES MICROCODE TO BE ON THE CONTROLLER.
LOGICAL MODE: RUNS THE LOGICAL DISK AS THE SYSTEM WOULD
SEE IT AND WILL LOAD MICROCODE FROM THE DISK DRIVE.
DO YOU WISH TO RUN IN PHYSICAL MODE (YES, [NO]): YES

At this time we will run a physical disk.

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

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

ENTER YOUR CHOICE [R]:
<cr>

**This question refers to the order in which the disk will be
accessed for all of the devices tested in the Reliability. We
will choose the default, "R".**

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COMMAND LIST

[E]NTER A DEVICE	[D]ELETE A DEVICE
[S]TART A DEVICE	[H]ALT A DEVICE
[R]ESTART THE PROGRAM	[L]IST ERROR TOTALS
[C]OMMAND LIST	[P]RINTER CONTROL
[F]LAGS	[M]ODE OF DISPLAY
[X]EQ AND ERROR LOG	[Q]UIT

ENTER A COMMAND SELECTION (C=CMD LIST):
E

ENTER THE DEVICE CODE [24]:
<cr>

**24 is the primary device code. If you have your controller
set up for the secondary device code of 64, you would enter
that number here.**

START INITIALIZATION OF CONTROLLER
CONTROLLER MICROCODE REV: X.XX
END INITIALIZATION OF CONTROLLER

**This is just telling you that the Reliability Program is
loading the microcode onto the SCSI Disk Controller from the
disk. The revision number is also displayed.**

UNIT 0. IS READY; SELECT (YES,[NO]):
<cr>

The Reliability Program has looked at the Controller and found that UNIT 0 is ready. It then asks you if you want to use this unit. If you do then you would type "YES". If you do not, then type <cr> and the Program will go on to the next ready unit.

THE DISK SIZE IS XXX. MB

WRITE ONLY (YES,[NO]):

<cr>

READ ONLY (YES,[NO]):

<cr>

VERIFY DATA ([YES],NO):

<cr>

SELECT DATA TYPE:

0 - LOGICAL BLOCK ADDRESS	1 - FLOATING ZERO
2 - FLOATING ONE	3 - ALTERNATE ZEROS (52525)
4 - ALTERNATE ONES (125252)	5 - ALL ZEROS
6 - ALL ONES	7 - RANDOM
8 - ROTATING (125252)	9 - DO ALL PATTERNS

SELECT DATA TYPE [0.]:

<cr>

UNIT 0. IS SELECTED
UNIT 1. IS NOT READY
UNIT 2. IS NOT READY
UNIT 3. IS NOT READY

GESCSI RELIABILITY UTILITY
REV. X.XX

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COMMAND LIST

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

ENTER A COMMAND CHOICE (C=CMD LIST):

S

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

<cr>

At this point you are finished Entering your device and have commanded the program to start running. The green LEDs on the front of the controller board should now be ON (they are actually flashing very rapidly), signifying that the controller is active. You may at any time initiate another command from the list simply by typing its letter.

L

RUN TIME 0. HRS. 20. MIN. 3. SECS.
DEVICE CODE 24 UNIT NUMBER 0. MAPPING NOT
ENABLED DEVICE STATE:
MODES: RANDOM, R/W, DATA CHECK-ADDRESS
SECTORS WRITTEN 451. # OF SECTORS READ 451.
TOTAL ERRORS : 0.

ENTER A COMMAND SELECTION (C=CMD LIST):

**We selected List to get a printout of the system's activity. In this case, there are no errors logged. If you select List again, you should see that the number of sectors written and read has increased; this confirms that the subsystem is operational. Data compare errors will require further trouble-shooting. For trouble-shooting help, see Section 3.0. We recommend that you run this for at least five minutes.

2.14 INITIALIZE THE DISK

The Initializer Program (File #5) consists of four modules:

1. ZDKINIT (Also does: INSTL MCODE, INIT SOFT LOG)
2. ANALYZE DISK
3. RELOCATE BLOCKS
4. MICROCODE INSTALL ONLY

In the opening menu there are selections to enter and start the devices. You will need to select the [E]nter device selection and then you will be given the menu listing the above choices.

We recommend at this point that you run the ZDKINIT module. This will write out RDOS DKINIT data, write out the microcode, and write out an empty soft error log for the microcode to use. You must run this path even if you are not going to use RDOS.

The following sample dialogue will guide you through this procedure.

