

Model SCZ-2

SCSI Disk Controller

Technical Manual

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NOTICE

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If installation problems arise after you thoroughly review the manual, please contact the ZETACO Customer Support Hotline at 1-800-328-2719.

Preface

This manual contains information regarding installation, testing, and operation of the ZETACO SCZ-2 SCSI Disk Controller. The technical contents have 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.*

The information in this manual is organized into the following chapters:

Chapter 1 - Product Overview

Describes the SCZ-2 Disk controller features, capabilities, specifications, power and interface requirements.

Chapter 2 - Installation Procedures

Describes and illustrates the procedures required to install the SCZ-2.

Chapter 3 - Trouble-shooting

Contains information useful in analyzing subsystem problems and how to get help.

Chapter 4 - Programming Notes

A detailed description of the assembly level programming characteristics of the SCZ-2.

Table of Contents

Chapter 1 - Product Overview

1.0 Introduction	1-1
1.1 Specifications	1-1
<i>Functional</i>	1-1
<i>Disk Drive Interface</i>	1-2
<i>SCSI Implementation</i>	1-2
<i>Mechanical</i>	1-5
<i>Power Requirements</i>	1-5
<i>Environmental</i>	1-5

Chapter 2 - Installation

2.0 Unpacking and Inspection	2-1
2.1 Before You Begin	2-2
<i>System Hardware Requirements</i>	2-2
<i>The Software Support Tape</i>	2-2
2.2 Preparing the Computer Chassis	2-2
<i>Slot Selection</i>	2-3
<i>Priority Selection</i>	2-3
2.3 Preparing the Controller	2-4
<i>Configuration Options</i>	2-4
<i>Disk Drives Supported</i>	2-6
2.4 Installing the Controller	2-8
<i>Paddleboard Installation</i>	2-8

2.5 Cabling	2-9
<i>Subsystem Grounding</i>	2-10
2.6 Powering Up the Subsystem.	2-10
2.7 Booting the Software Tape	2-11
2.8 Formatting the Disk	2-12
2.9 Verifying the Installation	2-12
2.10 Initializing the Disk.	2-12

Chapter 3 - Trouble-shooting

3.0 Introduction	3-1
3.1 Self-Test	3-1
3.2 Software Support Tape	3-2
<i>Using the Software Support Tape</i>	3-3
<i>Disk Formatter</i>	3-5
<i>Disk Diagnostic</i>	3-7
<i>Diagnostic Error Description</i>	3-8
<i>Disk Reliability</i>	3-9
<i>Reliability Error Description.</i>	3-9
<i>ZSDKINIT - RDOS Disk Initializer</i>	3-9
3.3 System Errors	3-11
<i>Non-destructive Test Programs</i>	3-11
3.4 Customer Support Hotline.	3-12
3.5 Warranty Information	3-13

3.6 Product Return Authorization	3-13
<i>General Installation Checklist</i>	3-15
<i>Material Return Information</i>	3-16

Chapter 4 - Programming Notes

4.0 Introduction	4-1
4.1 Program I/O Forword	4-1
4.2 Instruction Format	4-1
4.3 Accumulator Formats	4-3
<i>DOA - Specify Command and Drive</i>	4-3
<i>DOB - Load Starting Memory Address</i>	4-4
<i>DOC - Load Drive Address</i>	4-5
<i>Read Status - Non Alternate Mode</i>	4-5
<i>Read Status - Alternate Mode 1</i>	4-11
<i>Read Status - Alternate Mode 2</i>	4-12
4.4 Command Descriptions	4-12
<i>Data Transfer Commands</i>	4-13
<i>Drive Commands</i>	4-14
<i>Alternate Modes</i>	4-15

List of Tables

Table 1.1	Paddleboard Pinout Assignment	1-3
Table 2.1	Supported Drive List	2-7
Table 3.1	Self-Test Errors	3-1
Table 4.1	Read/Write Faults (DIA)	4-8

List of Illustrations

Figure 2.1 SCZ-2 Board Layout 2-3
Figure 2.2 Backplane Priority Jumpers 2-9

Appendix

A.0 Soft Switch Settings for Zetaco Utilities A-1

Product Overview

1.0 Introduction

ZETACO's SCZ-2 Disk Controller combines Zebra-emulating capability with the Small Computer Systems Interface (SCSI), to result in an advanced technology disk subsystem for the Data General Nova 3 and 4 and 16-bit Eclipse processors running the RDOS Operating System.

The SCZ-2 has been implemented on a single 15" x 15" 6-layer printed circuit board, with a paddleboard to route signals to and from the disk drives. The SCZ-2 is compatible with FCC hardened chassis requirements, and interfaces with DG's data channel.

1.1 Specifications

Functional

Drives per Controller:	Up to 4 SCSI targets.
Recording Format:	Media format is drive vendor unique.
Data Transfer Rate:	Up to 1.5 MB per second (Async.)
Maximum Capacity:	The theoretical maximum capacity supported by a single SCZ-2 is 2 gigabytes. The maximum for a single drive is 536.8 MB.
Device Code:	Switch selectable
Interrupt Priority Mask Bit:	Bit 7

Bus Load:	1 unit load (any I/O or MEM-I/O slot)
Data Channel Interface:	Selectable throttle rate from 1 word to 128 words per burst
Sector Data Field:	256 16-bit words per sector
Data Buffering:	Two 256-word buffers in a ping-pong configuration
Memory Address:	16 bits
Indicator Lights:	RED Self-Test GREEN Controller Busy YELLOW SCSI interface not busy

The SCZ-2 is designed to operate with the Data channel in any MEM I/O or I/O slot of a Nova or Eclipse computer.

Disk Drive Interface

Functional: SCSI Interface single-ended Asynchronous

Cabling: *Chassis with Bulkhead*

Internal: Optional 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.

External or non-bulkhead

Chassis: Contact ZETACO with your cabling requirements.

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

SCSI Implementation

The SCZ-2 Controller acts as a host adapter and interfaces to the drive via the industry standard interface known as Small Computer System Interface (SCSI). The controller adheres to the physical

specifications imposed by ANSI for single ended applications (differential is not supported).

The handshaking is accomplished by discrete logic as opposed to using a SCSI protocol VLSI IC. The disconnect/reconnect option and the arbitration function are not supported. The signals are connected to the Host Adapter thru the backplane pins and a paddleboard. The SCZ-2 is the initiator of all commands, and is the only initiator allowed on the SCSI bus. The drive is the target of the commands, and there may be up to 4 targets. The IDs of the target must be 0,1,2, or 3 only. A target may have more than one drive connected, however the subsystem must never exceed 4 physical drives.

The Host Adapter drives the SCSI signals with 7438's (open collector NAND gate) and receives the signals with 7414's (Schmitt-trigger inverter). This meets the requirement of the ANSI specification.

The pin-outs for both the backplane paddleboard and the cable to the drive (as defined by SCSI spec.) are defined by Table 1.1.

TABLE 1.1***Paddleboard Pin-Out Assignment***

(I) = signal originates from Host Adapter (Initiator)

(T) = signal originates from target drive

(I/T) = signal is bi-directional

SIG NAME	BACKPLANE PIN #	SCSI CABLE PIN #
-DB0 (I/T)	I A49	I 2
-DB1 (I/T)	I A59	I 4
-DB2 (I/T)	I A61	I 6
-DB3 (I/T)	I A63	I 8
-DB4 (I/T)	I A65	I 10
-DB5 (I/T)	I A67	I 12
-DB6 (I/T)	I A69	I 14
-DB7 (I/T)	I A71	I 16
-DBP (I/T)	I A73	I 18
GND	I A75	I 20

TABLE 1.1 Paddleboard Pin-Out Assignment (continued)

GND	I	A76	I	22
GND	I	A77	I	24
TERM PWR (I)	I	A78	I	26
GND	I	A79	I	28
GND	I	A81	I	30
-ATN (I)	I	A83	I	32 N.U.
GND	I	A84	I	34
-BSY (T)	I	A85	I	36
-ACK (I)	I	A86	I	38
-RST (I)	I	A87	I	40
-MSG (T)	I	A88	I	42 N.U.
-SEL (I)	I	A89	I	44
-C/D (T)	I	A90	I	46
-REQ (T)	I	A91	I	48
-I/O (T)	I	A92	I	50

Backplane pin-out A47, A57, A75, A76, A77, A79, A81, and A84 will be grounded by host adapter.

