Model SCZ-2

SCSI Disk Controller

Technical Manual

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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 controlelr 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

Chapter 2 - Installation

Chapter 3 - Trouble-shooting

Chapter 4 - Programming Notes

List of Tables

List of Illustrations

Appendix

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

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

The handshaking is accomplished by descrete 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 (±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.

2

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.**

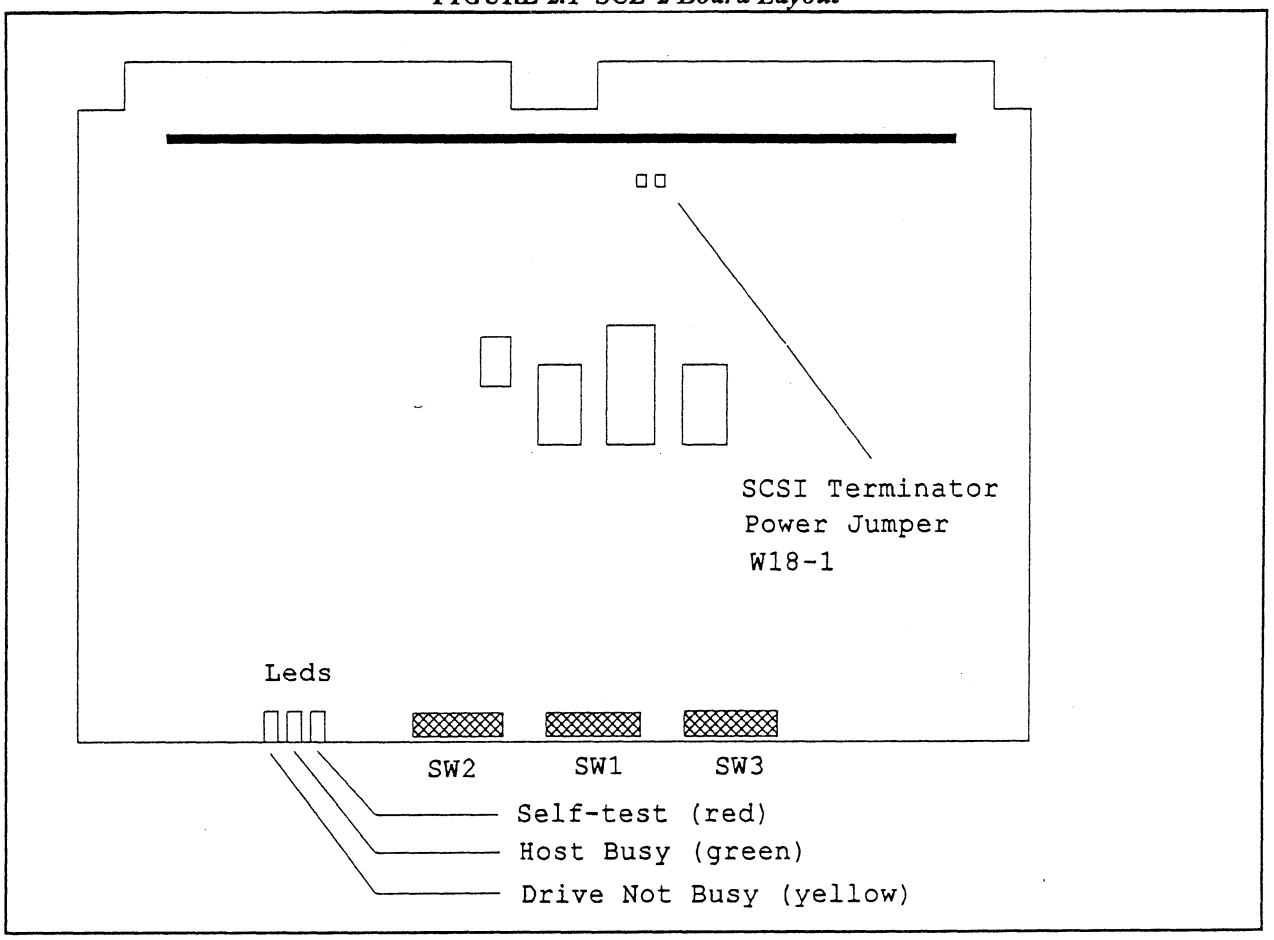
The Software Support Tape is structured so that the programs on Files 2 through 4 can be loaded and executed directly from the tape. Each is a Stand-Alone program; this means that they do not need, and cannot have, an operating system running when they are executed.

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 usedSwitch 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

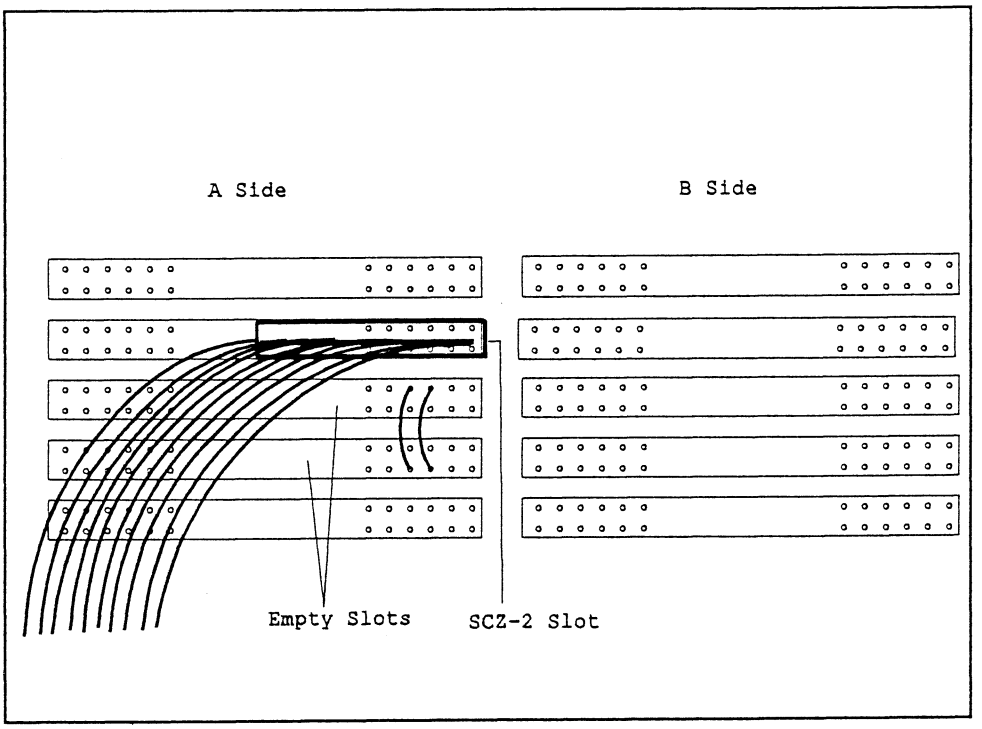
The computer backplane, viewed from the rear, has the "A" side pins on the left. On computers with vertically mounted controller boards, think of the component side of the boards as up, then the "A" side pins are on the left.

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 Formating 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.