To ZDKINIT the disk, boot the software support tape and load File #5. The sample dialogue below will guide you through the ZDKINIT module of the Initializer program.

GESCSI DISK INITIALIZER
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COMMAND LIST

[E]NTER A DEVICE	[D]ELETE A DEVICE
[S]TART A DEVICE	[H]ALT A DEVICE
[R]ESTART THE PROGRAM	[L]IST ERROR TOTALS
[C]OMMAND LIST	[P]RINTER CONTROL
[F]LAGS	[M]ODE OF DISPLAY
[X]EQ AND ERROR LOG	[Q]UIT

ENTER A COMMAND SELECTION (C=CMD LIST):

We want to enter the device that we want to ZDKINIT, so we type E.

E
ENTER THE DEVICE CODE [24]:
<cr>

24 is the primary device code. If you have your controller set up for the secondary device code of 64, you would enter that number here.

START INITIALIZATION OF CONTROLLER
CONTROLLER MICROCODE REV: X.XX
END INITIALIZATION OF CONTROLLER

This is just telling you that the program is loading microcode onto the SCSI Disk Controller and what the revision number is.

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

The Initializer Program has looked at the SCSI Disk Controller and found that Unit 0 is ready. It then asks you if you want to use Unit 0. If you do then you would type YES. If not, then type <cr> and the Initializer Program would go on to the next ready unit.

COMMAND CHOICES

[Z]DKINIT (ZDKINIT, INSTALL MICROCODE, INIT SOFT LOG)
[A]NALYZE DISK
[R]ELOCATE BLOCKS
[M]ICROCODE INSTALL ONLY

ENTER YOUR SELECTION [Z]:
Z

****At this time we want to ZDKINIT the disk.****

UNIT 0. IS SELECTED
UNIT 1. IS NOT READY
UNIT 2. IS NOT READY
UNIT 3. IS NOT READY

****** NOTE **** YOU MUST ENTER [S]TART IN ORDER TO HAVE THE
SELECTED OPERATIONS ACTUALLY TAKE PLACE.**

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COMMAND LIST

[E]NTER A DEVICE	[D]ELETE A DEVICE
[S]TART A DEVICE	[H]ALT A DEVICE
[R]ESTART THE PROGRAM	[L]IST ERROR TOTALS
[C]OMMAND LIST	[P]RINTER CONTROL
[F]LAGS	[M]ODE OF DISPLAY
[X]EQ AND ERROR LOG	[Q]UIT

ENTER A COMMAND SELECTION (C=CMD LIST):
S

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

****This will start the program initializing. Now you may enter
other commands such as [L]IST.****

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COMMAND LIST

[E]NTER A DEVICE	[D]ELETE A DEVICE
[S]TART A DEVICE	[H]ALT A DEVICE
[R]ESTART THE PROGRAM	[L]IST ERROR TOTALS
[C]OMMAND LIST	[P]RINTER CONTROL
[F]LAGS	[M]ODE OF DISPLAY
[X]EQ AND ERROR LOG	[Q]UIT

ENTER A COMMAND SELECTION (C=CMD LIST):

RUN TIME 0. HRS. 40. MINS. 3. SECS.
DEVICE CODE 24 UNIT NUMBER 0. DEVICE STATE: ****ACTIVE****
MODES: - ZDKINIT
THIS UNIT IS COMPLETE WITH ITS ASSIGNED TASKS.

****When the message is printed, the program has finished with
the unit, and you may now enter the [Q]UIT key.****

2.15 RUN RELIABILITY TO VERIFY THE INSTALLATION

At this point you may optionally run Reliability for several minutes, just to verify that the system is operating after the initial format. To do so, boot the software tape and load file #6.

NOTE: IF YOU OPT TO DO SO, YOU WILL HAVE TO COMPLETE SECTION 2.14 AGAIN IF RDOS IS TO BE RUN. IF YOU WANT TO RUN THIS, JUST FOLLOW SECTION 2.13 AND SELECT LOGICAL MODE WHEN ASKED.

3.0 TROUBLE-SHOOTING

The SCSI Disk Controller is supported by ZETACO in the following ways:

- Microprocessor-based Self-test of over 90% of the board each time it is powered up, with an LED status report.
- Reliability Program 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. (612-941-9480)
- 48-hour turnaround on most factory repairs or replacements.
- Up to a two year warranty on workmanship and materials.

3.1 SELF-TEST

Self-test checks out 90% of all the internal functions of the Controller once every time power is applied. Self-test is actually composed of 2 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)

The entire test takes approximately 2 seconds to execute. Once Self-test has passed, all LEDs will go out.