All odd pins, except pin 25 (pin 25 must be open), will be grounded by the paddleboard.

Note - Cable pin number 26 is dedicated to carrying +5v to any SCSI terminators on any devices attached to the SCSI bus. If Jumper W18-1 is in, the SCZ-2 will source +5v onto this pin. If not installed, the SCZ-2 is not electrically attached to this cable pin. This jumper must not be installed if some other device is also configured to source +5v onto this pin. Refer to Figure 2.1.

The subsystem may only be configured as a single initiator/single target, or single initiator/multiple target. Multiple initiator (dual port environments) configurations are NOT supported.

Mechanical

Dimensions: 15" x 15" x 1/2" (38.1 x 38.1 x 1.27 cm)

Ship Weight: 10 pounds (4.5 kg) - includes controller, paddleboards, cables (if ordered), software tape and documentation.

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

Power Requirements

+5 ($\pm 5\%$) Volts DC @ 3.5 amps typical

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/Nova temperature and humidity specifications.

Installation

2.0 Unpacking and Inspection

The following items are shipped standard with each SCZ-2:

	ITEM	P/N
A)	SCZ-2 Controller with Cover	500-452-00
B)	"A" Paddleboard	500-411-00
C)	Software Support Package (9-track magnetic tape)	400-452-00
D)	Technical Manual	600-452-00

In addition, the following optional disk cables may be ordered with the Controller:

1. Standard Internal Backplane-to-Bulkhead
300-148-00
2. D.G. CSS internal Backplane-to-Bulkhead
350-0067-00

Contact ZETACO with your external bulkhead-to-drive requirements.

Upon receipt of the Model SCZ-2 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.

2.1 Before You Begin

This section contains the procedures necessary for proper installation and configuration of the SCZ-2 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 2.7 involve preparation and installation of the hardware components. Subsections 2.8 through 2.10 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 SCZ-2.

System Hardware Requirements

- a) Eclipse or Nova CPU.
- b) Magnetic Tape Subsystem
- c) SCZ-2 Controller Board(s)
- d) 5 1/4" SCSI Disk Drives
- e) Console at Device 10/11

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

The Software Support Tape

Each of the programs on the Software Support Tape has been written by ZETACO specifically for the SCZ-2 Controller. Use this tape for Media Formatting, Disk Diagnostic and Reliability. **DG's corresponding programs may not work on this controller.**

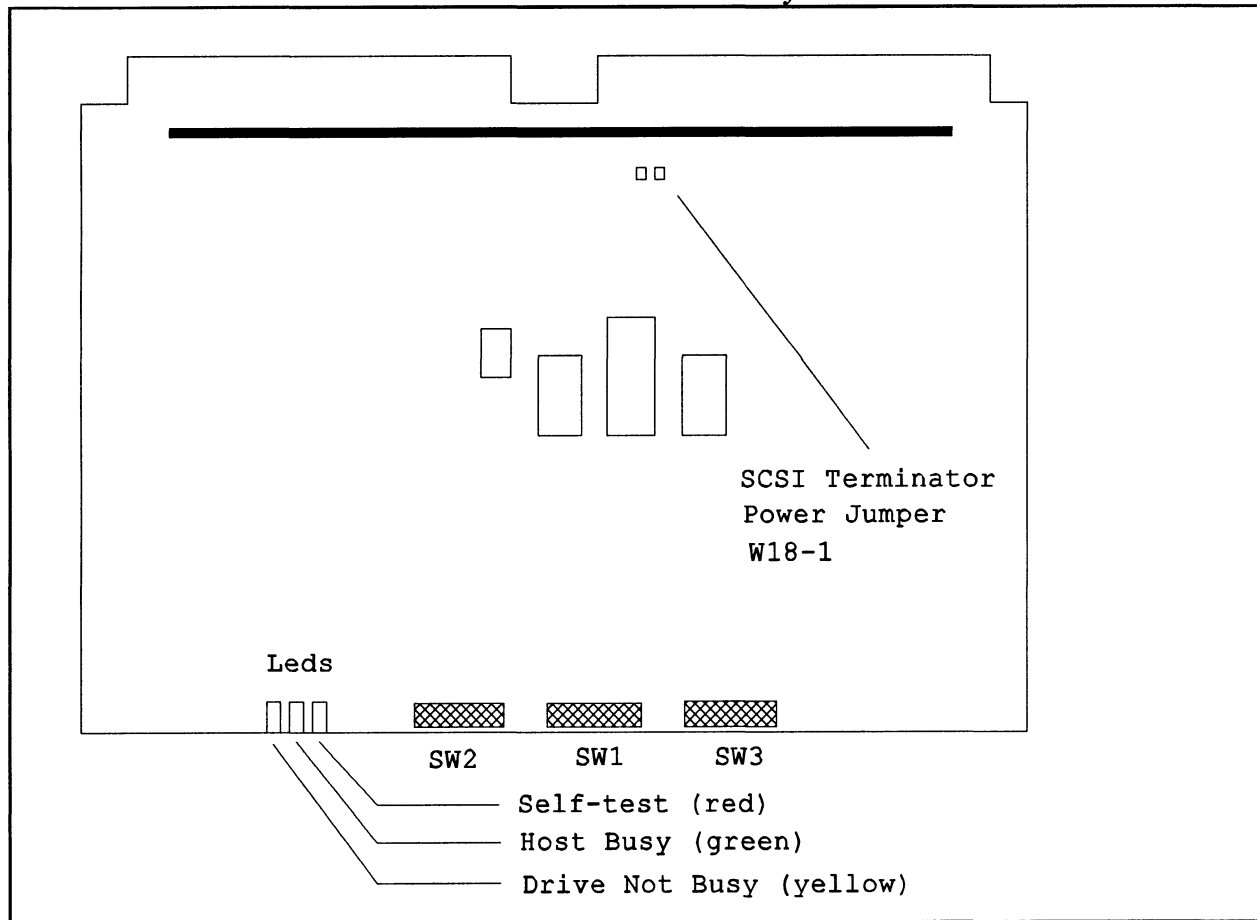
The Software Support Tape is structured so that the programs on Files 2 through 4 can be loaded and executed directly from the tape. Each is a Stand-Alone program; this means that they do not need, and cannot have, an operating system running when they are executed.

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.

2.2 Preparing the Computer Chassis

Before installing the SCZ-2, the computer chassis must be prepared. To do so, choose an available I/O or MEM I/O slot and establish the correct priority.

FIGURE 2.1 SCZ-2 Board Layout

**Slot Selection**

The SCZ-2 may be installed in any "I/O" or "MEM I/O" slot. Consult the hardware manual for your particular computer to identify the appropriate available slots.

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 SCZ-2 and the processor, or between the SCZ-2 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.

2.3 Preparing the Controller

Configuration Options

Adapter configuration is accomplished by three easy access DIP switches (piano key style). All three switches have eight positions. The switch positions are usually identified on the switch itself. If not, the positions are then counted left to right starting with position 1 and ending with position 8.

DIP SWITCH 1 (Silk Screen Identified as SW1)

POSITION	OPTION	DEFINITION
1	not used	Switch should be DOWN.
2	Defer	If switch is in DOWN position, actual SEEK will not take place until READ/WRITE command. Deferred SEEK is recommended when running only one drive. (DOWN position).
3	not used	Switch should be DOWN.
4	not used	Switch should be DOWN
5	Poll Mode	DOWN is recommended if using only one drive. UP is required if any drive other than SCSI id 0 is attached to SCSI bus. Exceptions - Set UP if Fuji M2624FA is selected or drive will not come ready until 2 minutes after power-up. Drives in removable enclosures and drives with removable media require this switch to be UP if drive(s) are to be deselected and removed (or media removed) without bringing the system down. Examples D. G. Model 6671-S, and HP Optical C1716T.
6-8	Throttle	The three throttle setting switches are for controlling the number of data channel words per request.

