Model SKZ-2221

SCSI Disk Subsystem

Technical Manual

Document No: 600-536-00
Revision: C
Date: 1/93

NOTICE

ZETACO, Inc. has prepared this Technical Manual for use by ZETACO personnel and its customers to assist in the installation, operation and maintenance of SKZ-2221 SCSI Disk Subsystem. The information contained herein is the property of ZETACO, Inc. and shall not be reproduced in whole nor in part without prior written approval of ZETACO, Inc.

ZETACO, Inc. makes every effort to produce quality products and documentation, however, the reader must be cautioned that changes may be made to the product not reflected in the supplied documentation. If you find errors or omissions, please notify ZETACO, Inc. to remedy the problem. ZETACO, Inc. shall not be responsible for any damages (including consequential) caused by reliance on this material as presented.

If installation problems arise after you thoroughly review the manual, please contact the ZETACO Customer Support Hotline at 1-800-537-5292.

Preface

This manual contains information regarding installation, testing, and operation of the ZETACO SKZ-2221 SCSI Disk Subsystem. 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 SKZ-2221 Subsystem features, capabilities, specifications, power and interface requirements.

Chapter 2 - Installation Procedures

Describes and illustrates the procedures required to install an SKZ-2221 Subsystem.

Chapter 3 - Trouble-shooting

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

Chapter 4 - Programming Notes

Detailed description of the assembly level programming characteristics of the SKZ-2221 subsystem.

Chapter 5 - Theory of Operation and Circuit Descriptions

An explanation of the schematics for the SCZ-2F including a look at a couple of data transfer examples.

Chapter 6 - SCZ-2F Adapter Signal Names

Descriptions of the signal names used in the 700-452-00 schematics.

Table of Contents

List of Tables

List of Illustrations

Appendices

1

Product Overview

1.0 Introduction

The SKZ-2221 Subsystem is a high capacity, digital data storage and retrieval system, designed for interface with Data General minicomputers.

The Subsystem is composed of ZETACO's DG-emulating disk controller (Model SCZ-2F), one or two 330-megabyte magnetic disk drives, a 3.5" extra high density floppy drive, and a rack-mountable enclosure for the drives and their power supplies. Both drive types use the Small Computer Systems Interface (SCSI). All components are connected by a shielded daisy-chain cabling system that is compatible with DG's shielding requirements, or its non-FCC compliant chassis.

The Controller pairs ZETACO's emulation of the DG Zebra Disk Subsystem with the SCSI peripheral interface on a single 15" x 15", 6-layer printed circuit board. Data transfers take place over the data channel (DCH) on DG's Nova and 16-bit Eclipse Series computers.

The SCZ-2F controller acts as a host adapter and interfaces to the drive(s) via the SCSI industry standard interface. The controller adheres to the specifications imposed by ANSI for single ended applications. (differential is not supported.)

Handshaking is accomplished by discrete logic as opposed to using a SCSI protocol VLSI IC. The disconnect/reconnect option and the arbitration function are not supported. The SCZ-2F is the initiator of all commands, and is the only initiator allowed on the SCSI bus.

Note that your SKZ-2221 Subsystem has been integrated at the factory as a complete unit. Its components have been designed and tested together, and none should be substituted with any other type or brand of component, however similar. If substitutions are made ZETACO cannot guarantee the proper functioning of the Subsystem.

1.2 Features

- The SKZ-2221 subsystem interfaces to DG's data channel bus on 16-bit Eclipse and Nova Series processors running RDOS or ERDOS. The SCZ-2F controller can be installed in any MEM I/O or I/O only slot of these machines.
- The controller supports simultaneous control of up to two - 330 MB SCSI Wren Runner drives (Seagate's 94181-385H), and a single 3½ inch, 4 MB unformatted floppy drive (TEAC's FD-235JS-501).
- The controller's device code and throttle rate are easily selected via switches on the board edge.
- By flipping a switch on the front of the drive enclosure, the operator can select the floppy as SCSI ID0, or the hard drive as SCSI ID0, thus designating the boot device.

1.3 Specifications

Functional

General

Drives per Controller:	2 SCSI hard drives (330 MB) 1 SCSI floppy drive (4 MB)
Transfer Rate:	Maximum SCSI burst rate of 1.5 MB/sec.
Indicator Lights:	Red - Selftest Green - Host Busy Yellow - SCSI not Busy
Device Code, Throttle, DZ0 Device Selection	Switch-selectable
Data Buffering	Two 256-word buffers in a ping-pong configuration

Computer Interface

CPU models	16 bit NOVA and ECLIPSE
DG Emulation	Zebra Disk Subsystem (RDOS or ERDOS)
Bus Load	1 load (any MEM I/O or I/O slot)
Data Channel Interface	Selectable throttle rate of 1 to 128 16-bit words/access.