3

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 MT0
        LOAD/A/R/V MT0:6
        RELEASE MT0
```

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, ann 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. Wiith 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 seeked. 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. Thsi 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.

This page left intentionally blank.

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: _____

4

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:

Subsys #	Cylinders	Heads	Sectors	Capacity (bytes)
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 occured 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)***

STATUS BIT	POSITION	CONTROLLER ACTION	ERROR RECOVERY
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 catystrophic.
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	Currnet 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.

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

Data Transfer Commands

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 onlym ake 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 scatch 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.

Bit	Binary value	Interpretation
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.

Bit	Binary value	Interpretation
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:

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

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ZETA

6850 Shady Oak Road
Eden Prairie, MN 55344

Model SCZ-2

SCSI Disk Controller

Technical Manual

Document No: 600-452-00
Revision: G
Date: 9/93

ZETA

Please give us your comments.

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

Date_____

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Address_____

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TECHNICAL MANUAL TITLE_____

DOCUMENT NUMBER_____REVISION_____

ERRORS IN MANUAL:

SUGGESTIONS FOR IMPROVING EITHER THE MANUAL OR THE PRODUCT:

APPENDIX B

B.0 FORMATTER PROGRAM DETAILS

```
;
;
;*****************************************************************
;
;
; DESCRIPTION: SCZ-2 DISK CONTROLLER FORMATTER PROGRAM
;
;
; Product of ZETACO, 1987
;*****************************************************************
        .TITL   SCZ2F
        .DUSR   X=1
        .NOMAC  X
;1.0    PROGRAM NAME:   SCZ2F.SR

;2.0    REVISION HISTORY:
;
;       REV.        DATE
;        01      09/29/87        ;
;

;3.0    MACHINE REQUIREMENTS:

;       NOVA/ECLIPSE FAMILY CENTRAL PROCESSOR
;       16K READ/WRITE MEMORY
;       SCZ-2 DISK CONTROLLER
;       0-3 DISK DRIVES
;       TELETYPE or CRT and CONTROL

;4.0    TEST REQUIREMENTS:      N/A

;5.0    SUMMARY:

;       The ZETACO DISK CONTROLLER FORMATTER PROGRAM
;       is designed to FORMAT and then run a short Seek
;       exerciser (seek read one sector). The PROGRAM is
;       !NOT! A MAINTENANCE PROGRAM and ASSUMES the HARDWARE
;       to be in WORKING ORDER. The Device Code may be 20-76
;       OCTAL with the Default being 27.

;6.0    RESTRICTIONS:
;
;       NONE
;
```

```
;7.0     PROGRAM DESCRIPTION/THEORY OF OPERATION:

;       A. FORMATTER PROGRAM (STARTING ADDRESS <SA> 500)
;       The disk is first formatted after which a "FORMAT DONE"
;       message is printed. Then a random seek test is performed,
;       and "PASS" is printed. Since the FORMAT is a FORMAT DRIVE
;       command, the log is NOT available while the drives are
;       being formatted.

;       B. FORMATTER PROGRAM (SA 501)
;       Same as SA 500.

;       C. LOG RECOVERY (SA 502)
;       Use to recover log of program after it has stopped to get a
;       LOG PRINTOUT.

;       D. COMMAND STRING INTERPRETER (SA 503)
;       As a trouble shooting aid the service engineer may type in
;       their own TEST LOOP. After starting at 503, three ARGUMENTS
;       must be entered in response to three program questions;
;       "UNIT", "DATA", and "COMMAND STRING". All numbers must be
;       entered in OCTAL.

;       I.      UNIT:   Type unit # or carriage return
;                       to use the previous entry

;       II.     DATA:   RAN=RANDOM
;                       ALO=ALL ONES
;                       ALZ=ALL ZEROS
;                       PAT=110110 PATTERN
;                       FLO=FLOATING ONE PATTERN
;                       FLZ=FLOATING ZERO PATTERN
;                       ADR=ALTERNATING CYLINDER and
;                       HEAD,SECTOR WORDS
;                       VAR=Existing words entered previously as
;                       described below

;                       Alternatively enter a string of up to 7
;                       OCTAL 16 bit words to be used as DATA.
;                       The words entered are used repeatedly
;                       to make up a sector block. Type carriage
;                       return to use the previous entry.

;       III.    COMMAND STRING:

;       OPTIONS 1.      READ HEAD,SECTOR,#SECTORS
;               2.      WRITE SAME
;               3.      SEEK CYLINDER
;               4.      RECALIBRATE
;               5.      LOOP (go to beginning or LR)
;               6.      DELAY N (N=DELAY in MS)
;               7.      TRESPASS
;               8.      RELEASE
;               9.      OFF (OFFSET FORWARD)
;               10.     OFR (OFFSET REVERSE)
;               11.     LR  (begin LOOP here)
;               12.     VERIFY (WRITE)
;               13.     Type Carriage Return to use the
;                       previous COMMAND STRING.

;               Note that either SPACES or a COMMA
;               may be used as an argument delimiter.
;               Each response is terminated by
;               typing carriage return.  If more
```

```
;                feed to space to the next line. The
;                word "SAME" used with READ, or WRITE,
;                will cause the previous disk address
;                parameters to be used.

;        An R typed while a string is being executed will
;        cause the program to return to command string start.
;        The ESCAPE KEY will bypass UNIT and DATA prompts to
;        the command string prompt.

;        The following example would cause UNIT
;        1 to SEEK CYLINDER 50, then repeatedly
;        WRITE SECTORS 2 and 3 of HEAD 5, then
;        READ it back and CHECK.  Data is specified
;        as ALTERNATE WORDS of ZEROS then ONES.

;        UNIT: 1
;        DATA: 0,177777
;        COMMAND STRING: SEEK 50 LR WRITE 5,2,2 READ SAME LOOP
```

```
;8.0  OPERATING MODES/SWITCH SETTINGS:

;8.1     SWITCH SETTINGS
;
;        Location "SWREG" is used to select the program options.
;        This Location will be set according to the answers
;        supplied by the Operator. The Options can be changed
;        or verified by using one of the commands given in Sec.
;        8.3
;
;8.2     SWITCH OPTIONS
;        Different bits and their interpretation at location
;        "SWREG" is as follows:
;
;        BIT      OCTAL    BINARY   INTERPRETATION
;                 VALUE    VALUE
;
;        1         40000     0       LOOP on ERROR
;                 000000     1       SKIP LOOPING on ERROR
;
;        2         20000     0       PRINT to CONSOLE
;                 000000     1       ABORT PRINT OUT to CONSOLE
;
;        5         02000     0       DO NOT PRINT on the LINE PRINTER
;                 000000     1       PRINT on the BYTE I/O LINE PRINTER(DC17)
;
;        16(G)     00000     0       DO NOT PRINT on DMA LINE PRINTER
;                 100000     1       PRINT on DMA LINE PRINTER(DC17)
;
;8.3     SWITCH COMMANDS
;        Once the Program starts executing the state of any of
;        the Bits can be changed by Hitting KEYS 1-9, A-Z. The
;        Program will Continue Running after Updating the Options.
;        Each Key will Complement the state of the Bit affiliat-
;        ed with it, thus Bit 4 can be Altered by Hitting Key 4.
;        Setting of any Bit of Location "SWREG" will Set Bit 0.
;        (Default Mode is defined as all Bits of SWREG Set to 0)
;
;8.4     OTHER COMMANDS  (© = CONTROL KEY)
;
;        "CR"     A "RETURN" can be typed to Continue the Program
;                 after its locked in a Switch Modification Mode
;
;        ©D       This Command given at any time will reset "SWREG"
;                 to Default Mode and Restart the Program.
;
;        ©R       This Command given at any time will Restart the
;                 Program. Switches are left with the values they
;                 had before the Command was issued.
;
;        ©O       This Command given at any time will cause the
;                 Program Control to go to ODT.
;
;        M        This Command given at any time will print the
;                 Current Operating Modes.
;
;        0        This Command given at any time will lock the
;                 Program into Switch Modification Mode where
;                 more than 1 Bit can be changed.
;
```

```
;9.0     OPERATING PROCEEDURE/OPERATOR INPUT:

;        A. Verify drive (s) are ready on-line
;        B. Load Program
;        C. To RUN other than TEST 500, Enter CONTROL "O"
;           at 9.2, Enter STARTING ADDRESS followed by an "R"

;        STARTING ADDRESS (SA)
;        200      Read Unit Characteristics and then Run FORMATTER (500)
;        500      FORMATTER PROGRAM
;        501      FORMATTER PROGRAM
;        502      ERROR LOG RECOVERY
;        503      COMMAND STRING INTERPRETER