Switch Position			Throttle Count
6	7	8	# of words/req
down	down	down	1
down	down	up	2
down	up	down	4
down	up	up	8
up	down	down	16
up	down	up	32
up	up	down	64
up	up	up	128

NOTE: up = open, down = closed

The Throttle burst rate is defined as the number of word transfers that take place over the Data Channel 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 DCH device. The controller may be set to burst rates of 1, 2, 4, 8, 16, 32, 64, and 128 words per access. A burst rate of 16 is recommended for most applications.

DIP SWITCH 2 (Silk Screen Identified as SW2)

POSITION	NAME	DEFINITION
1	INTLV	Sector interleave option. UP for interleave by 2. DOWN for no interleave. DOWN for most applications.
2		not used Switch should be down.
3-8	Dsk Para	Select one of a possible 64 drive parameter banks. A bank consists of the number of cylinders, heads, and sectors/track that will be assigned to that drive from a system point of view. The switches are binary weighted, switch 3 is most significant and switch 8 is the least significant. If a bank is selected that has not yet been defined, it will be assigned the

maximum parameters (ea. 1024 cylinders, 32 heads, and 32 sectors). **In all cases, all attached units will be seen as the same size.** Please refer to Table 2.1 for additional information about the drive parameters you are choosing.

Disk Drives Supported

The SCZ-2 is designed to support drives that meet the SCSI Interface Specification and utilize the SCSI Common Command Set. ZETACO has verified several drives with the SCZ-2 and will continue to test additional drives for verification of compatibility with the SCZ-2. If you don't find the drive you want to interface in the Configuration list, call us to discuss your requirements. To select the drive refer to Table 2.1.

The following list contains the drives that have been fully tested at ZETACO with the SCZ-2. The columns labeled 3 through 8 are the Disk Parameter select switches on Switch Pack 2. The next three columns indicate the number of cylinders, heads, and sectors per track assigned to the drive for best efficiency for the number of user blocks available. The read capacity is a SCSI command and which when executed will return the amount of user blocks available with this model drive (a user block is 512 bytes). The BYTES column is the actual number of bytes available to the system.

Switch combinations for Switch pack 2 positions 3-8 specify the head/sector/cylinder parameters the SCZ-2 will emulate from the Host computer. Note that in addition to RDOS, AOS may also be built with the SCZ-2 provided the user selects one of the three 606x emulations and has attached to the SCZ-2 a drive of capacity at least as great as the emulation selected.

The maximum parameters for the SCZ-2 are 1024 cylinders, 32 heads, and 32 sectors. This amounts to 1,048,576 blocks and 536,870,912 bytes given 512 bytes/block. Therefore, drives larger than 537 MB most likely will function with the SCZ-2, but only the first 537 MB of these drives will be utilized.

The Seagate ST1480, Fujitsu M2624FA and M2684S, IBM 45G9480 and the Connor CFA540S are supported with auto relocation of faulty sectors found during writes and reads. To enable this feature, the SCSI command "Mode Select" is issued from firmware after power-up if one of these drives is selected with SW 2 positions 3 - 8. Drives may vary in their "Mode Select" parameters, so to insure proper drive operation use only the drive model specified by the bank selection as shown in Table 2.1.

Table 2.1 **Supported Drive List**

3	4	5	6	7	8	BLK#	Cyl	Hd	Sc	Read Cap	Bytes Used	Model
d	d	d	d	d	d	00	793	12	32	304,604	155,910,144	Seagate Wren-3 94161-156
d	d	d	d	d	u	01	621	9	32	178,850	91,570,176	Seagate Wren-3 94211-86
d	d	d	d	u	d	02	411	19	24	---	95,956,992	D.G. 6060 parameters
d	d	d	d	u	u	03	815	19	24	---	190,279,680	D.G. 6061 parameters
d	d	d	u	d	d	04	815	5	24	---	50,073,600	D.G. 6067 parameters
d	d	d	u	d	u	05	764	24	32	586,763	300,417,024	Seagate Wren-4 (300)
d	d	d	u	u	d	06	685	13	32	285,039	145,899,520	Micropolis 1375
d	d	d	u	u	u	07	661	8	32	169,224	86,638,592	Seagate Wren-3 94161-86
d	d	u	d	d	d	08	1008	20	32	645,299	330,301,440	Seagate 94181-385H (330)
d	d	u	d	d	u	09	949	19	32	576,998	295,419,904	Sony SMO-S501 and S502
d	d	u	d	u	d	0A	987	21	32	663,475	339,591,168	Micropolis 1684-7 (332MB)
d	d	u	d	u	u	0B	1024	32	32	1,279,537	536,870,912	Maxtor XT-8760S (663MB)
d	d	u	u	d	d	0C	813	32	32	832,537	426,246,144	Seagate ST1480 (426MB)
d	d	u	u	d	u	0D	1024	31	32	1,015,812	520,093,696	Fujitsu M2624FA (520MB)
d	d	u	u	u	d	0E	1024	32	32	1,163,145	536,870,912	H.P. C1716T Optical (536)
d	d	u	u	u	u	0F	992	32	32	1,015,812	520,095,744	I.B.M. 45G9480 (520MB)
d	u	d	d	d	d	10	1024	32	32	1,056,707	536,870,912	Connor CFA540S (540MB)
d	u	d	d	d	u	11	1014	32	32	1,039,328	531,628,032	Fujitsu M2684S (532MB)

DIP SWITCH 3 (Silk Screen Identified as SW 3)**POSITION NAME****DEFINITION**

- | | | |
|---|---------|--|
| 1 | FMT NEW | Format new drive if DOWN; uses manufacturers defect list only. Verifies and uses grown list if UP. UP only if an older drive and soft or hard media errors are suspected when formatting a drive. See Section 3.2. |
| 2 | RETRY | Report SCSI media related retries if the switch is UP. This switch should normally be set in the DOWN position. It is only used during reliability program if you wish to |

expose any media related soft errors.

3-8 DEV SEL Device select code switches. Primary device code = 27 (octal), secondary device code = 67 (octal).

CODE	3	4	5	6	7	8
------	---	---	---	---	---	---

27	up	down	up	down	down	down
67	down	down	up	down	down	down

For other selections, switch 3 is the most significant and 8 is the least. (UP Switch=0, DOWN Switch=1)

The standard Primary device code for the SCZ-2 is 27 octal; the Secondary is 67 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.

If, at a later date, you wish to change the device code for the SCZ-2, 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 Installing the Controller and Paddleboard

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. 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.

Paddleboard Installation

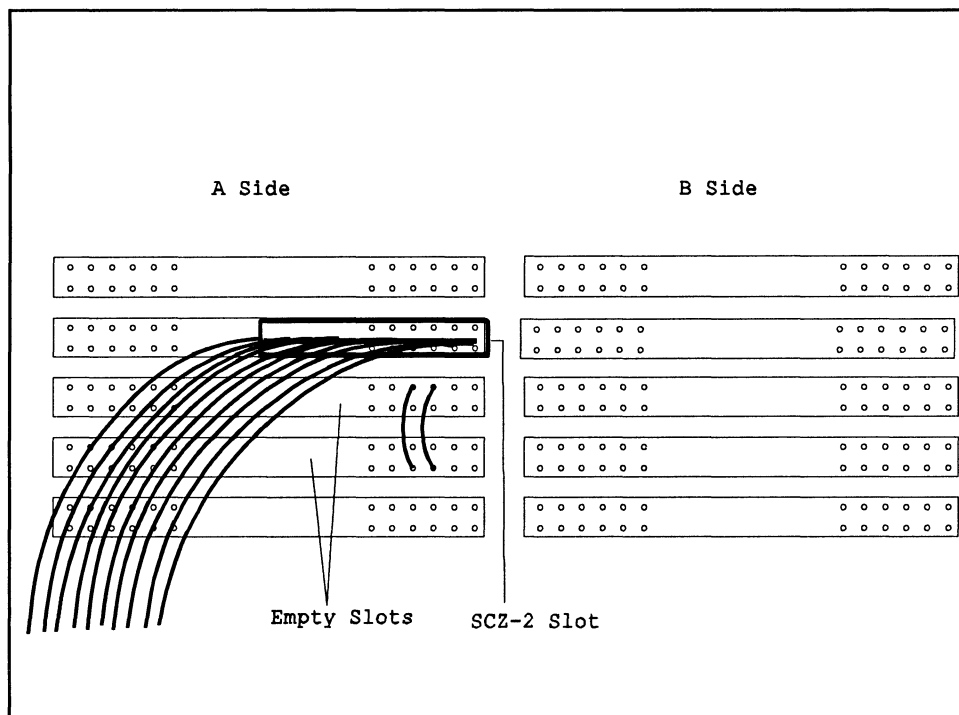
The computer backplane, viewed from the rear, has the "A" side pins on the left. On computers with vertically mounted controller boards, think of the component side of the boards as up, then the "A" side pins are on the left.