If a failure is detected in either the SCSI or HOST module, one or both red LEDs will flash a repeating numerical series; the number of flashes in the series corresponds to the specific subtest that failed. Tables 3.1 and 3.2 identify the subtests for the SCSI and HOST modules.

-- Both red LEDs remain steadily lit:

1. TURN OFF THE COMPUTER, remove the controller and re-install it. Be sure it is firmly seated in the backplane connectors.
2. TURN OFF THE COMPUTER, remove the controller and install it in a different slot. To do so, you will need to rearrange your priority jumpers. See Section 2.3.
3. Call your maintenance organization.

-- Either or both red LEDs flash an error code:

1. TURN OFF THE COMPUTER, clean the gold fingers on the edge connector and re-install the controller.
2. Record the error code and call your maintenance organization.

3.1.1 ERRORS DURING SYSTEM OPERATION

When an error is displayed during system operation, write down the message that appears on the screen. If either red LED is flashing an error code, make note of it and consult Table 3.3 for a description of the error code. Then contact your maintenance organization.

TABLE 3.1 Host Module Error Codes

CODE	TEST
1	RAM TEST
2	HI-SPEED BUFFER 1
3	HI-SPEED BUFFER 2
4	DONE
5	BURST COUNTER
6	BREAK COUNTER
7	BMC CB TEST
8	SECTOR TRANSFER SIMULATION
9	EEPROM CHECKSUM
10	DUAL PORT RAM
11	RESERVED
12	RESERVED
13	RESERVED
14	ERROR CONDITION

TABLE 3.2 SCSI Module Error Codes

CODE	TEST
1	RESERVED
2	DYNAMIC RAM TEST
3	BMC DATA BUFFER
4	DUAL PORT RAM
5	5380 SCSI IC
6	DYNAMIC RAM PARITY
7	NOT USED
8	NOT USED

TABLE 3.3 Operation Error Codes

CODE	TEST
9	BMC DATA BUFFER PARITY ERROR
10	DYNAMIC RAM PARITY
11	ILLEGAL INTERRUPT FROM HOST SIDE

3.2 SYSTEM ERRORS

If a system error occurs, refer to the DG User's Manual provided with the system to help determine what is wrong. For example, if a panic code is given, look up the code by referring to the DG User's Manual. This information should help determine how to solve the problem. Next, try to execute a similar function and see if the same results are obtained. If a BURST or a COPY is not working, try a DUMP. This could add vital information about the problem.

3.2.1 TEST PROGRAMS TO USE IF THE SYSTEM IS BUILT BUT PROBLEMS HAVE ARISEN

This section explains a test that can be done on a disk that has a system or system data on it without destroying that system or data. This provides an avenue for conditions requiring diagnostic testing, but where time does not permit for rebuilding the system.

This test requires that the Reliability program on the Software Support Package tape be loaded into system memory.

Go through the enter procedure as you would normally (select Logical Mode), except when it asks you "READ ONLY (YES,[NO]):" answer YES. Then when it asks you "VERIFY DATA ([YES],NO):" answer NO. Now start RELI with the S Command.

This will test the controller's ability to seek, read data from the disk and transfer data on the BMC without destroying the data on the disk.

3.3 RELIABILITY - ERROR DESCRIPTION

If Self-test was successful but there are still problems with the subsystem, run the Reliability program. Reliability will display PIO errors, CB errors and Data Compare errors.

PIO errors will be of the format:

```
                Timeout type errors
                RUN TIME 0. HRS. 20. MINS. 3. SECS.
                DEVICE CODE: 24 UNIT NUMBER: 0.          STATE:
**ACTIVE**
                MODES: RANDOM, R/W, DATA CHECK - ADDR
                   REG A   REG B   REG C
OPERATION          0     3400     201
STATUS             0         0         0
                TIMEOUT WAITING FOR INTERRUPT.
```

****Timeout errors are generally fatal and will likely cause other unrelated errors to occur.****

```
                PIO status type errors
                RUN TIME 0. HRS. 20. MINS. 3. SECS.
                DEVICE CODE 24 UNIT NUMBER 0.          STATE: **ACTIVE**
                MODES: RANDOM, R/W, DATA CHECK - ADDR
                   REG A   REG B   REG C
OPERATION          0     3400     201
STATUS             0     3400  144201
```