Drive Interface

Small Computer Systems Interface (SCSI):

- supports parity generation and checking
- complies with "Common Command Set"
- Byte-wide parallel data bus
- supports single initiator only

Mechanical

Controller Dimensions

Width	15 inches (38.1 cm)
Length	15 inches (38.1 cm)
Height	0.5 inches (1.3 cm)

Controller Shipping Weight

10 pounds (4.5 kg) - includes controller, paddleboard, cables, Software Support Floppy and Tape, documentation, and SCSI Bus terminator.

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 and Nova temperature and humidity specifications.

Disk Drive Enclosure

Drives per enclosure .	Up to three drives total. Up to two 330 MB disks; up to one 4 MB floppy disk.
Mechanical Height . .	5.25" (133*mm*)
Width	19.00" (483*mm*)
Depth	25.00" (635*mm*)
Weight	66 lbs. (30 *kg*) max. (maximum weight with 2 hard drives, and 1 floppy drive.)

Power Input

Standard	90 to 135 Vac 47 to 63 Hz

(20 Amp maximum peak current at power-up.)

Power Output Per Drive

+5 Vdc @ 3.0 Amps

+12 Vdc @ 3.5 Amps continuous

+12 Vdc @ 4.5 Amps max at power-up

50 watts maximum continuous

2.0% maximum on +5V

3.0% maximum on +12V

Environmental

Operating Environment

Temperature	+10 to +38 degrees C
Relative Humidity . .	+10% to +80% (non-condensing)
Altitude	-1000 to +10000 feet

Non-operating Environment

Temperature	-34 to +60 degrees C
Relative Humidity . .	5% to +95% (non-condensing)
Altitude	-1000 to +40000 feet

2

Installation

2.0 Before You Begin

This section contains the procedures necessary for proper installation of the SKZ-2221 Subsystem. We recommend that you read through it once in its entirety before you begin.

The following sections are in order of execution. In Sections 2.2 through 2.4 you will select a slot and device code for the Controller, establish slot priority, and install the controller. Section 2.5 covers rack-mounting of the enclosure and cable connections. Section 2.6 details the power-up sequence.

In Sections 2.7 through 2.11 you will use programs on the Software Support Floppy to complete the installation. Finally, you will run ZSDKINIT on the subsystem and bring it into full system operation.

You will need the following tools to install the SKZ-2221 Subsystem:

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

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

2.1 Unpacking & Inspection

The SKZ-2221 Subsystem consists of the following parts:

QTY	DESCRIPTION
1	SCZ-2F Disk Controller
1	Disk Drive Enclosure with drives
1	External SCSI Cable
1	Software Support Diskette
1	SKZ-2221 Subsytem Manual
1	SCSI Bus Terminator

In this procedure, we assume that you are installing an SKZ-2221 Subsystem that consists of one drive enclosure containing one hard drive and one floppy drive. An additional hard drive may be ordered (along with an add-on power supply) for expansion.

Upon receipt of the SKZ-2221 Subsystem from the carrier, inspect the shipping cartons immediately for any evidence of damage or mishandling in transit.

If the shipping cartons are water stained or damaged, contact the carrier and shipper immediately, specify the nature and extent of the damage and request that the carrier's agent be present when the cartons are opened.

ZETACO'S warranty does not cover shipping damage.

For repair or replacement of any ZETACO product damaged in shipment, call ZETACO to obtain return authorization instructions. See Section 3.7.

System Hardware Requirements

a) Eclipse or Nova CPU.
b) Magnetic Tape Subsystem (for first-time operating system build)
c) Console on Device 10/11

The Software Support Package

The programs on the Software Support Package have been written by ZETACO specifically for the SKZ-2221 Subsystem. You will use these programs for Media Formatting, Diagnostic, Reliability, and RDOS Initialization. DG's CORRESPONDING PROGRAMS MAY NOT WORK ON THIS CONTROLLER.

The software support package comes in two flavors - A 1600 bpi 9-track tape and a 3.5 inch ED diskette. Both packages contain the same ZETACO programs.

Tape

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

Files 0 and 1 contain the software that enables you to boot from the tape and select the particular program you want to load into the system.

Diskette

This diskette contains a starter RDOS operating system onto which was loaded Zetaco's software support programs. These programs can be executed by booting the diskette. Each of these programs are stand-alone; they cannot have an operating system running when they are executed.

Detailed information on using this Diskette is provided in Section 2.7.

2.2 Prepare the Computer Chassis

The Controller may be installed in any I/O or MEM-I/O slot. Consult the hardware manuals for your particular computer to identify the appropriate 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 Controller and the processor, or between the Controller and another controller already installed in the chassis, jumper wires must be installed to obtain priority continuity. To "jumper across" unused slots, connect DCH Priority Out (Pin A93) to DCH Priority In (Pin A94) and Interrupt Priority Out (Pin A95) to Interrupt Priority (Pin A96). See Figure 2.2.