Locate the two rows of pins on the "A" side of the backplane for the slot containing the SCZ-2 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



2.5 Cabling

Internal Cabling

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.

External Cabling

Contact ZETACO with your external bulkhead-to-disk drive cabling requirements.

Non-Bulkhead Cabling

Contact ZETACO with your non-bulkhead paddleboard-to-disk drive requirements.

Subsystem Grounding

Because the AC power system safety ground does not necessarily satisfy all system grounding requirements, additional connections are required to earth ground, referred to as system ground. The Controller and its attached drive(s) must be connected to a singlepoint ground system. Ground connections are made via ground braids (5/8" minimum flat braid) that pass from enclosure to enclosure, enclosure to computer chassis and computer chassis to earth ground. Refer to Figure 2.5. If shielded cables are used, this grounding procedure is not required.

WARNING: To ensure proper ground return to earth, each component in the system must be connected using a daisy-chain ground system. The AC and DC grounds within each drive may need to be joined (consult your drive manual). The drives must then be joined by a daisy-chain grounding braid and connected to the grounding post at the rear of the computer cabinet.

2.6 Powering up the System

To find out the basic status of the controller upon power-up, observe the four LEDs at the front edge of the board. Their meanings from right to left are as follows:

RED	SELFTEST - When on, the SCZ-2 is executing Self-test Diagnostics. Flashing indicates a selftest failure.
GREEN	HOST BUSY - This LED indicates the controller is executing one of the READ/WRITE commands.
YELLOW	SCSI BUSY - When on, this LED indicates that no drives are connected or that none are busy. When dim or flashing, the SCSI bus is active. If extinguished, the SCSI bus may be locked up

which would indicate a controller or drive failure or improper SCSI bus termination. (An exception is during format when this LED should be off.)

Always allow the attached drives to spin up and finish their power-up sequence before applying power to the SCZ-2. This is especially important for the Hewlett Packard C1716T optical. If not allowed to complete its power-up sequence (approximately 10 seconds) the drive will be found not ready by the SCZ-2.

Self-test takes approximately two seconds to complete. At that point the red LED should turn OFF and remain off. If it does not, or if it blinks, this indicates a Self-test failure. See Section 3.0 for assistance.

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

The yellow LED may be dim or blink during the idle state depending on the position of SW1 position 5. Test Unit Ready commands are sent to the drive frequently during idle times.

2.7 Booting the Software Tape

The bootstrap procedure for the software support tape is as follows:

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. Program Load. Boot the tape in your normal fashion.

For the S/140 virtual console, set 11A to 100022 (or 100062 for secondary tape drive). Then enter 100022L (or 100062L).

3. The software support package menu will be displayed:

```

FILE          #PROGRAM
 2            SCZ-2 DIAGNOSTIC
 3            SCZ-2 FORMATTER
 4            SCZ-2 RELIABILITY
 5            SCZ-2 ZSDKINIT
 6            ".SV & .LS" Files in RDOS DUMP Format

```

File Number?

Enter the number of the program you wish to execute. At this point of the installation procedure, you enter the file number, but first refer to section 3.2 for program execution details.

2.8 Formatting the Disk

Format the drive first if the drive (or drives) has never been formatted before. To format the disk, boot the software support tape and load file #3. Refer to section 3.2 for details.

2.9 Verifying the Installation

We recommend that the Disk Reliability program be run for at least one pass to ensure a reliable subsystem before storing the system data on it. If any problems are encountered, the disk Diagnostic (File #2 on tape) can be used to identify the source of the problem. 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 #4. Refer to Section 3.2 for details.

2.10 Initializing the Disk

The disk is now ready to be initialized for RDOS or ERDOS. Using Zetaco's initializer (FILE #5, ZSDKINIT) will insure the best drive capacity efficiency. The sample dialogue found in section 3.2 will guide you through this procedure.

Trouble-Shooting

3.0 Introduction

The SCZ-2 is supported by ZETACO in the following ways:

- Microprocessor based Self-test of over 70% of the board upon each powerup.
- Reliability and Diagnostic 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. (CST) to answer your questions. (800-328-2719)
- Up to a two year warranty on workmanship and materials.

3.1 Self-Test

Self-test checks out 70% of all the internal functions of the controller board once for every time power is applied to the board. The test takes approximately 2 seconds to execute.

If Self-test passed, the red LED will go out. If a failure was detected, the LED will blink a number of times which corresponds to the subtest that failed. Depressing the front panel IORESET switch will cause the LED to stay lit (no blinking) and Self-test will loop on the error.

TABLE 3.1
Self-Test Errors

	CODE TEST	POSSIBLE FAILURE
1	EPROM Checksum	The data in the EPROM did not compare with expected check word. The data is the processor firmware.

2	Scratchpad Memory	Data read from RAM did not compare with data written.
3	Ram Test	Test patterns have determined that the buffer ram cannot support error free data handling.

3.2 Software Support Tape

In addition to the diagnostic functions provided by the SCZ-2 Controller via on-board Self-test, ZETACO provides Reliability and Diagnostic 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 SCZ-2 Controller. You should use this tape for loading Media Formatting, Disk Diagnostic and Reliability, and RDOS initializing. **DG's CORRESPONDING PROGRAMS MAY NOT WORK ON THIS CONTROLLER.**

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 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 "***".

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.

For the S/140 virtual console, set 11A to 100022 (or 100062 for secondary tape drive). Then enter 100022L (or 100062L).

3. The Software Support Package menu will be displayed:

FILE #	PROGRAM
2	SCZ-2 DIAGNOSTIC
3	SCZ-2 FORMATTER
4	SCZ-2 RELIABILITY
5	SCZ-2 ZSDKINIT
6	".SV & .LS" Files in RDOS DUMP Format

File Number?

Enter the file number of the program you wish to execute.

Using the Software Support Tape

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

Programs cannot be loaded onto your disk directly from Files 0-5. File 6 for RDOS contains the programs in the standard system dump format and you can load them from this file to your disk. Even after the programs have been transferred to your disk, retain the Software Support Package tape in case of disk subsystem problems.

The following sequence of events is recommended by ZETACO. Each step is described in greater detail in the subsequent sections of this chapter.

1. Mount the Software Support Package tape and boot it.
2. Select #3 - Format the Media.
3. Select #2 - Disk Diagnostics.
4. Select #4 - Disk Reliability.

NOTE: It is not essential that you run Diagnostics or Reliability, however, they will locate disk subsystem problems. It is better that this be checked out at this point than after you have loaded your data.

5. If the controller is to run in an RDOS system, select #5 to initialize the disk.
6. You can load the programs from File 6 any time after you have built your disk.

The Bootstrap Procedure for the Software Support Package tape is:

1. Mount the Software Support Package tape on the drive and put it on-line. Be sure that the BPI setting matches that specified on the tape label.
2. Program Load - The method of program load varies for the different processors. Some of the possibilities are described here.

If your system has front-panel switches, set them to 100022 when loading from the primary tape drive, or to 100062 when loading from the secondary tape drive. Then press reset and the program load switch.

For the S/140 virtual console, set 11A to 100022 (or 100062 for secondary tape drive). Then enter 100022L (or 100062L).

For the S/120 virtual console, enter 22H (or 62H for the secondary tape drive).