CB errors will have the following format:

```
RUN TIME 0. HRS. 20. MINS. 3. SECS.
DEVICE CODE 24 UNIT NUMBER 0. MAPPING NOT ENABLED
STATE: **ACTIVE**
MODES: RANDOM, R/W, DATA CHECK - ADDR
LOGICAL BLOCK      124532      SECTOR COUNT      4
MEMORY ADDRESS     64321 COMMAND      WRITE
PAGE TABLE ADDRESS 0      RETURNED XFER COUNT 0
PHYSICAL BLOCK: 125452 = CYLINDER: 123 HEAD: 3 SECTOR:
                    34
ASYNC STATUS      :          3
                    CB EXECUTION ERROR : HARD ERRORS
CB STATUS         : 100001
                    ANY CB HARD EXECUTION ERROR
                    CB DONE BIT
CB ERROR          :          1
                    HEADER NONCOMPARE
CB UNIT STATUS   : 24000
                    READY
                    PORT RESERVED BIT 1
DISK ERROR       : 5000
```

The physical block shown above can be entered into the initializer as a bad block address. The logical block is the starting logical block address. If the returned transfer count is added to the logical block, you will have the logical block in error, but this block is not the ACTUAL block on the disk due to controller features. The physical block is in fact the actual block in error on the disk

Data Compare errors will have the following format:

***** DATA COMPARE ERROR *****

```
DEVICE CODE 24 UNIT NUMBER 0. MAPPING NOT ENABLED
STATE: **ACTIVE**
MODES: RANDOM, R/W, DATA CHECK - ADDR
LOGICAL BLOCK      : 12345 SECTOR COUNT      :          3
PAGE TABLE ADDRESS :          0 LOGICAL XFER ADDRESS: 56271
PHYSICAL XFER ADDRESS: 56271
EXPECTED      RECEIVED      OFFSET
165346      165347          1
165346      165347          3
165346      165347          5
TOTAL ERROR COUNT: 384.
```

For further description of the error status, refer to Data General Programmer's Reference Series: Models 6236/6237 and 6239/6240 Disk Subsystems.

3.4 FORMATTER & INITIALIZER - ERROR DESCRIPTION

If Reliability fails, you can try reformatting the disk drive. This will destroy any data on the disk, but it may get the subsystem working again. You could then rebuild your system on the disk. The initializer error display is as follows.

PIO errors will have the following format:

(Same as the Reliability in Section 3.4)

CB errors will have the following format:

```
RUN TIME 0. HRS. 20. MINS. 3. SECS.
DEVICE CODE 24 UNIT NUMBER 0. STATE: **ACTIVE**
MODES: - ANALYZE
PHYSICAL BLOCK 124532 SECTOR COUNT 1240
MEMORY ADDRESS 64321 COMMAND WRITE ONE/WORD
PAGE TABLE ADDRESS 0 RETURNED XFER COUNT 22
PHYSICAL BLOCK: 124554 = CYLINDER: 123 HEAD: 3 SECTOR: 34
ACTIVE DATA AAAA
ASYNC STATUS : 3
      CB EXECUTION ERROR : HARD ERROR
CB STATUS : 10001
      ANY CB HARD EXECUTION ERROR
      CB DONE BIT
CB ERROR : 1
      HEADER NONCOMPARE
CB UNIT STATUS : 24000
      READY
      PORT RESERVED BIT 1
DISK ERROR : 17000
```

The physical block shown at the top is the starting physical block and the erroring physical block is shown below with the cylinder, head, and sector.

For further description of the error status refer to Data General 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 disk 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 controller you will need to issue the E command in the GESCSIF program to load microcode onto the board. Do not select any device. Default through and enter Quit.

3.5.1 GLOBAL PARAMETERS

These are the overall operating conditions of the program under which the test set will run. They are the display mode, test loop count, and pass count.

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 "." (e.g., 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.