;9.1     Operator is requested to enter DEVICE CODE of CONTROLLER
;        (DEFAULT 27)
;9.2     Operator is requested to SET SWPAK followed by a Carriage
;        Return (SEE 8.3)
;9.3     MONTH, DAY, YEAR (I.E. 77...), HOUR, & MIN (If [CR] is
;        given this routine is bypassed)
;9.4     Unit Numbers, Types, and their Characteristics are then
;        Displayed, (The Operator should Verify these values) Operator
;        is then requested to enter UNIT NUMBERS to be tested(0-3)
;9.5     Operator is then requested to enter TYPE of disk ( to create a
;        User Defined enter 10)
;        A.       If TYPE entered is 10, enter 0, 1, 2, or 3 to
;                 RE-DEFINE a disk TYPE
;        B.       # of HEADS for NEW TYPE (in DECIMAL)
;        C.       # of CYLINDERS for NEW TYPE (in DECIMAL)
;        D.       # of SECTORS for NEW TYPE (in DECIMAL, CANNOT be
;                 DOWNSIZED)
;        E.       Return to 9.5

;        OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:
;
;        L        = First 200. DATA, or ADDRESS ERRORS.
```

```
;10.0   DEBUG HELP:
;
;OCTAL DEBUGGER  (ODT)
;
;       This Formatter is equipped with a built in ODT which can be
;       accessed by hitting CONTROL O at any time during the execution
;       of the Program (after Setting the Parameters). On entering ODT
;       the Address of the Location having the next instruction to be
;       executed will be typed-out.
;
;       The following Conventions are used by the ODT:
;       ?       Pressing any Illegal key causes the ODT to respond
;               with a "?".
;       @       ODT is ready and at your service.
;
;       An ODT Command has the following Format:
;               [ARGUMENT][COMMAND]
;       An Argument may be one of the following:
;       "EXP"   An OCTAL Expression consisting of OCTAL Numbers
;               separated by Plus (+) or Minus (-) signs. Leading
;               Zeros need not be typed.
;       "ADR"   An Address is the same as an Expression except
;               that Bit 0 is neglected.
;       A Command is a single teletype character
;
;       The Locations that can be EXAMINED and MODIFIED by the user
;       are called CELLS. These CELLS are of two Types: Internal CPU
;       Cells and Memory Locations. The Command to OPEN one of the
;       Internal Registers is of the form "nA" where n is any OCTAL
;       Expression between 0 and 7.
;
;       0-3     For ACCUMULATORS 0-3
;       4       For PC of the next Instruction to be Executed in the
;               event of a "P" Command.
;       5       CPU and TTO Status
;               BIT     INTERPRETATION
;               15      Status of TTO DONE FLAG
;               14      Status of INTERRUPTS (ION FLAG)
;               13      Status of CARRY BIT
;       6       Address of the Location having the BREAK POINT (If any)
;       7       Instruction at the BREAK POINT Location
;
;       Other Commands to OPEN Cells are:
;
;       "ADR"/  Open the Cell and Print its contents
;       ./      Open the Cell currently pointed to by the Pointer and
;               Print its contents.
;       .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its
;               contents.
;       .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and
;               Print its contents.
;       "CR"    The Return Key is used to Close the Open Cell with or
;               without Modification.
;       "LF"    Line Feed is used to Close the Open Cell with or without
;               Modification and to Open the succeeding Cell.
;       CTRL    Close the Open Cell with or without Modification and
;               Open the preceeding Cell.
;       /       Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents.
;       +"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents + "ADDR".
;       -"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents - "ADR".
;
```

```
;       Modification of a Cell:
;
;       Once a Cell has been opened its contents can be Modified by
;       typing the New Value the Cell is to contain in the form of
;       an OCTAL Expression followed by "CR" or "LF". If a + or - is
;       typed as the first character of the Expression then the Value
;       of the Expression is Added to or Subtracted from the Old
;       contents of the Cell. The Address itself or an Expression
;       relative to the Address can be Deposited by typing a "." or
;       :,+/-OCTAL Expression". A Rubout Command given right after
;       opening a Cell allows the Modification of its contents as if
;       they were typed in just before the Command was issued.
;
;       Other ODT Commands:
;
;       RUBOUT  This Key is used to Delete ERRONEOUSLY typed digits.
;               Each time the Key is pressed the right most digit is
;               Deleted and Echoed on the Terminal. If the Rubout
;               Key is pressed right after opening a Cell then it
;               Deletes the right most digit of the Cells contents.
;               This allows the Modification of the Cell as if its
;               contents were typed in just before the Key was pressed.
;       "ADR"B  Insert a BREAK POINT at Location "ADR".
;               Only one Break Point can be inserted and any entry to
;               ODT after Executing a Break Point will cause it to be
;               Deleted.
;       D       Delete the Break Point if any.
;       P       Restart the Execution of the program at CURRENT Location
;       "ADR"R  Start Executing the program at "ADR" after an IORST.
;       K       Kill the String typed so far. The ODT responds with a
;               "?" and the Open Cell is closed without Modification.
;       =       Print the OCTAL Value of the INPUT only.
;               This will Close any Open Cells without  Modification and
;               will not Open a Cell
;
;       NOTE:   In Programs which RELOCATE THEMSELVES the
;               user should place Break Points ONLY in the
;               ORIGINAL PROGRAM AREA. If a Break Point is
;               placed outside this area the results will
;               be unpredictable.
;
;
;11.0   SPECIAL NOTES/SPECIAL FEATURES:

;       The Program is !NOT! a Maintenance Program and assumes
;       the HARDWARE to be in working order.

;12.0   PROGRAM RUNTIME:

;       Runtimes are dependant on Drive Size and Drive Type.

        .EOT
```

APPENDIX C

C.0 DIAGNOSTIC PROGRAM DETAILS

```
;
;
;*****************************************************************
;
;
; DESCRIPTION: SCZ-2 DISK CONTROLLER DIAGNOSTIC
;
;
; Product of ZETACO, 1987
;*****************************************************************
        .TITL   SCZ2D
        .DUSR   X=1
        .NOMAC  X
; 1.0 PROGRAM NAME:     SCZ2D.SR

; 2.0 REVISION HISTORY:
;
;       REV.        DATE
;
;        01      09/29/87        ;INITIAL RELEASE (4)

; 3.0 MACHINE REQUIREMENTS:
;       NOVA/ECLIPSE FAMILY CENTRAL PROCESSOR
;       MINIMUM of 16K READ/WRITE MEMORY
;       SCZ-2 DISK CONTROLLER
;       0-3 DISK DRIVES
;       TELETYPE or CRT and CONTROL

; 4.0 TEST REQUIREMENTS:        N/A

; 5.0 SUMMARY:
;       The SCZ-2 DISK CONTROLLER DIAGNOSTIC PROGRAM is a
;       HARDWARE DIAGNOSTIC for the SCZ-2 DISK CONTROLLER
;       and DRIVES. The Device Code may be 20-76 OCTAL
;       with the Default being 27.


; 6.0 RESTRICTIONS:
;
;       NONE

; 7.0 PROGRAM DESCRIPTION/THEORY OF OPERATION:

;       7.1 "A" TESTS CHECK:

;       - BUSY, DONE, I/O BUS SELECT LOGIC
;       - DISK SELECT LOGIC
```

```
;       7.2 "B" TESTS CHECK:

;       - START, BUSY, CLEAR LOGIC
;       - RECALIBRATE, ATTN, INTERRUPT LOGIC
;       - INTERRUPT DISABLE, INTA LOGIC
;       - That SEEKS to CYL'S 0,1/2 CYL MAX,and CYL MAX
;         can at least be EXECUTED and SET DRIVE BUSY.
;       - READY/SELECT LOGIC

;       7.3 "C" TESTS CHECK:

;       - That the CA REGISTER INCREMENTS properly
;         VIA DCH
;       - That a WRITE can be EXECUTED
;       - SELD, CLEAR LOGIC
;       - That SEEK/WRITE Operations can be EXECUTED
;       - WRITES to Different HDS,SECTORS
;       - MULTI-SECTOR WRITES
;       - The INCREMENT HEAD LOGIC
;       - ILLEGAL SECTOR, SURFACE, CYLINDER Conditions

;       7.4  "E" TESTS CHECK:

;       - That a READ may be EXECUTED
;       - 8 SECTOR WRITE/READ OPERATIONS (9 Different
;         Data Patterns) at CYL'S 0,1/2 CYL MAX and CYL MAX
;         with Full Core Compare
;       - Data VERIFY Function (Normal and with Forced Errors)
;       - OFFSET MODES
;       - ILLEGAL COMMAND TRAPS
;       - WRITE CYL# to HEAD 0,SECTOR 0 of All Cylinders
;       - WRITE HEAD # to SECTOR 0 of All Heads on CYL 0
;       - WRITE SECTOR # to All Sectors of Head 0,CYL 0
;       - Each of the above Operations is followed by
;         a Corresponding READ/CHECK Operation to Verify
;         Disk Addressing Logic.