3. The Software Support Package Menu will be displayed:

```

FILE #      PROGRAM
  2         SCZ-2 DIAGNOSTIC
  3         SCZ-2 FORMATTER
  4         SCZ-2 RELIABILITY
  5         ZSDKINIT-RDOS DISK INITIALIZER
  6         Previous ".SV" Files in RDOS Dump
              Format
File Number?
    
```

Enter the file number of the program you wish to execute.

To load files from File 6, use the standard CLI Command for loading from tape.

```

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

Disk Formatter

The Disk Formatter Program, contained in File #3, is a program designed to format a drive. Formatting the disk is required to prepare the media with the necessary overhead information to accept user data.

Note that a couple of options exist when running Format.

Switch 2 position 1 defines the interleave. When down, no interleaving is done, sectors are addressed consecutively. When up, an interleave by 2 is performed. This switch should be set for no interleaving for optimum performance.

Switch 3 position 1 defines the Media defect handling strategy used when formatting. With this switch down, the drive will reallocate all sectors in the manufacturer's primary list and any sectors which fail the format verify phase. Any previous grown list will be erased. With this switch up, the drive will reallocate the same sectors as above (the primary list and verify list) and will also retain and reallocate any other sectors contained in the grown list. Set this switch up if you are using an old drive which may have a sizable grown list of defective sectors.

The following is a sample dialogue:

```
ZETACO...SCZ-2 DISK CONTROLLER FORMATTER REV. XX

STARTING ADDRESSES:

    500-FORMATTER/CHECK PROGRAM
    502-ERROR LOG RECOVERY
    503-COMMAND STRING INTERPRETER

ENTER DEVICE CODE [27]: 67

SET SWPAK AS PER APPENDIX A, OR HIT (CR) TO CONTINUE

START TIME? - MON, DAY, YR  HR, MIN

UNIT      TYPE      HDS      CYLS      SEC/TRK
  0         0         9        621        32

** This is a list of all the ready units connected to the SCSI
    interface, and the parameters assigned to them. The same
    parameters that were configured by the board edge switches.

ENTER UNIT NUMBERS (0,1,2,3) TO RUN:  0
```

****** Enter the unit numbers of the drives you wish to have formatted. The drives will be formatted one at a time consecutively.

UNIT: 0
ENTER TYPE OF DISK: 0

****** Enter the TYPE that is associated with the UNIT as listed above (same line that shows the parameters). Specify UNIT: and ENTER TYPE OF DISK: will repeat for each unit number that was declared in the ENTER UNIT NUMBERS TO RUN: statement.

FORMATTING UNIT 0,

****** The display will freeze right here until the entire drive has been formatted. Notice (if board edge is visible) that the green LED is on and the yellow is off. The amount of time it takes to format a drive is dependent upon size and manufacturer. In most cases it will take approximately ten to thirty minutes. ******

FORMATTING DONE ON ALL UNITS, NOW DOING SEEK EXERCISER.

The Seek Exerciser performs random seeks and reads of the header information of sectors on the tracks being sought. This portion of the test is not critical and may be aborted after a few minutes by entering a 'control O' on the keyboard.

The IBM 45G9480 and the Connor CFA540S drives enter a "degrade mode" as a result of various error conditions or abnormal operations. Examples of these degrade-causing conditions are: improper spindle speed, failed RAM microcode load, failed format, failed reassign blocks, and failed Power On selftests.

When in a degrade condition, the drive will fail to execute various SCSI commands and the drive is virtually inoperable until the degrade condition is cleared. Some degrade conditions can be cleared with a Power On sequence. Others require the successful execution of specific SCSI commands.

The SCZ-2 specifically addresses only the format degrade condition. This condition results when a format unit command fails to complete successfully. Failure to complete could occur due to a reset or power down during format execution. To recover from this state, the user must re-issue the format command and allow the command to complete. If this recovery is not done the drive will remain in an inoperative state.

Disk Diagnostic

This Diagnostic program is provided to find failures that are related to the basic operations of the disk controller. The disk diagnostic program is designed to test the basic hardware functions of the controller board and the SCSI subsystem and to identify or help isolate any possible hardware problems.

Load the File #2 from Software Support Package tape provided. (See Using the Software Support Package Tape in Section 3.0).

The following is a sample dialogue:

```
...SCZ-2 DISK CONTROLLER DIAGNOSTIC REV. XX
```

```
STARTING ADDRESSES:
```

```
200-DIAGNOSTIC (INITIALIZE)
```

```
201-DIRECT ODT ENTRY
```

```
202-RANDOM SEEK EXERCISERS
```

```
SEEK EXER 1 IS A SINGLE DRIVE EXERCISER
```

```
SEEK EXER 2 IS A TWO DRIVE EXERCISER WITH
```

```
SEEK OVERLAP
```

```
500-DIAGNOSTIC (RESTART)
```

```
DO YOU WANT HELP (Y/N) ? N
```

** You may want to select Y if this is the first time you have entered the diagnostic program. The information available in the HELP section may be found useful. **

```
ENTER DEVICE CODE [27]: 27
```

** Please enter the selected device code. Review the switch settings if necessary. **