2. 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

When you run the program you:

1. Select some global program parameters
2. Modify the test set if desired
3. Enter your device
4. Run the tests
5. 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 test 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 first have to 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])?
```

PROCEED FROM ERROR: 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
DISPLAY RUN TIME OF EACH TEST ([N])?
```

10. 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:

```
ILLEGAL CMD TST
PC      :   7711      LISTING PC:   47
TEST # :    16.     TEST NAME :  RECAL COMMAND TEST
                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 THE COMMAND STRING

The Command String is a program that will allow the operator to create a string of controller commands and have them executed under a controlled environment. The CMDSTR has support of most ARGUS type commands as well as any special product related commands. It also has some control commands to allow loops and delays to be used as well.

3.6.1 GLOBAL PARAMETERS

These are the overall operating conditions of the program under which the strings will run.

1. Mode of Display (M Key)

The display mode option allows you to select the numbering system in which most of your numbers will be displayed. Decimal numbers will be followed by a ".". Octal numbers will not. Hex numbers will include any required leading zeroes.

Note that when the program asks for a number it will display the required numbering system to use. Any leading zeroes need not be entered nor the trailing ".". Whenever the program asks for 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.

3.6.2 THE COMMAND LIST

The following is a list of some of the commands and their basic functions.

1. [E]NTER a String

This choice allows us to set up our command string. There are 8 available strings to set up and run as you wish. At this point, you will be sitting at a command question. The default will be NOP. This is a "do-nothing" command. To see the list of commands, enter HELP. Note that (esc) is used to terminate entry of a string. This can be entered at any time without any loss of data that is after the point of exit. The UP and DOWN commands are for editing purposes. DISPLAY will allow the displaying of the string as it is so far. Commands cannot be deleted, thus, the command NOP is used to replace them with a do-nothing command. Upon termination of the entry of a string, the program will automatically display the string.

2. [S]TART a String

This command will start any string. If the string has not been entered it is filled with a NOP command and will do nothing. Only one string can be running at a time. If the string has a halt or reaches the end, it will display a halting message and the time of execution.

3. [H]ALT a String

This command will halt the currently executed string.

3.6.3 COMMANDS

The following is a list of some of the commands and their proper usage.

UP	Move UP to the previous command
DOWN	Move DOWN to the next command
NOP	Do-Nothing Command - Use to fill command slots that you want to delete.
DISPLAY	DISPLAY the string thus far
HALT	HALT execution of string at this point
GOTO	Loop to a command indefinitely
LOOP	LOOP to a command X times
DELAY	DELAY x tenths of a second
INITIALIZE	INITIALIZE controller (microcode on disk)
REINITIALIZE	REINITIALIZE a controller (microcode on controller)
PIO COMMAND	Issue a PIO COMMAND (refer to programmer's notes)
RC, OR RECAL	Issue a RECAL
RDS, OR READ SECTOR	Issue a READ CB
RDO, OR READ ONE WORD	Issue a READ ONE WORD CB
WTS, OR WRITE ONE WORD	Issue a WRITE ONE WORD CB
DP, OR DUAL PORT	Issue a DUAL PORT command directly to Dual Port - Use this command to communicate to the SCSI side of the controller.

3.6.4 EXAMPLES OF ERRORS REPORTED BY THE PROGRAM

The error displays for this program are the same as those for the Reliability program.

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.

Please review the General Installation Checklist before calling the Hotline.

3.8 WARRANTY INFORMATION

All ZETACO products are warranted free from manufacturing and material defects, when used in a normal and proper manner, for a period of up to two years from date of shipment. Except for the express warranties stated above, ZETACO disclaims all warranties including all implied warranties 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.

3.9 PRODUCT RETURN AUTHORIZATION

All possible effort to test a suspected malfunctioning controller should be made before returning the controller to ZETACO for repair. However, if controller or module malfunction has been confirmed using the tests outline in Sections 3.1 to 3.5, the board can be returned to ZETACO for warranty repair or for time-and-material repair if it is out of warranty. 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.