;       7.5 "S" TESTS ARE SEEK EXERCISERS

;       - Performs RANDOM SEEKING. Each SEEK is Followed
;         by a Read to Head 0,Sector 0

;       - Performs RANDOM OVERLAPPED SEEKING to TWO DRIVES.
;         Each SEEK is Followed by a Read to Head 0,Sector 0.
;         U1 is the the Primary Unit under Test and U2
;         is the next Drive found in a 1,2,3,0 ETC. Search.
;         If only 1 Drive, Test is Bypassed. Test is only run
;         after a Pass is Achieved on All Drives.
```

```
; 8.0  OPERATING MODES/SWITCH SETTINGS:

;8.1     SWITCH SETTINGS
;
;        Location "SWREG" is used to select the program options. This
;        Location will be set according to the answers supplied by
;        the Operator. The Options can be changed or verified by
;        using one of the commands given in Sec. 8.3.
;
;8.2     SWITCH OPTIONS
;        Different bits and their interpretation at location
;        "SWREG" is as follows:
;
;        BIT      OCTAL    BINARY  INTERPRETATION
;                 VALUE    VALUE
;
;        1         40000     0      LOOP on ERROR
;                 000000     1      SKIP LOOPING on ERROR
;
;        2         20000     0      PRINT to CONSOLE
;                 000000     1      ABORT PRINT OUT to CONSOLE
;
;        3         10000     0      DO NOT PRINT % FAILURE
;                 000000     1      PRINT % FAILURE
;
;        5         02000     0      DO NOT PRINT on the LINE PRINTER
;                 000000     1      PRINT on the BYTE I/O LINE PRINTER(DC17)
;
;        6         01000     0      DO NOT HALT on ERROR
;                 000000     1      HALT on ERROR
;
;        8         00200     0      N/A
;                 000000     1      RECALIBRATE during SCOPE LOOP
;
;        9         00100     0      N/A
;                 000000     1      1 SECOND DELAY during SCOPE LOOP
;
;        10(A)     00040     0      N/A
;                 000000     1      PRINT TEST #'S on all passes
;
;        11(B)     00020     0      N/A
;                 000000     1      PROGRAM will EXIT to ODT, SWT is Set
;                                   to 0 upon EXIT
;        16(G)     00000     0      DO NOT PRINT on the DMA LINE PRINTER
;                 100000     1      PRINT on the DMA LINE PRINTER(DC 17)
;
;8.3     SWITCH COMMANDS
;        Once the Program starts executing the state of any of
;        the Bits can be changed by Hitting KEYS 1-9, A-Z. The
;        Program will Continue Running after Updating the Options.
;        Each Key will Complement the state of the Bit affiliat-
;        ed with it, thus Bit 4 can be Altered by Hitting Key 4.
;        Setting of any Bit of Location "SWREG" will Set Bit 0.
;        (Default Mode is defined as all Bits of SWREG Set to 0)
```

```
;8.4     OTHER COMMANDS  (© = CONTROL KEY)
;
;        "CR"    A "RETURN" can be typed to Continue the Program
;                after its locked in a Switch Modification Mode
;
;        ©D      This Command given at any time will reset "SWREG"
;                to Default Mode and Restart the Program.
;
;        ©R      This Command given at any time will Restart the
;                Program. Switches are left with the values they
;                had before the Command was issued.
;
;        ©O      This Command given at any time will cause the
;                Program Control to go to ODT.
;
;        M       This Command given at any time will print the
;                Current Operating Modes.
;
;        O       This Command given at any time will lock the
;                Program into Switch Modification Mode where
;                more than 1 Bit can be changed.
;


; 9.0 OPERATING PROCEEDURE/OPERATOR INPUT:

;        9.1 Load the Program

;        9.2 STARTING ADDRESSES
;                200-To IDENTIFY DISK TYPE (INITIALIZE)
;                    PROGRAM then PROCEEDS to 500.
;                201-ODT DIRECT ENTRY ONLY
;                202-RANDOM SEEK EXERCISERS. (1 PASS of DIAG FIRST)
;                 SEEK EXER 1 is a SINGLE DRIVE EXERCISER
;                 SEEK EXER 2 is TWO DRIVE EXERCISER with SEEK OVERLAP
;                500-DIAGNOSTIC (RESTART)
;                501-TIMEOUT FF TEST

;        9.3 The Program Prints"PASS" following each
;           Complete Pass through the Tests. Random
;           Seek Exerciser performs 1000 Seeks
;           per "PASS" Message.

;        9.4 Device Code of Controller is Requested (27 is Default)

;        9.5 Unit Numbers to be Tested are Requested to which the
;            Operator Enters the Unit Numbers to be Tested, Separating
;            the Individual #'s by a <,> or <Space>.

;        9.6 Operator is Requested to Enter 1, if Unit Characteristics
;            Displayed are INCORRECT, and Wants to LOOP on Reading them.
```

```
; 10. PROGRAM OUTPUT/ERROR DESCRIPTION:
;       When an ERROR is Detected the Program Prints the ERROR
;       PC, AC'S 0,1,and 2 at the point of ERROR, the Program then
;       goes into a Scope Loop between the Entries to .SETUP and
;       .LOOP allowing the Operator to Set  SWPAK. In General the
;       ERROR PC will point to a Call ERROR.

;       The Printout will be of one of the following Formats:

;       A. STANDALONE CONTROLLER TEST FAILURES-

;       B. STATUS ERRORS

;       MODE    UNIT    #       DATA
;       CYL     #       HEAD    #       SECTOR  #
;       AC1(STATUS) SHOULD =AC0
;       DESCRIPTIONS of FAILING STATUS BITS

;       C. MEMORY/DISK ADDRESS ERROR

;       MODE    UNIT    #       DATA
;       CYL     #       HEAD    #       SECTOR  #
;       ENDING MEMORY/DISK ADDRESS ERROR
;       AC1(MA/DA) SHOULD =AC0

;       C. INTERRUPT TIMEOUT

;       MODE    UNIT    #       DATA
;       CYL     #       HEAD    #       SECTOR  #
;       INTERRUPT TIMEOUT

;       Additional Test Significance can be found in the Program
;       Listing, although it is hoped that a need for the Listing
;       will be Minimal. SWPACK(SWREG) will provide all Control
;       over Test Loop Options and Printouts.


;       Data Errors will result in the 1st 3 Good/Bad pairs and
;       their Addresses being Printed along with the Total Count.
;       If an ECC Error is Detected, the Call EHECC will
;       Acknowledge the Fact and Return to the Main Test for
;       the Data Compare. Printouts result on the 1st Error Pass
;       only. As the Check Routine Checks the entire Read Buffer,
;       any Error accompanied by an ECC Error,terminating the
;       Read, may cause all Data in succeeding Sectors to appear Bad.

;       Tests that perform a Recalibrate have a 2 SEC. Delay built
;       into the Scope Loop.  Set SWPAK 9 = 1 to introduce an
;       additional 1 Second Delay during the Scope Loop.