```
ENTER UNIT NUMBERS (0,1,2,3) TO RUN: 0
```

```
SET SWPAK AS PER APPENDIX A, OR ENTER RETURN (CR) TO CONT.
```

```
TESTING UNIT 0
```

** Will list the tests being run. **

```
.  
.
.
```

UNIT	HDS	CYLS	SEC/TRK
0		9	621 32

These are the units and characteristics found, do you want to loop on reading them? Enter 1, otherwise enter Return (CR).

** Normally enter Return unless instructed to otherwise do to a problem with reading the selected characteristics from the controller. **

.
.

** Listing tests again. **

TEST(S) COMPLETE.
SEEK EXERCISER TESTS.
PASS

Diagnostic Error Description

When the diagnostic detects an error, it prints out the test number that failed along with what is wrong. Use the SWPACK register to help determine whether or not the error is intermittent. This is done by setting switch 3, which prints out an error percentage. Refer to Appendix A.

Disk Reliability

The Disk Reliability program is a maintenance program designed to exercise and test the disk subsystem. The program will test from one to four drives. Boot the Disk Reliability Program from File #4 in the Software Support Package tape.

The following is a sample dialogue:

ZETACO...SCZ-2 DISK RELIABILITY REV. XX

STARTING ADDRESSES:

500-RELIABILITY TEST
501-RELIABILITY TEST WITH OPTIONS
502-DISK ADDRESS TEST
503-COMMAND STRING INTERPRETER
504-ERROR COUNT/LOG RECOVERY
505-RUN ALL TESTS
506-SEEK EXERCISER
507-RANDOM SEEK EXERCISER
510-ENTER MULTIPLE DEVICE CODES

ENTER DEVICE CODE [27]: 27

STARTING ADDRESS = 505

SET SWPAK AS PER APPENDIX A OR HIT (CR) TO
CONTINUE. ARE MAPS TO BE EXERCISED (YES/NO)?
YES

START TIME? - MON, DAY, YR HR, MIN

UNIT	TYPE	HDS	CYLS	SEC/TRK
0	0	9	621	32
1	1	9	621	32

ENTER UNIT NUMBERS (0,1,2,3) TO RUN: 0,1

UNIT: 0

ENTER TYPE OF DISK: 0

UNIT: 1

ENTER TYPE OF DISK: 1

TESTING UNIT 0,1

** Enter a "W" while the test is running to display the results of
the test. Refer to Appendix A.**

Reliability Error Description

Reliability errors are displayed when they are detected. The controller status will be displayed with the particular problem spelled out below the status. Each status bit is explained in the programming section but since the error is also spelled out, referencing the programming section may not help. Most errors that can occur are default or ready errors.

Zsdkinit - RDOS Disk Initializer

(ZETACO's version of DKINIT, referred to as ZSDKINIT, is supplied on the Software Support Package tape File #5.)

Before you load any RDOS system onto a Model SCZ-2, YOU MUST INITIALIZE THE DISK BY RUNNING ZSDKINIT. This is a stand-alone program that performs all the functions of D.G.'s DKINIT. Please refer to D.G. manual on loading an RDOS system for full details on the functionality of disk initialization.

Remember that only ZSDKINIT will work correctly for Model SCZ-2 controllers. If you are building your system from an RDOS release tape, do NOT run File #4 on the D.G. tape after running ZSDKINIT. D.G.'s DKINIT cannot be run in expanded emulation on a SCZ-2.

The following is a sample procedure/dialogue for running ZSDKINIT:

Load ZSDKINIT from the Software Support Package tape or from a disk that previously had the program loaded on it.

PROGRAM DISPLAYS:

FILENAME?

you respond with:

ZSDKINIT (or DIR:ZSDKINIT, if the program file is located in directory, DIR, other than the master).

PROGRAM DISPLAYS:

DISK INITIALIZER - REV. NN.NN/with ZETACO Disk Support-REV. 1

DISK DRIVE MODEL NUMBER?

you respond with:

SCSI

NOTE: SCSI will instruct the initializer to read the drive characteristics that were selected by the configuration switches.

If the disk type is not valid then the program responds:

ILLEGAL DISK TYPE

and the request for the model number will be repeated until your response is acceptable.

The Program next requests the disk unit:

DISK UNIT?

you respond with:

DZx, where x indicates drive number: 0, 1, 2, or
If the disk unit is not valid then the program responds:

ILLEGAL DISK UNIT DECLARATION

and will repeat the question until a valid answer is given.

If the disk unit is valid then the program responds:

#HEADS	#SEC/TRK	#CYLINDERS	MGB/BLK
(1)	(2)	(3)	Megabytes if disk is >4000 blks. Blocks if disk <4000 blks.

(1) = The number of heads specified by the selected drive configuration switches.

(2) = The number of sectors per track specified by the drive configuration switches.

(3) = The number of cylinders specified by the selected drive configuration switches.

EXAMPLE: WREN-3 FH 94161-156

#HEADS	#SEC/TRK	#CYLINDERS	MGB/BLK
12	32	793	156

From this point on the commands which can be selected are identical to those of DKINIT and ZSDKINIT will perform exactly as DKINIT.

3.3 System Errors

If a system error occurs, use the User Manuals 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 D.G. User's Manual. This information could 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 is not working, try a dump. This could add vital information about the problem.

Non-destructive Test Programs

This Section explains tests 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 the luxury of being able to rebuild a system.

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

Answer the question "enter device code" with the correct information. Next, depress control O. An @ should be on the console. There are two different tests that can be run: a random

seek test, or a sequential seek test.

To run the random seek test, enter a 501R after the prompt (@). If the sequential test is desired, enter a 502R after the prompt (@).

Now answer the questions the program asks, as in the normal reliability testing, with the exception of one question. When the question "SET SWPAK PER 8.0, OR HIT (CR) TO CONT." is asked, enter an "8" one time and enter "9" one time. Bit 8 set puts the program in read only mode, bit 9 set prevents the data from being checked. Enter an "M" to verify that switch 8 is now on; if it is not, writes will be done, crashing the disk. The 501 and 502 Reliability will behave in the following manner:

A. Random Reliability Test (SA 501) with Options.

The operator is given options on data patterns (from the command string data) and may choose a constant cylinder, head, sector, or # of sectors. Any letter response or just a carriage return will cause the program to select the random function for that variable. **Your response to the DATA question must not result in RANDOM data, instead enter ADR or ALO to select some pattern. If random becomes the data parameter, writes to the disk will occur even if switch 8 has been set to request read only.**

The operator is also asked to respond to jitter option (Yes/No). If yes, a random delay (0-40,50MS) is inserted into the background loop to create a more asynchronous disk I/O loop.

B. Sequential Disk Address Test (SA 502)

The operator is given option on data (from the command string data). Requested data is first written over the entire pack. The data is then read from all sectors. This ensures that all disk pack blocks are usable and are formatted properly. The test is then repeated for all ready disks, and "Pass" is printed. The sequence is repeated indefinitely. Setting Switch 8 will cause the program to run in read only mode.

3.4 Customer Support Hotline

ZETACO, Inc. provides a Customer Support Hotline (800-328-2719) 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 on page 3-15 before calling the Hotline.

3.5 Warranty Information

ZETACO controllers 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. All drives and power supplies in ZETACO subsystems are warranted for 6 months 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 damages arising out of or in connection with the use or performance of ZETACO's products.

3.6 Product Return Authorization

When a controller malfunction has been confirmed using the tests outlined in Sections 3.1 to 3.4 above, the controller can be returned to ZETACO for warranty repair if the product has been damaged 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 controller during shipment, please use packaging that is adequate to protect it from physical and electrostatic damage. Mark the box "Delicate Instrument" and indicate the RMA number(s) on the shipping label.

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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 when (during Dump, Reliability, etc.)? _____

Intermittent or consistent problem? _____

Does self-test pass? _____

Priority of Board in CPU (Slot) _____

BMC Priorities of other BMC Devices (BMC Products Only) _____

Reviewed Interrupt and Priority Jumpers on Vacant Slots? _____

Tried Different Slot? _____

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

Did Zetaco-supplied software support diskette or tape "boot" correctly? _____

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

For peripheral disk drives, what is Sector Switch setting? _____

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

Result of Zetaco Reliability or Diagnostics: _____

MATERIAL RETURN INFORMATION