GENERAL INSTALLATION CHECKLIST

CPU_____ Operating System and Rev._____

Is board replacing a previously installed subsystem?_____

Device Code of New Product:_____ Any similar subsystem in the CPU?

YES NO If yes, then its Device Code:_____

Configuration Facts_____

Problem Description_____

Problem happens where (during DUMP, RELIABILITY, etc.)?_____

Intermittent or consistent problem?_____

Does Self-test pass?_____

Priority of Board in CPU (slot)_____

BMC Priorities of other BMC Devices_____

Reviewed Interrupt and Priority Jumpers on vacant slots?_____

Tried different slot?_____

Cleaned gold-fingered contact points of board and reset board?_____

Supplied ZETACO 1/2" tape "BOOT" correctly?_____

Is disk drive set to correct unit number, and is terminator in?_____

What is sector switch setting on the disk drive?_____

Double checked PIN 1 of cable to PIN 1 of controller, backplane and peripheral?_____

Result of ZETACO Reliability or Diagnostic?_____

MATERIAL RETURN INFORMATION

All possible effort to test a suspected malfunctioning controller should be made before returning the controller to ZETACO, Inc. for repair. 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.

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

1. Does the problem appear to be intermittent or heat sensitive? (If yes, explain.)
2. Under what operating system are you running? (AOS, AOS/VS, RDOS, etc.)
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 CONTROLLER USAGE GUIDELINES

4.1 CONTROLLER FEATURES PROGRAMMED BY THE CONFIGURATOR

4.1.1 CONFIGURATOR AID (HELP)

The SCSI Disk Controller Configurator Program includes two "HELP" commands: one for OPERATIONAL questions and one that suggests WHAT you might want to do. You can get an explanation for any item by responding with an "H" to the question. Please use these functions whenever you are uncertain as to what to do.

4.1.2 THROTTLE BURST RATE

This is defined as the number of word transfers that take place over the BMC during a single bus access by the disk controller. Throttle adjustment is dependent upon the type of system configuration in which the controller is installed. Too low a throttle setting could result in slow disk performance and too high a setting could cause a data late on another BMC device. The controller may be set to burst rates of 1, 2, 4, 8, 16, 32, 64, 128 and 256 words per access. A burst rate of 32 is recommended for most applications.

To maximize overall performance, the Burst Rate should be set to the largest value that doesn't cause interference on other controllers, such as "data lates".

4.1.3 BMC BUS PRIORITY

The SCSI Disk Controller has the capability of functioning with up to seven other BMC peripheral controllers. However, some DG computers, such as the MV/4000 and S/280 only support up to four BMC devices.

In this case you must select priorities 0 through 3, 3 being the highest priority. The lower the priority number the lower the priority level. If there is more than one BMC device, make sure you select a priority level that is different than the other BMC devices.

4.1.4 BREAK COUNT INTERVAL

The Break Count Interval is defined as the period of time that the SCSI Disk Controller is off the BMC bus. This period is a multiple of the BMC Sync Clock period, which in turn varies from computer to computer. A Break Count interval setting of 1 is equal to one Sync Clock period. The maximum setting is 255. A setting of 4 is recommended.

If there are other BMC devices present, it may be desirable to increase this count to allow more time for the other devices to access the bus. If the Break Count is set too large, slow disk performance may result. A larger Break Count also allows the CPU more memory time.

APPENDIX A

A.0 THEORY OF OPERATION

The SCSI Disk Controller is an Argus-emulating disk controller that interfaces to magnetic disk drives via the Small Computer Systems Interface (SCSI). The controller supports single-ended transmissions over the SCSI bus.

A.1 ARCHITECTURAL OVERVIEW OF THE SCSI DISK CONTROLLER

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 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 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.

APPENDIX B

B.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 controller. In the instructions below, "DSKP" stands for the controller device code.

1. In the RDOS CLI, do INIT DAO, then RELEASE DAO.
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:	A	l	t	D	e	v	C	d	!	1	0	1	0	0	0	1
OCTAL:	x	x	1	2	1	7										
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 com 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.

APPENDIX C

C.0 EXECUTION LOG