;       In General each successive Test Assumes all Previous Tests
;       work. Bypassing Errors can result in confusing situations
;       in the setup of more Complex Tests.
```

```
; 11. DEBUG HELP:
;
;OCTAL DEBUGGER  (ODT)
;
;       This Diagnostic is equipped with a built in ODT which can be
;       accessed by hitting CONTROL O at any time during the execution
;       of the Program (after Setting the Parameters). On entering ODT
;       the Address of the Location having the next instruction to be
;       executed will be typed-out.
;
;       The following Conventions are used by the ODT:
;       ?       Pressing any Illegal key causes the ODT to respond
;               with a "?".
;       @       ODT is ready and at your service.
;
;       An ODT Command has the following Format:
;               [ARGUMENT][COMMAND]
;       An Argument may be one of the following:
;       "EXP"   An OCTAL Expression consisting of OCTAL Numbers
;               separated by Plus (+) or Minus (-) signs. Leading
;               Zeros need not be typed.
;       "ADR"   An Address is the same as an Expression except
;               that Bit 0 is neglected.
;       A Command is a single teletype character
;
;       The Locations that can be EXAMINED and MODIFIED by the user
;       are called CELLS. These CELLS are of two Types: Internal CPU
;       Cells and Memory Locations. The Command to OPEN one of the
;       Internal Registers is of the form "nA" where n is any OCTAL
;       Expression between 0 and 7.
;
;       0-3     For ACCUMULATORS 0-3
;       4       For PC of the next Instruction to be Executed in the
;               event of a "P" Command.
;       5       CPU and TTO Status
;               BIT     INTERPRETATION
;               15      Status of TTO DONE FLAG
;               14      Status of INTERRUPTS (ION FLAG)
;               13      Status of CARRY BIT
;       6       Address of the Location having the BREAK POINT (If any)
;       7       Instruction at the BREAK POINT Location
```

```
;       Other Commands to OPEN Cells are:
;
;       "ADR"/  Open the Cell and Print its contents
;       ./      Open the Cell currently pointed to by the Pointer and
;               Print its contents.
;       .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its
;               contents.
;       .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and
;               Print its contents.
;       "CR"    The Return Key is used to Close the Open Cell with or
;               without Modification.
;       "LF"    Line Feed is used to Close the Open Cell with or without
;               Modification and to Open the succeeding Cell.
;       CTRL    Close the Open Cell with or without Modification and
;               Open the preceeding Cell.
;       /       Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents.
;       +"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents + "ADDR".
;       -"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents - "ADR".
;
;       Modification of a Cell:
;
;       Once a Cell has been opened its contents can be Modified by
;       typing the New Value the Cell is to contain in the form of
;       an OCTAL Expression followed by "CR" or "LF". If a + or - is
;       typed as the first character of the Expression then the Value
;       of the Expression is Added to or Subtracted from the Old
;       contents of the Cell. The Address itself or an Expression
;       relative to the Address can be Deposited by typing a "." or
;       :,+/-OCTAL Expression". A Rubout Command given right after
;       opening a Cell allows the Modification of its contents as if
;       they were typed in just before the Command was issued.
;
;       Other ODT Commands:
;
;       RUBOUT  This Key is used to Delete ERRONEOUSLY typed digits.
;               Each time the Key is pressed the right most digit is
;               Deleted and Echoed on the Terminal. If the Rubout
;               Key is pressed right after opening a Cell then it
;               Deletes the right most digit of the Cells contents.
;               This allows the Modification of the Cell as if its
;               contents were typed in just before the Key was pressed.
;       "ADR"B  Insert a BREAK POINT at Location "ADR".
;               Only one Break Point can be inserted and any entry to
;               ODT after Executing a Break Point will cause it to be
;               Deleted.
;       D       Delete the Break Point if any.
;       P       Restart the Execution of the program at CURRENT Location
;       "ADR"R  Start Executing the program at "ADR" after an IORST.
;       K       Kill the String typed so far. The ODT responds with a
;               "?" and the Open Cell is closed without Modification.
;       =       Print the OCTAL Value of the INPUT only.
;               This will Close any Open Cells without  Modification and
;               will not Open a Cell
;
```

```
;
;
; 12. SPECIAL NOTES/SPECIAL FEATURES:

;       12.1 If the Disk Pack has media flaws on Cylinder
;       0, or on the First 8 Sectors of Head 0 of any Cylinder,
;       Error Printouts may result if errors are Encountered.

;       12.2  Some Scope Loops will require a Recalibrate to
;       Initialize the Disk Drive following a failure. Set
;       SWPAK 8 = 1 to Introduce the Recalibrate to the Unit
;       under Test.

;       12.3  DISK DRIVES
;       Only use Disk DRIVES Formatted by the SCZ-2 Formatter
;       Program. The Diagnostic Program will Write over most of
;       the Disk Surface.

; 13. RUN TIME:
;       The Run Time for a PASS is approximately: 12 MIN.
```

APPENDIX D

D.0 RELIABILITY PROGRAM DETAILS

```
;
;
;*****************************************************************
;
;
; DESCRIPTION: SCZ-2 DISK CONTROLLER RELIABILITY PROGRAM
;
;
; Product of ZETACO, 1987
;*****************************************************************
        .TITL   SCZ2R
        .DUSR   X=1
        .NOMAC  X
;1.0    PROGRAM NAME:   SCZ2R.SR

;2.0    REVISION HISTORY:
;
;       REV.      DATE
;
;        01     09/29/87                ;INITIAL RELEASE (5)
;

;3.0    MACHINE REQUIREMENTS:

;       NOVA/ECLIPSE FAMILY CENTRAL PROCESSOR
;       16K READ/WRITE MEMORY
;       SCZ-2 DISK CONTROLLER
;       0-3 DISK DRIVES
;       TELETYPE or CRT and CONTROL

;4.0    TEST REQUIREMENTS:      N/A

;5.0    SUMMARY:

;       The SCZ-2 DISK CONTROLLER RELIABILITY PROGRAM is a
;       MAINTENANCE PROGRAM designed to EXERCISE and TEST the
;       SCZ-2 DISK SUB-SYSTEMS and 1-4 DISK DRIVES.

;       The Device Code may be 20-76 OCTAL with the Default
;       being 27.
```

;6.0 RESTRICTIONS:

; NONE

;7.0 PROGRAM DESCRIPTION/THEORY OF OPERATION:

; A. RELIABILITY TEST (SA 500)

; A Random Number Generator is used to select a Disk Drive,
; Cylinder,Head,Beginning Sector, and Number of consecutive
; Sectors. Random Data is then Generated, Written, and Read.
; The Sequence is repeated indefinately. If running Multiple
; Units, Over Lapped SEEKS are employed, If the next Random
; Unit is different from the current Unit under I/O Execution.

; B. RELIABILITY TEST (SA 501) with OPTIONS

; Same as A, Except that Operator is given Options on Data
; Patterns and may choose a Constant Cylinder,Head,Sector
; or # or Sectors. Any Letter response to CYL,HEAD ETC.
; gets Random function for that Variable. A Carriage Return
; only gets the Random function for all Variables.

; 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.

; C. INCREMENTAL DISK ADDRESS TEST (SA 502)

; Operator is given Option on Data; Requested Data is first
; Written (SEE SWPAK10) over the entire Pack. Then the Data
; is Read from all Sectors . This insures that all Disk
; Blocks are useable and are Formatted properly. The Test
; is then repeated for all Ready Disks, and PASS is Printed.
; The sequence is repeated indefinitely.

; #NOTE
; SWPAK7=1, Program waits after Write with Read Verification
; allowing Operator to change Packs. SWPAK8=1, puts Program
; into Read ONLY Mode ## SA'S 501,502 ONLY. If SA 501-Data
; must !NOT! be Random.

; All Numbers entered above must be in Octal. Any Non-Octal
; input is treated as a letter. Any letter input for CYL,Head,
; Sector, or # of Sectors gets Random function in the Reliability
; Test with Options.

```
;       D. COMMAND STRING INTERPRETER (SA 503)
;       As a trouble shooting aid the service engineer may type in
;       their own TEST LOOP. After starting at 503, three ARGUMENTS
;       must be entered in response to three program questions;
;       "UNIT", "DATA", and "COMMAND STRING". All numbers must be
;       entered in OCTAL.