All possible effort to test a suspected malfunctioning controller should be made before returning the controller to Zetaco for repair. This will: 1) Determine if the board is actually defective. 2) Increase the speed and accuracy of a product's repair, which is often dependent upon a complete understanding of the user's checkout test results, problem characteristics, and the user system configuration. Test results for the SCZ-2F Controller should be obtained by performing the tests below. (Include error program counter numbers and accumulator contents if applicable). Use back of sheet if more space is needed.

FUNCTION	TEST	RESULT
Power-up	Self-test	_____
Controller	Diagnostics	_____
Subsystem	Reliability	_____

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 board.

1. Does the problem appear to be intermittent or heat sensitive? (If yes, explain).
2. Under which operating system are you running? Include revision number.
3. Describe the system configuration (i.e., peripherals, I/O controllers, model of computer).

To be filled out by CUSTOMER:

Model #: _____

Serial #: _____

RMA #: _____ (Call Zetaco to obtain an RMA number.)

Returned by:

Your name: _____

Firm: _____

Address: _____

Phone: _____

Programming Notes

4.0 Introduction

This section discusses, in detail, the assembly level programming characteristics of the D.G. system in relation to this disk controller. This is of most use to technicians involved in component level diagnostic testing and to programmers involved with utility writing.

4.1 Program I/O Foreword

The program I/O accumulator format is the vehicle used to communicate the control of the disk subsystem between the SCZ-2DP controller and the CPU. This is the requirement of the SCZ-2DP to be considered a true ZEBRA emulator. The program I/O established by ZEBRA was specific to the following drive sizes:

<u>Subsys #</u>	<u>Cylinders</u>	<u>Heads</u>	<u>Sectors</u>	<u>Capacity (bytes)</u>
6060	411	19	24	95,956,992
6061	815	19	24	190,279,680
6067	815	5	24	50,073,600

4.2 Instruction Format

Symbolic form for the I/O instructions:

DXXF AC, DSKP

DXX - DOA, DOB, DOC, DIA, DIB, DIC

F = Function:

C (clear) - Resets Busy and Done flags to zero, aborts all data transfer commands, and clears the data transfer status (DIA) fault bits 6,7,8,9, 10,11,12,13,14 & 15. Also clears RD/WRT and the drive attention flags and interrupt req.

S (start) - Sets the busy flag, clears done and initiates one of the following commands selected by a DOA: Read, Write, Format, Read Buffers or Verify. Also clears interrupt request and data transfer status (DIA) fault bits 6,7,8, 9,10,11,12,13,14 & 15.

P (pulse) - Sets control full flag and initiates one of the following commands selected by a DOA: Recal, Seek, Stop, Offset, Write Disable, Release, Trespass and Exam Controller RAM.

AC = Accumulator: 0, 1, 2 or 3.

DSKP = Device Code: Primary - 27 Octal
 Secondary - 67 Octal
 (Others available)

BINARY REPRESENTATION OF AN I/O INSTRUCTION

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC	OP	CODE			FUN		DEVICE CODE					

INTERRUPT MASK BIT 7

MSKO AC

Execution of the Mask Instruction with BIT 7 equal to a one in the selected accumulator will set the interrupt mask within the controller. This will inhibit any further interrupt requests by the controller until the interrupt mask is cleared, either by an IORST instruction or execution of the Mask Instruction with accumulator BIT 7 equal to a zero.

IORESET INSTRUCTION (IORST)

Execution of an IORST instruction serves as a master reset to the controller. Upon completion of an IORST the controller will attempt to select unit zero and default the command register to a read operation.

IOSKIP INSTRUCTION

Used to poll the state of the controller (command is done or busy).
If the skip condition is met, the next instruction is skipped;
otherwise the next instruction is executed.

SKPBZ DSKP - SKIP IF BUSY FLIP-FLOP IS CLEAR.
SKPBN DSKP - SKIP IF BUSY FLIP-FLOP IS SET.
SKPDZ DSKP - SKIP IF DONE FLIP-FLOP IS CLEAR.
SKPDN DSKP - SKIP IF DONE FLIP-FLOP IS SET.

4.3 Accumulator Formats

*DOA - Specify
Command and
Drive*

DOAF AC, DSKP

0 1 2	3 4	5 6 7	8 9	10 11 12 13 14 15
0 1 1	AC	0 1 0	F	DEVICE CODE

Accumulator

0	1 2 3 4	5 6 7 8	9 10	11 12 13 14 15
R/W DN	Clr Seek Done	Command	Drive	EMA MSB's

Bit Position

- 0 - Clear Read/Write done if it is a one.
- 1 - Clear Seek Done Attention Flag for Drive Unit 0
if it is a ONE.
- 2 - Clear Seek Done Attention Flag for Drive Unit 1
if it is a ONE.
- 3 - Clear Seek Done Attention Flag for Drive Unit 2
if it is a ONE.
- 4 - Clear Seek Done Attention Flag for Drive Unit 3
if it is a ONE.

5 - 8 Specify Command:

		Function required to Initiate
0000	Read	Start
0001	Recalibrate	Pulse
0010	Seek	Pulse
0011	Stop Disc	Pulse (1)
0100	Offset Forward	Pulse
0101	Offset Reverse	Pulse
0110	Write Disable	Pulse (1)
0111	Release Drive	Pulse (1)
1000	Trespass	Pulse (1)
1001	Set Alt Mode 1	None
1010	Set Alt Mode 2	None
1011	Examine Ram	Pulse
1100	Data Verify	Start
1101	Read Buffers	Start
1110	Write	Start
1111	Format	Start

(1) These commands are not supported by the controller. Any attempt to execute these will be ignored and if a pulse is received, the command full will be cleared.

9-10 Drive Selection:

- 00 - Drive unit 0
- 01 - Drive unit 1
- 10 - Drive unit 2
- 11 - Drive unit 3

11-15 Extended Memory Address:

Not supported, intended for controllers with BMC.

*DOB - Load
Starting Memory
Address*

DOBF AC, DSKP

0 1 2	3 4	5 6 7	8 9	10 11 12 13 14 15
0 1 1	AC	1 0 0	F	DEVICE CODE

Accumulator

0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Ex Mem Add	Memory Address Bits

Execution of this instruction will load the controllers address counter with the contents of the specified accumulator and will be used as the starting memory address for a command that requires a DCH transfer operation.

DOC - Load Drive Address

DOC - Specify Cylinder

DOCF AC, DSKP

0 1 2	3 4	5 6 7	8 9	10 11 12 13 14 15
0 1 1	AC	1 1 0	F	DEVICE CODE

Accumulator (if previous DOA specified a Seek)

0 1 2 3 4 5	6 7 8 9 10 11 12 13 14 15
Not Used	Cylinder Address

DOC - Read/Write Operations

If the command implies a READ or WRITE type of operation, then the DOC is the starting surface and sector address, and the number of sectors to transfer in two's complement form.

0	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15
Enable BMC maps n.u.	Surface Addr	Sector Addr	Count

Read Status - Non Alternate Mode

DIA - Read Data Transfer Status

DIAF, AC, DSKP

0 1 2	3 4	5 6 7	8 9	10 11 12 13 14 15
0 1 1	AC	0 0 1	F	DEVICE CODE

Accumulator

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

- 0 - Control Full
- 1 - R/W Done
- 2 - Unit 0 Atten Done
- 3 - Unit 1 Atten Done
- 4 - Unit 2 Atten Done
- 5 - Unit 3 Atten Done
- 6 - SCSI Bus Parity Error
- 7 - Illegal Sector Adr
- 8 - ECC Error
- 9 - Bad Sector Flag
- 10 - Cyl Addr Error
- 11 - Surf/Sect Addr Error
- 12 - Verify Error
- 13 - R/W Timeout
- 14 - Data Late
- 15 - Read/Write Fault

0 CONTROL FULL	Will be a one when the controller receives a pulse function. Will be a zero once the controller completes the function to the drive that was specified by the command (Recal, Seek, Offset, Trespass and Exam Ram).
1 R/W DONE	A one indicates that the done flag was set following a data transfer command.
2-5 UNIT ATTENTION (UNITS 0-3)	A one indicates that the respective drive completed a successful seek or recalibrate operation. If the drive was unsuccessful in its attempt to seek, a positioner fault status will be indicated. A recalibrate operation will clear the fault.
6 BUS PARITY	Indicates a Parity error was detected

	during a SCSI transfer either by the host or initiator.
7 ILLEGAL SECTOR ADDRESS	Indicates the starting sector address (DOC) exceeded the capacity of the drive if set to a one. Done sets immediately.
8 ECC ERROR	A sector of data read from the disk did not correlate with the appended polynomial. This means that the data read does not agree with the data that was originally written.
9 BAD SECTOR FLAG	Indicates the controller detected the bad sector flag set to a one.
10 CYLINDER ADDR ERROR	The Cylinder Address contained within the sector's header did not match the requested cylinder given by the previous seek command. Bit 11 will set, instead, if there is no match due to a media flaw. The Read/Write operation will be terminated immediately.
11 SURFACE/SECTOR ADDRESS ERROR	A media flaw occurred in the header field as reported by the SCSI target drive.
12 VERIFY ERROR	Data in memory did not agree with the data on the disk. (See Verify Command).
13 READ/WRITE TIMEOUT	A Read or Write type of operation did not complete within five seconds.
14 DATA LATE	Not implemented.
15 READ/WRITE FAULT FLAG	A one indicates that at least one bit is set in bit positions 6 through 14 or a drive fault occurred during a Read/Write transfer operation.

Refer to Table 4.1 for detailed description.

TABLE 4.1***Read/Write Faults (DIA)***

<u>STATUS BIT POSITION</u>	<u>CONTROLLER ACTION</u>	<u>ERROR RECOVERY</u>
BUS ERROR	6 Sets done immediately.	New command. Re-try Read/Write Transfer.
ILLEGAL SECTOR ADDRESS	7 Sets done immediately.	New command if error re-occurs. Make sure the controller is configured to match the drive type.
ECC ERROR	8 Sets done at the end of sector transfer.	New command. Re-tries with ECC may correct the data.
BAD SECTOR FLAG	9 Sets done immediately.	New command. This sector should be ignored.
CYLINDER ADDRESS ERROR	10 Sets done immediately	New command. The system should diagnose this as a positioner fault.