The controller SCSI processor maintains an execution log in RAM which records each 8-byte command passed from the controller host processor to SCSI processor. The controller also records a reference "time" for each log entry from a free-running clock on the controller. The log is circular and holds 128 entries. A pointer in the word preceding the log points to the oldest entry.

C.1 EXAMINING THE EXECUTION LOG

To examine the execution log, load and run either the Reliability or Initializer program. Anytime after the controller device code has been specified, access to the execution log is made by entering "X". A submenu will appear that will allow you to display or clear the log, or select the base (hex, oct, dec) used in displaying the information.

Entering the Display Log command will list the entries beginning with the most recent. Each entry consists of 8 words of information, displayed across one line on the screen. The layout of an entry is illustrated in Table C.1.

TABLE C.1 EXECUTION LOG ENTRY LAYOUT

WORD	UPPER BYTE	LOWER BYTE
0	TIME OF EVENT	
1	COMMAND CODE	1 LOGICAL UNIT NO.
2	BLOCK ADDRESS UPPER	
3	RESERVED (1)	0 BLOCK ADDR LOWER
4	TRANSFER BLOCK COUNT	
5	NOT USED	
6	NOT USED	
7	NOT USED	

C.2 FIELD DEFINITIONS

C.2.1 TIME OF EVENT

This represents the "time" of the entry and is taken from a free-running clock on the controller. The clock is incremented by 1 every 25 milliseconds. The clock is initialized to 0 upon reset or a Begin command.

C.2.2 LOGICAL UNIT/VALID

This value represents the logical unit specified by the system to the controller, before controller re-mapping. Bit 7 of word 1 indicates a valid command and should be 1.

C.2.3 COMMAND CODE

This is the command passed to the controller SCSI processor. The runtime command codes are listed below:

- 01 - RECALIBRATE
- 02 - READ NEXT BLOCK
- 03 - WRITE NEXT BLOCK
- 04 - READ
- 05 - WRITE
- 09 - READ POSITION
- 11 - SEEK
- 13 - LOAD PARAMETER
- 14 - LOAD NEXT PARAMETER
- 18 - READ UNIT STATUS
- 1C - BEGIN

C.2.4 BLOCK ADDRESS UPPER

This word contains the upper 16 bits of the 23 bit logical block address passed to the SCSI processor.

C.2.5 BLOCK ADDRESS LOWER

This byte contains the lower 7 bits of the 23 bit logical block address passed to the SCSI processor. The upper bit is always zero.

C.2.6 TRANSFER BLOCK COUNT

The number of blocks of data to transferred between the controller and the logical unit for the command.

APPENDIX D

D.0 ERROR LOG

The controller SCSI processor uses an error logging system that saves information related to errors, detected during operation, in controller memory. The log saves 32 16-bit words of information for each error. The log is circular and holds up to 16 entries. The log is cleared upon power-up only.

D.1 EXAMINING THE ERROR LOG

To examine the error log, load and run either the Reliability or Initializer program. After the device code has been specified, enter the ELOG by entering "X". Enter DE to display the Error Log. The display is from most to least recent and will loop back to the most recent entry when the end is reached.

The layout of an entry is illustrated in Table D.1.

TABLE D.1 ERROR LOG ENTRY LAYOUT

WORD	UPPER BYTE	LOWER BYTE
0	UNIT SCSI ID	ERROR CODE
1	TIME OF ERROR	
2	RETURNED SCSI STATUS	DRIVER STATUS
3 THRU 7	COMMAND DESCRIPTOR 1 - - - - COMMAND DESCRIPTOR 9	COMMAND DESCRIPTOR 0 - - - - COMMAND DESCRIPTOR 8
8	SCSI MESSAGE IN	SCSI MESSAGE OUT
9	INTERFACE STATUS	
A	INTERFACE ERRORS	
B	DRIVER CONTROL BLOCK OFFSET	
C THRU F	5380 BYTE 1 - - - - 5380 BYTE 7	5380 BYTE 0 - - - - 5380 BYTE 6
10 THRU 17	SENSE BYTE 1 - - - - SENSE BYTE 15	SENSE BYTE 0 - - - - SENSE BYTE 14
18-1F	RESERVED	

D.2 FIELD DEFINITIONS

D.2.1 ERROR CODE

The error code indicates the failing controller or drive operation. Table D.2 lists the error codes.

TABLE D.2 ERROR CODES

CODE (HEX)	DESCRIPTION
01	SKIPPED A SECTOR
02	NO UNIT RESPONSE
04	SECTOR HEADER MISCOMPARE
06	SECTOR NOT FOUND
07	ILLEGAL COMMAND RECEIVED
08	CONTROLLER DETECTED DATA (PARITY) ERROR
09	DRIVE FAULT
0B	DRIVE WRITE PROTECTED
13	RECOVERED MEDIA ERROR
14	NON-RECOVERABLE MEDIA ERROR
20	HANG TIMER TIMEOUT
21	UNUSED 186 INTERRUPT DETECTED
22	DATA BUFFER PARITY ERROR INTERRUPT
23	DYNAMIC RAM PARITY ERROR INTERRUPT

D.2.2 UNIT SCSI ID

This byte contains the SCSI ID bit of the device associated with the error.

D.2.3 TIME OF ERROR

This represents the "time" of the error and is taken from the execution log's free-running event clock on the controller. Each clock iteration represents 25 milliseconds.

D.2.4 DRIVER STATUS

This byte contains status related to controller operation not specific to a particular drive. The bit meanings are listed in Table D.3.

TABLE D.3 DRIVER STATUS BIT DEFINITION

BIT	MEANING
7	ILLEGAL 5380 INTERRUPT - An interrupt from the interface was detected which should not have occurred due to no units active.