;       I.      UNIT:   Type unit # or carriage return
;                       to use the previous entry

;       II.     DATA:   RAN=RANDOM
;                       ALO=ALL ONES
;                       ALZ=ALL ZEROS
;                       PAT=155555 PATTERN
;                       ROT=155555 PATTERN Rotated on
;                       Successive Passes.
;                       FLO=FLOATING ONE PATTERN
;                       FLZ=FLOATING ZERO PATTERN
;                       ADR=ALTERNATING CYLINDER and
;                       HEAD,SECTOR WORDS
;                       VAR=Existing words entered previously as
;                       described below

;                       Alternatively enter a string of up to 7
;                       OCTAL 16 bit words to be used as DATA.
;                       The words entered are used repeatedly
;                       to make up a sector block. Type carriage
;                       return to use the previous entry.

;       III.    COMMAND STRING:

;       OPTIONS 1.      READ HEAD,SECTOR,#SECTORS
;               2.      WRITE SAME
;               3.      SEEK CYLINDER
;               4.      RECALIBRATE
;               5.      LOOP (go to beginning or LR)
;               6.      DELAY N (N=DELAY in MS)
;               7.      TRESPASS
;               8.      RELEASE
;               9.      OFF (OFFSET FORWARD)
;               10.     OFR (OFFSET REVERSE)
;               11.     LR  (begin LOOP here)
;               12.     VERIFY (WRITE)
;               13.     Type Carriage Return to use the
;                       previous COMMAND STRING.

;               Note that either SPACES or a COMMA
;               may be used as an argument delimiter.
;               Each response is terminated by
;               typing carriage return.  If more
;               room is needed on a line, type line
;               feed to space to the next line. The
;               word "SAME" used with READ, or WRITE,
;               will cause the previous disk address
;               parameters to be used.

;       An R typed while a string is being executed will
;       cause the program to return to command string start.
;       The ESCAPE KEY will bypass UNIT and DATA prompts to
;       the command string prompt.

;       The following example would cause UNIT
;       1 to SEEK CYLINDER 50, then repeatedly
;       WRITE SECTORS 2 and 3 of HEAD 5, then
```

```
;       as ALTERNATE WORDS of ZEROS then ONES.

;       UNIT: 1
;       DATA: 0,177777
;       COMMAND STRING: SEEK 50 LR WRITE 5,2,2 READ SAME LOOP

;       E. ERROR COUNT/LOG RECOVERY (SA 504)
;       In the event a Program was stopped during a run, the Error
;       Logs may be recovered at this Starting Address.
;       ***MUST be done before any Program RESTART as Program
;       Initialization Zeroes all Logs.

;       F. RUNALL (SA 505)
;       Program alternates between the Programs described in 7.B
;       (4 Data Patterns -PAT,RAN,FLZ,FLO) and 7.C(6 Data Patterns
;       -PAT,RAN,ADR,ALT1,ZEROES,ONES) and 7.H, and in that order.

;       G. SEEK EXERCISER (SA 506)
;       Program provides a SEEK scan sequence converging from the
;       extreme Outermost Tracks into the adjacent track in the
;       center, then diverging again to the extremes.

;       H. RANDOM SEEK EXERCISER (SA 507)
;       Program provides a Random SEEK sequence

;       ###G,H all SEEKS in G/H are followed by a 1 Sector Read but
;       with no Data Check. All SEEKS are timed with MAX,MIN, and
;       AVE. times being Logged in MS. SEEK Paths for MAX,MIN Values
;       are also Logged.
;
;8.0  OPERATING MODES/SWITCH SETTINGS:

;8.1    SWITCH SETTINGS
;
;       Location "SWREG" is used to select the program options.
;       This Location will be set according to the answers
;       supplied by the Operator. The Options can be changed
;       or verified by using one of the commands given in Sec.
;       8.3
;
;
;8.2    SWITCH OPTIONS
;       Different bits and their interpretation at location
;       "SWREG" is as follows:
;
;       BIT     OCTAL   BINARY  INTERPRETATION
;               VALUE   VALUE
;
;       1        40000  0       LOOP on ERROR
;               000000  1       SKIP LOOPING on ERROR
;
;       2        20000  0       PRINT to CONSOLE
;               000000  1       ABORT PRINT OUT to CONSOLE
;
;       4        04000  0       PRINT PASS
;               000000  1       DO NOT PRINT PASS
;
;       5        02000  0       DO NOT PRINT on the LINE PRINTER
;               000000  1       PRINT on the BYTE I/O LINE PRINTER(DC17)
;
;       6        01000  0       DO NOT EXIT to ODT on ERROR
;               000000  1       EXIT to ODT on ERROR
;
;       7        00400  0       **** N/A
```

```
;
;       8        00200  0       **** N/A
;                000000 1       For READ ONLY MODE (SA 501,502)
;
;       9        00100  0       N/A
;                000000 1       BYPASS DATA CHECK
;
;       10(A)    00040  0       N/A
;                000000 1       DO VERIFY After WRITE (SA 502 ONLY and
;                               NOT RANDOM DATA)
;
;       12(C)    00010  0       N/A
;                000000 1       HALT on DRIVE ERROR prior to
;                               Recovery RECALIBRATE Operation
;
;       13(D)    00004  0       NO TRACE
;                000000 1       TRACE PRINTOUT on ERROR
;
;       16(G)    00000  0       Do NOT PRINT on the DMA LINE PRINTER
;                100000 1       PRINT on the DMA LINE PRINTER(DC17)


;
;8.3    SWITCH COMMANDS
;       Once the Program starts executing the state of any of
;       the Bits can be changed by Hitting KEYS 1-9, A-Z. The
;       Program will Continue Running after Updating the Options.
;       Each Key will Complement the state of the Bit affiliat-
;       ed with it, thus Bit 4 can be Altered by Hitting Key 4.
;       Setting of any Bit of Location "SWREG" will Set Bit 0.
;       (Default Mode is defined as all Bits of SWREG Set to 0)
;
;
;8.4    OTHER COMMANDS  (© = CONTROL KEY)
;
;       "CR"    A "RETURN" can be typed to Continue the Program
;               after its locked in a Switch Modification Mode
;
;       ©D      This Command given at any time will reset "SWREG"
;               to Default Mode and Restart the Program.
;
;       ©R      This Command given at any time will Restart the
;               Program. Switches are left with the values they
;               had before the Command was issued.
;
;       ©O      This Command given at any time will cause the
;               Program Control to go to ODT.
;
;       M       This Command given at any time will print the
;               Current Operating Modes.
;
;       O       This Command given at any time will lock the
;               Program into Switch Modification Mode where
;               more than 1 Bit can be changed.
;
;9.0    OPERATING PROCEEDURE/OPERATOR INPUT:

;       A. Verify drive (s) are ready on-line
;       B. Load Program
;       C. To RUN other than TEST 505, Enter CONTROL "O"
;          at 9.2, Enter STARTING ADDRESS followed by an "R"

;       STARTING ADDRESS
;       200     Read Unit Characteristics and then RUN ALL TEST (505)
```

```
;       501     RELIABILITY TEST, (OPTIONS)
;       502     INCREMENTAL DISK ADDRESS TEST
;       503     COMMAND STRING INTERPRETER
;       504     ERROR COUNT/LOG RECOVERY
;       505     RUN ALL
;       506     SEEK EXERCISER (CONVERGING,DIVERGING PATTERN)
;       507     SEEK EXERCISER (RANDOM PATTERN)
;       510     MULTIPLE DEVICE CODE ENTRY

;9.1    Operator is requested to enter DEVICE CODE of CONTROLLER
;      (DEFAULT 27).
;9.2    STARTING ADDRESS is Displayed and Operator is requested to
;      SET SWPAK followed by a Carriage Return (SEE 8.3).
;9.3    Operator is requested to enter YES/NO to Exercise Maps, If
;      present and supported.
;9.4    MONTH, DAY, YEAR (I.E. 77...), HOUR, & MINUTE (If [CR] is
;      given this routine is bypassed).
;9.5    Unit Numbers, Types, and their Characteristics are then
;      Displayed, (The Operator should Verify these values) Operator
;      is then requested to enter UNIT NUMBERS to be tested (0-3).
;9.6    Operator is then requested to enter TYPE of disk ( to create a
;      User Defined enter 10)
;       A.      If TYPE entered is 10, enter 0, 1, 2, or 3 to
;               RE-DEFINE a disk TYPE
;       B.      # of HEADS for NEW TYPE (in DECIMAL)
;       C.      # of CYLINDERS for NEW TYPE (in DECIMAL)
;       D.      # of SECTORS for NEW TYPE (in DECIMAL, CANNOT be
;               DOWNSIZED)
;       E.      RETURN to 9.6

;       ## A [CR] only response to Unit Numbers, will leave Unit
;       information in previous state.