SURF/SECT ERROR	11 Sets done immediately.	New command.
VERIFY ERROR	12 Sets done at the end of the sector transfer.	New command. Check ECC error also to determine if the error occurred due to a flaw in the media.
READ/ WRITE TIMEOUT	13 Sets done immediately.	New command.

DIB - Read Drive Status

DIB AC, DSKP

0 1 2	3 4	5 6 7	8 9	10 11 12 13 14 15
0 1 1	AC	0 1 1	F	DEVICE CODE

Accumulator

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

- *0 - Invalid Status
- *1 - Drive Reserved
- *2 - Trespassed
- 3 - Ready
- 4 - Busy
- 5 - Positioner Offset
- *6 - Write Disabled
- *7 - 0
- 8 - Ill Sur/Cyl Addr
- 9 - Illegal Command
- 10 - DC Voltage Fault
- 11 - Pack Unsafe
- 12 - Positioner Fault
- 13 - Servo Clock Fault
- 14 - Write Fault
- 15 - Drive Fault

*These bits are not implemented by the SCZ-2F controller.

0 always zero

1 always zero

2 always zero

3 READY

Drive unit specified by a previous DOA command is selected, spindle is up to speed and positioner is on cylinder.

4	BUSY	The positioner within the currently selected drive is not on cylinder.
5	POSITIONER OFFSET	The selected Read/Write head was moved from on cylinder dead center as was specified by an offset forward or reverse command.
6	always zero	
7	always zero	
8	ILLEGAL SURFACE OR CYLINDER ADDRESS	The requested surface or cylinder address exceeds the capacity of the drive. Read/Write operation will terminate immediately. The translated address for SCSI exceeds the logical block address of the target drive.
9	ILLEGAL COMMAND	The controller was requested to perform a write type of command while servo is offset or drive is write protected. The SCSI target received an illegal command.
10	DC VOLTAGE FAULT	Received a SCSI error from the target drive that is considered catastrophic.
11	PACK UNSAFE	Conditions exist within the drive that may impair the safety of the media. This bit will be a one if a SCSI error status is received that would imply this condition.
12	POSITIONER FAULT	This indicates that the drive was unable to complete a seek command properly. The system should send a recal command to recover from this error.
13	SERVO CLOCK FAULT	An unrecoverable media error reported by the SCSI target that is not related to the data field.
14	WRITE FAULT	A write fault error was reported by

the target drive during a data transfer phase.

15 DRIVE FAULT

One or more bits are set in positions 8 through 14.

DIC - READ SURFACE, SECTOR AND COUNT

DICF AC, DSKP

0 1 2	3 4	5 6 7	8 9	10 11 12 13 14 15
0 1 1	AC	1 0 1	F	DEVICE CODE

Accumulator

0	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15
n.u.	Current Surface Addr	Current Sector Addr	2's Comp of # of Sectors remaining in Xfer

Read Status - Alternate Mode One

See detailed description of Alternate Mode One Command.

DIA - Read Current Memory Address

DIAF AC, DSKP

Accumulator

0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
EMA	Current Memory Address

After the execution of this instruction the value of the accumulator will contain the memory address to where the next data word transfer will take place. The memory address counter is incremented by one after each DCH transfer.

*Read Status -
Alternate Mode
Two*

DIA - READ ECC REMAINDER UPPER

DIAF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Bits 0 thru 7 will always be zero's. Bits 8 thru 15 depends on if an ECC error was reported or not. An uncorrectable syndrome of all one bits will be forced if an ECC error was reported in the read/write done DIA status word. If not an error it is the mechanism used to transfer drive configuration facts (examine RAM).

DIB - READ ECC REMAINDER LOWER

DIBF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
x	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

will always be reported as all zero's.

DIC - Not Currently implemented.

4.4 Command Descriptions

The command set (16 in all) provided by the controller is basically broken up into three groups:

1. Data Transfer Command
2. Drive Commands
3. Alternate Mode Commands

The command is stored in the controller via a DOA instruction.

*Data Transfer
Commands*

Before any command is initiated, the selected unit must have valid status and be ready.

Start (Set Busy) will initiate any one of the following commands: Read, Write, Format, Verify or Read Buffers. Up to 64 contiguous sectors may be transferred.

Read/Write Initialization Steps:

1. Control Full and Drive Status must be tested for proper state before commencing with a Read/Write Command.
2. Send the Starting Surface and Sector Address along with the Two's Complement of the number of sectors transferred. (See DOC)
3. Send the Starting Memory Address of where the data should be stored or retrieved. (See DOB)
4. Send the Command type and the desired Drive Unit Number. (See DOA)
5. Issue a Start Pulse.

Read/Write Termination Possibilities (Done Set):

1. All the sectors implied by the Two's Complement sector count were transferred.
2. A Drive or Read/Write Error was encountered. DIC command should be issued to determine which sector the error occurred at.
3. Busy was cleared by an IORESET instruction or a clear pulse was issued to the controller during the Read/Write transfer. Done will not set in this case.

The following commands are considered read/write type:

READ
WRITE
VERIFY
READ BUFFERS
FORMAT (drive)

Drive Commands

IOPULSE (sets control full) initiates any one of the following commands: Recalibrate, Seek, Offset, Trespass and Examine Ram.

RECALIBRATE

This command moves the heads to cylinder 0, selects Head 0, and issues a fault clear to the drive.

This command moves the heads more slowly than a seek to 0, so it should not be used for data acquisition.

SEEK

Seek moves the heads to the cylinder specified by the DOC. The controller stores the cylinder address for that particular unit, initiates the SEEK operation and clears control full. While that unit is busy seeking the controller can accept another SEEK command for a different unit (overlapped seeks), or commence with a Read/Write Command for the unit busy seeking.

See the disk drive specification for the Seek Timing.

OFFSET FORWARD

"OFFSET FORWARD" offsets the heads forward off the track center-line. This operation is cleared by the next command. (The drive does not allow write operations when the positioner is Offset). The controller does not actually send an offset type of command to the target drive, it was designed to only make it appear so. Cannot support offsets with SCSI.

OFFSET REVERSE

"OFFSET REVERSE" offsets the heads reverse off the track center-line. This operation is cleared by the next command. (The drive does not allow write operations when the positioner is Offset.) The controller does not actually send an offset type of command to the target drive, it was designed to only make it appear so. Cannot support offsets with SCSI.

EXAMINE RAM COMMAND

This command provides a method of transferring drive parameters to the CPU for each unit based on what is stored in the controllers scratch pad ram's characteristics block. The RAM is initialized with

the characteristics selected by switches 3-8 in switchpack 2. This initialization occurs during power up and following an IORST.

This feature is used for obtaining drive characteristics for Formatter, Reliability, and ZSDKINIT programs.

PROGRAMMING REQUIREMENTS:

NOTE: make sure control full is not set prior to issuing DOA.

DOA AC,DSKP ; specify unit # and NOP cmd DOC
P AC,DSKP ; specify desired parameter

WAIT FOR CONTROL FULL TO DROP

DOA AC,DSKP ; select ALT MODE 2 command
DIA C AC,DSKP ; get characteristic byte

DOC (specify para) DIA (unit para received)

-----	-----
0000	upper byte of max cyl adr
0001	lower byte of max cyl adr
0002	max head adr
0003	max sector adr

Alternate Modes

A command that will change the context of the data received from a DIA, DIB or DIC. A command other than Alternate Mode or an IORESET will clear Alternate Mode.

ALTERNATE MODE ONE

Changes the context of DIA to read the current memory address. The ending address after a Read/Write transfer will point to the last address plus one.

ALTERNATE MODE TWO

Changes the context of the DIA and DIB command. This is used to extract the syndrome (ECC remainder not equal to zero after a read command) from the controller.

Appendix

A.0 Soft Switch Settings for Zetaco Utilities

Following are the program soft switches common to all three of the Zetaco Utilities (Format, Diagnostic, and Reliability):

Note - Enter "M" to view the state of the switches.

<u>Bit</u>	<u>Binary value</u>	<u>Interpretation</u>
1	0	Loop on error.
	1	Skip looping on error.
2	0	Print to console.
	1	Skip printing to console.
5	0	Do not print to the printer.
	1	Print to the printer.

Additional switches used by the Reliability program:

Note - Enter "W" to examine test results.

<u>Bit</u>	<u>Binary value</u>	<u>Interpretation</u>
8	0	Writes to disk will occur.
	1	Set read only mode (only applies to tests starting at 501 or 502).
11	0	Disable bad sector printouts.
	1	Enable bad sector printouts.

Additional switches used by the Diagnostic program:

<u>Bit</u>	<u>Binary value</u>	<u>Interpretation</u>
1	0	Loop on error.
	1	Continue running test past error.
3	0	Do not print % of failure.
	1	Print % of failure.