6	5380 RESET INTERRUPT - A SCSI hard reset was detected.
5	UNRECOGNIZED RESELECTION DETECTED - A reselect interrupt was detected from an inactive or unknown SCSI device.
4	SCSI INTERFACE BUSY - The controller is currently connected to a device via the SCSI bus.

D.2.5 RETURNED SCSI STATUS

This byte is the ending status byte returned from the drive following execution of the command contained in the command descriptor bytes. Status = 00H indicates good completion. However, the status byte is only valid if bit 7, "Status Buffer Invalid", of Interface Errors (entry word C), is = 0. Status of 02H indicates "Check Condition"; upon receiving this status the controller attempts a Request Sense command to receive further drive status. The Sense Information bytes are logged in words 10-17 of the entry (see section D.2.12).

D.2.6 COMMAND DESCRIPTORS

These bytes contain the SCSI command descriptors of the last drive command executed. The descriptors make up either a 6-byte or a 10-byte command which is sent from the controller to the drive. Refer to the drive manufacturers' interface specification for further information on individual commands.

D.2.7 SCSI MESSAGE OUT/SCSI MESSAGE IN

These bytes contain the last messages sent to the drive and received from the drive by the controller. Refer to the drive manufacturers' interface specification for message descriptions.

D.2.8 INTERFACE STATUS

This word contains general operating status of the SCSI command. The bits are defined in Table D.4.

TABLE D.4 INTERFACE STATUS BIT DEFINITION

BIT	MEANING
15	COMMAND ACTIVE - the SCSI command is active.
14	TRANSFER READY - data transfer is ready/active
13	COMMAND COMPLETE - the SCSI command is complete.
12	DISCONNECTED - drive is currently disconnected from the controller.
11-10	NOT USED
9	ABORT COMMAND - The controller has issued an Abort message to the drive. This is a normal condition after termination of read pre-fetch.
8	MESSAGE OUT COMMAND - The controller is initiating a message out sequence to the drive.
7	THROWOUT DATA - The controller is discarding the data being read. This is a normal condition following read pre-fetch.
6	STRING MOVE ACTIVE - Data transfer to/from drive is active.
5-1	NOT USED
0	COMMAND ERROR - The command has been terminated with an error condition; see Interface Errors for more information.

D.2.9 INTERFACE ERRORS

This word contains error status flags set by the controller driver routine to indicate error conditions detected while executing the SCSI command. All bits zero indicates no errors detected. The bits are defined in Table D.5.

TABLE D.5 INTERFACE ERROR BIT DEFINITION

BIT	ERROR CONDITION
15	TARGET NOT FOUND - The controller could not select the drive. Possible causes include drive malfunction, wrong SCSI ID, drive not powered up, cabling.
14	LOSS OF BUSY - An unexpected loss of the BUSY signal occurred before normal command termination.
13	ILLEGAL RESTORE POINTERS MESSAGE ATTEMPTED BY DRIVE - Drive attempted to retry data transfer at a point not acceptable to controller.
12	ILLEGAL PHASE - Controller detected an illegal combination of the SCSI phase signals.
11	PROGRAMMED I/O PARITY ERROR - Controller detected SCSI parity error from drive or drive detected controller parity error during command, message or status transfer.
10	BUFFER OVERFLOW - Controller detected drive attempting to transfer too many bytes during an information transfer phase.
9	DMA PARITY ERROR - Controller detected SCSI parity error during data transfer.
8	UNKNOWN 5380 INTERRUPT
7	STATUS BYTE BUFFER INVALID - Indicates controller did not receive command completion status from the drive.
6	DRIVER ABORTED - The driver initiated a SCSI command abort sequence due to another error condition indicated by other error flags.
5	INITIATE MESSAGE OUT ERROR - Controller was unable to initiate a message-out sequence to the drive.
4	TARGET REJECTED MESSAGE - The drive would not accept a message sent by the controller.
3-0	NOT USED

D.2.10 DRIVER CONTROL BLOCK OFFSET

This word points to the control block in controller memory that contains the information needed to execute the SCSI command.

D.2.11 5380 READ BYTES

These bytes reflect the contents of the SCSI interface controller IC. Refer to the 5380 specification for more information.

D.2.12 REQUEST SENSE DATA BYTES

These words contain the data returned by the drive from a Request Sense command issued by the controller. A Request Sense command is issued if the drive returns ending command status of 02H, "Check Condition". Valid sense data is indicated by the first byte being either 70H or F0H.

The sense data contains specific information regarding the error returned by the drive for those errors detected by the drive and reported to the controller. Refer to the drive interface specification for more detailed information.