;       ## A [CR] only response to YES/NO will DEFAULT to NO.
;

;       OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:

;       L       = FIRST 100. DATA, or ADDRESS ERRORS
;       S       = SEEK TIMING STATISTICS (506,507 ONLY)
;       W       = SECTORS W/R, ERROR COUNTS
;
;       **NOTE** Any Character typed will end Printouts at the next
;       change of Data Type.


;10.0   PROGRAM OUTPUT/ERROR DESCRIPTION:


;       All Errors are Identified, Counted, and the Program is
;       routed via base to a call to CKSW. on the basis of Switch
;       Settings (SEE 8.2) The Program will go into a scope loop,
;       or proceed, depending on the SWPAK Settings.

;       Upon loss of Ready and a Single Drive, the Program will
;       print the appropriate Error Message and will not proceed
;       until Ready is returned. If Multiple Drives exist, The
;       Program will continue with the remaining Drives. If the
;       down Drive is placed back On-line, the Program will resume
;       Testing of that Drive. The above also applies to the loss
;       of Write enable if the Program is in a Write Mode.

;       RECALIBRATE - Any unusual Status is reported immediately
;       and an Error Return executed.
```

```
;10.1    SEEK - Positioner Fault Status increments Seek Error
;        Counter.  Any Error Status  results in Status Printout and
;        Error Return. A Recalibrate will be performed by the Error
;        Handler. Program will Log the first 20. Cylinders TO/FROM
;        on finding Seek Errors.

;10.2    WRITE - Following "DONE" on a Write, Errors are checked in
;        the sequence shown below. Error recovery proceedure is
;        outlined for each case. If the Error is not present the
;        next Check is made.

;        Drive Status (DIB) is Checked 1st for both Read and Write
;        before any DIA Checks are made.
;
;        1. READ/WRITE TIMEOUTS, DATA LATE, ILLEGAL SECTOR, PARITY,
;        DATA VERIFY, or any DRIVE FAULTS- Increment the appropriate
;        Error Count, Print the Illegal Status and do an Error Return.
;        Any Drive Fault will cause a Recalibrate to be performed by
;        the Error Handler.

;        2. ADDRESS ERROR- Repeat the Write, if Test Passes the
;        second time, increment the Soft Address Error Count and do
;        a Normal Return; otherwise increment the Hard Address Error
;        count and do an Error Return.

;        If a Hard Cylinder Address Error occurs, a Read on an
;        adjacent Head will be attempted to determine whether the
;        Fault should be classed as a Seek Error or an Address Error.
;        The First 20. Address Errors will have their Addresses Logged.
;
;        3. BAD SECTOR- Log the Disk Address (1st 100.) and do a Normal
;        Return. No Printout will result, although the I/O Operation
;        was prematurely terminated. A "SOFT" Error will be Recorded
;        if the Sector under Test Passes at Least 1 of 4 Retrys. The
;        Log denotes SOFT Errors by a count greater than 0,
;        representing the Error Count tallied. ***SEE 10.3A.

;        4. ENDING MEMORY ADDRESS - Increment the Memory Address Error
;        Count, Print the Error Message, Check for a Disk Address Error
;        and do an Error Return.

;        5. ENDING DISK ADDRESS - Increment the Disk Address Error
;        Count, Print the Error Message, and do an Error Return.

;10.3    READ - All Read Errors with the exception of Data related
;        Errors are handled the same as described for the Write
;        Operations.

;        DATA ERRORS - Data is REREAD 3 X (4X if ECC UNDETECTED) If
;        Program is in Write/Read Mode and Data ia Bad all 4 tries,
;        A Hard Error Count is incremented and an Error Return is
;        taken. If Data is Good on any of Four tries, a Soft Error
;        Count is incremented and a Normal Return is taken.

;        If the Program is in a Read ONLY Mode (IE. Read Mode for any
;        502 Program or when 505 is running a 502 Program), the Data
;        will be REREAD an additional 4 times in both Offset Forward
;        and Offset Reverse Modes before the Problem is classed as a
;        Hard Error.

;        Thus Total retries for a Hard ECC Detected Error in a Read
;        ONLY Mode is 12 (13 for ECC UNDETECTED), and 4 if in a
;        Write/Read Mode (5 if ECC UNDETECTED). ***SEE 10.3A
```

```
;       Printed and Logged. The Disk Addresses of all Data problems
;       will be Printed and the First 100. will be Logged. The First
;       Three Good/Bad word pairs and respective Addresses will be
;       Printed.

;       If SWPAK9=1 (Bypass Data Check) Hard or Soft Data  Errors
;       will be determined by ECC Status.

;10.3A  ECC (ERROR CORRECTION CODE) ANALYSIS

;       All Read Passes including retries will have the ECC results
;       Logged as per the following 4 Categories:

;       1. ECC CORRECTED -The ECC detected and successfully
;       corrected the DATA ERROR.

;       2. NON-CORRECTABLE ECC -The ECC detected and CORRECTLY
;       diagnosed the Error Pattern as UNCORRECTABLE.

;       3. ECC UNDETECTED -The ECC Failed to detect a Data Error.
;       This may be a Malfunction of the ECC Logic, but it is
;       more likely one of the following problems:

;       A Failure of the Drive to Write a Sector.

;       A Failure in the Controller Data paths.

;       4. ECC FAILED -Two Conditions may fall into this Category.

;       4A. An ECC Error was detected but with no Accompanying
;       Data Error. A Check is made to see whether the ECC Words
;       point to an Error within the two Appended Write ECC Words.
;       If such an Error is determined to be the case, the Error
;       will be Logged as Correctable and no ECC Failed message
;       will result. This type of Error should represent only a
;       very small Percentage of the Data Errors (<1%- Large
;       Sample). If a Significantly Higher Percentage of this
;       Error results,  Then an ECC Problem would be Indicated.

;       If the ECC does not point to the two Appended Write ECC
;       Words, then an ECC Failed message (1st Pass only) will
;       result and the Actual ECC Words Read from the Controller
;       will be printed.

;       4B. An ECC Error was detected, but the ECC either Failed
;       to Correct a Correctable Error, or tried to Correct an
;       Uncorrectable Error. These Conditions (Possibly caused
;       by Problems other than ECC) will result in a printout
;       (1st Pass only) of the Simulated Write and Simulated
;       Read ECC Words plus the Actual Read ECC Words as Read
;       from the Controller.

;       The Simulated Write ECC Words are the result of a
;       Program Simulation of the ECC Logic on what the Program
;       believes to be the Write Data (A Write Error will cause
;       this Assumption to be False), and represents what the
;       Program believes should have been written as the Actual
;       two Write ECC Words on the Disk.

;       The Simulated Read ECC Words are the result of another
;       Program Simulation of the ECC Logic on the Read Data
;       in Memory, and represent what the Program believes
;       should be Read from the Controller as the two ECC
;       Words. The Actual Read ECC Words are those two Words
```

;10.4 ERRORS- Error Status is printed whenever encountered
; as follows:

; 'MODE' UNIT: 'N'
; CYL- 'N' HEAD 'N' SECT 'N' #SECT 'N'
; DIA/DIB STATUS= 'N' 'DESCRIPTIVE MESSAGE'

; Where CYL,HEAD,SECT refer to the final Disk Address at
; the point of Error, and #SECT refers to the Number of
; Sectors already done in the Multiple Sector Transfer.

; When Data Errors are found, only THREE are printed per
; encounter plus the Total Number of Errors.(See PARA 5)
; If the Data Error is ECC UNDETECTED and the System is
; Mapped, the Map, Physical 1K Address, and the DCH
; Logical Addresses are also printed.

; When Looping is involved (Retried or for Scoping)
; Status is printed on the 1st Pass only.

;10.5 STATISTICS -

; Type a W during random testing to get a Report of the
; Number of Sectors Written(and/or)Read, plus Error Counts
; in Decimal.

; Type L for First 100. Disk Addresses of Bad Sectors and
; Data Errors, and First 20. of Address Errors and Seek
; Errors (Seek Path). If Error Addresses are encountered
; more than once (1st Pass), a Count of up to 32. will be
; recorded in the Log. Also a Count of up to 15. Hard Errors
; will be recorded. This Count will be A subset of the the
; first Count.

; The Address Information will be in OCTAL while the Counts
; will be DECIMAL.

; Type S for Seek Timing Statistics if running either Seek
; Exerciser.

```
;11.0   DEBUG HELP:
;
;OCTAL DEBUGGER  (ODT)
;
;       This Reliability is equipped with a built in ODT which can be
;       accessed by hitting CONTROL O at any time during the execution
;       of the Program (after Setting the Parameters). On entering ODT
;       the Address of the Location having the next instruction to be
;       executed will be typed-out.
;
;       The following Conventions are used by the ODT:
;       ?       Pressing any Illegal key causes the ODT to respond
;               with a "?".
;       @       ODT is ready and at your service.
;
;       An ODT Command has the following Format:
;               [ARGUMENT][COMMAND]
;       An Argument may be one of the following:
;       "EXP"   An OCTAL Expression consisting of OCTAL Numbers
;               separated by Plus (+) or Minus (-) signs. Leading
;               Zeros need not be typed.
;       "ADR"   An Address is the same as an Expression except
;               that Bit 0 is neglected.
;       A Command is a single teletype character
;
;       The Locations that can be EXAMINED and MODIFIED by the user
;       are called CELLS. These CELLS are of two Types: Internal CPU
;       Cells and Memory Locations. The Command to OPEN one of the
;       Internal Registers is of the form "nA" where n is any OCTAL
;       Expression between 0 and 7.
;
;       0-3     For ACCUMULATORS 0-3
;       4       For PC of the next Instruction to be Executed in the
;               event of a "P" Command.
;       5       CPU and TTO Status
;               BIT     INTERPRETATION
;               15      Status of TTO DONE FLAG
;               14      Status of INTERRUPTS (ION FLAG)
;               13      Status of CARRY BIT
;       6       Address of the Location having the BREAK POINT (If any)
;       7       Instruction at the BREAK POINT Location
;
;       Other Commands to OPEN Cells are:
;
;       "ADR"/  Open the Cell and Print its contents
;       ./      Open the Cell currently pointed to by the Pointer and
;               Print its contents.
;       .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its
;               contents.
;       .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and
;               Print its contents.
;       "CR"    The Return Key is used to Close the Open Cell with or
;               without Modification.
;       "LF"    Line Feed is used to Close the Open Cell with or without
;               Modification and to Open the succeeding Cell.
;       CTRL    Close the Open Cell with or without Modification and
;               Open the preceeding Cell.
;       /       Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents.
;       +"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents + "ADDR".
;       -"ADR"/ Close the Open Cell without Modification, and Open the
;               Cell pointed to by its contents - "ADR".
```

```
;
;       Modification of a Cell:
;
;       Once a Cell has been opened its contents can be Modified by
;       typing the New Value the Cell is to contain in the form of
;       an OCTAL Expression followed by "CR" or "LF". If a + or - is
;       typed as the first character of the Expression then the Value
;       of the Expression is Added to or Subtracted from the Old
;       contents of the Cell. The Address itself or an Expression
;       relative to the Address can be Deposited by typing a "." or
;       :,+/-OCTAL Expression". A Rubout Command given right after
;       opening a Cell allows the Modification of its contents as if
;       they were typed in just before the Command was issued.
;
;       Other ODT Commands:
;
;       RUBOUT  This Key is used to Delete ERRONEOUSLY typed digits.
;               Each time the Key is pressed the right most digit is
;               Deleted and Echoed on the Terminal. If the Rubout
;               Key is pressed right after opening a Cell then it
;               Deletes the right most digit of the Cells contents.
;               This allows the Modification of the Cell as if its
;               contents were typed in just before the Key was pressed.
;       "ADR"B  Insert a BREAK POINT at Location "ADR".
;               Only one Break Point can be inserted and any entry to
;               ODT after Executing a Break Point will cause it to be
;               Deleted.
;       D       Delete the Break Point if any.
;       P       Restart the Execution of the program at CURRENT Location
;       "ADR"R  Start Executing the program at "ADR" after an IORST.
;       K       Kill the String typed so far. The ODT responds with a
;               "?" and the Open Cell is closed without Modification.
;       =       Print the OCTAL Value of the INPUT only.
;               This will Close any Open Cells without  Modification and
;               will not Open a Cell
;
;       NOTE:   In Programs which RELOCATE THEMSELVES the
;               user should place Break Points ONLY in the
;               ORIGINAL PROGRAM AREA. If a Break Point is
;               placed outside this area the results will
;               be unpredictable.
;
```

```
;
;MAPPED ODT COMMANDS
;
;       In addition to the previously listed ODT Commands, there
;       is available a Command Set that allow Map Translations for
;       Debugging purposes.
;
;       Map Command Format

;       The Letter "M" is used to specify a Map Command and is
;       used in conjuction with the Set of Characters that form
;       the Map Command Group. A Map Command is thus formed by
;       using the Letter "M" and following it with the desired
;       Command Letter (Such as "MT", "MA", ETC.)
;
;       Map Command Errors
;
;       If a Map Command is entered and the Error Message "No Map"
;       appears, then either:
;       A) A Map was not found
;       B) The Program does not support Mapped ODT.

;       Map Commands
;
;       Note: All Map Commands must be preceeded by an "M" to
;       indicate that they are Map Commands.

;       "A"     Enable User "A" Map Translations
;       "B"     Enable User "B" Map Translations
;       "M"     Enable Map Translations with the last "User"
;       "U"     Disable Mapping
;       "L"     Map Supervisor Last Block
;       "E"     Print Single Map Entry
;       "T"     Print Map Entry Table
```

```
;12.0    SPECIAL NOTES/SPECIAL FEATURES:
;
;        1. A CR only response to Unit Numbers, ETC will leave
;        information in Previous State.
;
;        2. The Program will Account for up to a MAX. of 2**31 Sectors
;        Written or Read. Special Test runs exceeding this facility
;        will require an OPERATOR'S TEST LOG to augment software
;        accounting. 2**31 Sectors = Approx. 2* 10**9 Words.
;
;        4. SWPAK7=1, Program halts after write with Read Verification
;        allowing operator to change packs. SWPAK8=1, Puts Program into
;        Read only mode ## SA'S 501,502 Only. If SA 501-Data must !NOT!
;        be Variable. Start at the above selected Address.

;        5. All Numbers entered in 7.0 must be in Octal. Any Non-Octal
;        input is treated as a Letter. Any Letter input for CYL, HEAD,
;        SECTOR, or # of SECTORS gets Random function in the Reliability
;        Test with Options.
;
;        6. At times the ECC may attempt to Correct a Non-Correctable
;        Data Error and the Simulated ECC and Actual ECC will Match
;        even though an ECC Failure will have been Printed. This is
;        Due to a Failure of the ECC Polynomial itself to Distinguish
;        between two different Error Patterns. One Correctable and one
;        Uncorrectable. This is !NOT! a Hardware Failure.

;13.0    PROGRAM RUNTIME:
;
;        Program Runtimes are substantially reduced with Memories of
;        16K or Larger. Program can use up to 24K using 2 Buffers
;        and up to 32K using 4 Buffers in the Random Reliability
;        Tests.

;        Runtime is defined as Time from Start to a "PASS" Message.
;        Typical runtime for a Read only or Write only Pass of SA
;        502 (Incremental Disk Address Test) is Approx. 3 and 1/2
;        Minutes with a Nova 800 (or Faster CPU) with at least 24K
;        of Memory, and 96 Megabyte.
;
;
```