2.3 Prepare the Controller

The SCZ-2F controller has been shipped preconfigured for your SKZ-2221 Subsystem. Check the following table to make sure the switches on the Controllers front edge are properly set before installing your SCZ-2F.

Table 2.1 Configuration Switch Settings

Recommended (Default) Switch Settings for the SKZ-2221:

Switch Position:
(down = D, up = U)

	1	2	3	4	5	6	7	8	
SW1	D	D	D	D	U	U	D	D	(Recognize multiple targets) (throttle = 16)
SW2	D	D	D	D	D	D	D	D	(Bank of switches not used.)
SW3	D	D	U	D	U	D	D	D	(Device code = 27_8)

Configuration Options

The recommended configuration for your application is selected prior to shipping. Please refer to Appendix A if it is necessary to deviate from the recommended configuration. All optional switch settings are defined in Appendix A.

2.4 Install the Controller

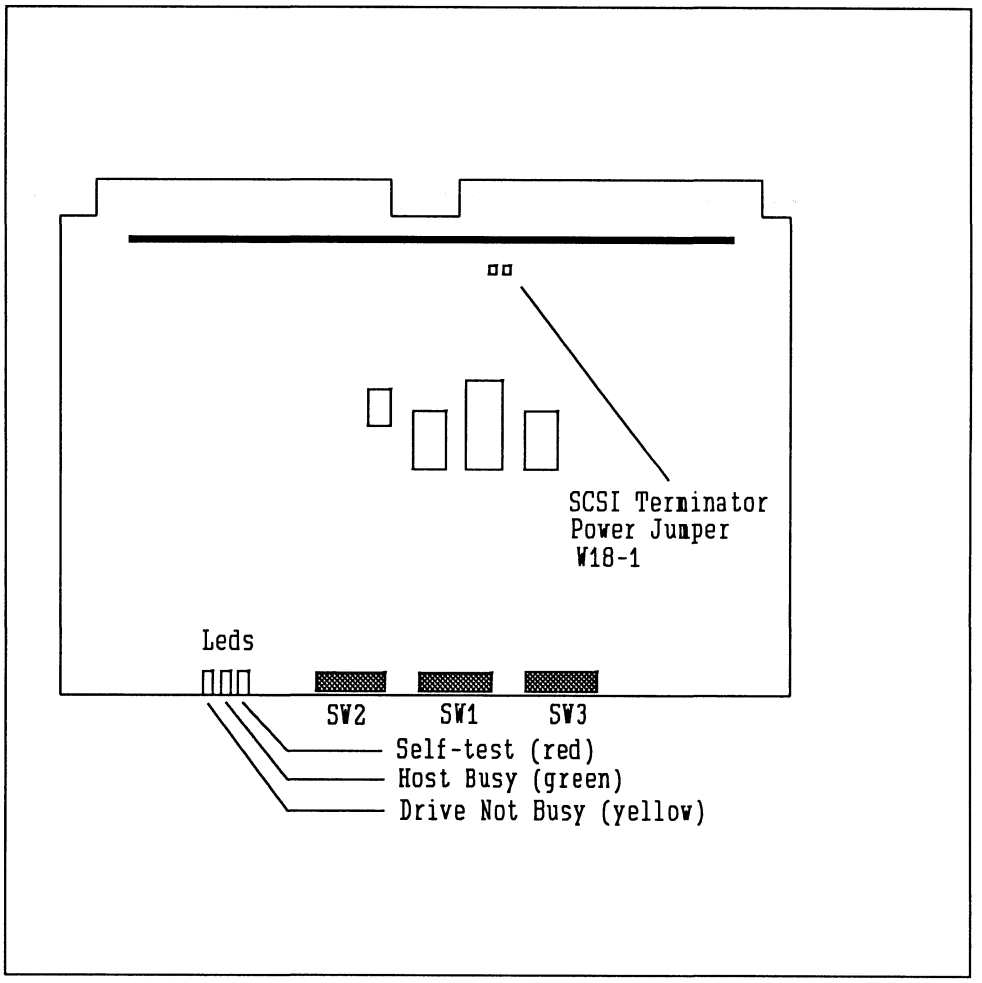
First, be sure the computer is turned OFF. Pull the lock tabs on the two front corners of the controller out as far as they will go. Next, carefully guide the controller into the slot you selected in Section 2.2. When the board engages the backplane connectors, gently press the lock tabs in to provide insertion leverage. Use equal pressure on both lock tabs until the board seats firmly into the backplane connectors.

Device Code Selection

The recommended device code for the SKZ-2221 Subsystem Controller is 27_8. However, any usable device code can be selected, as long as there is not already a controller in the system with that code.

A set of switches on the edge of the board allows you to easily set the device code. Refer to Appendix A if an alternate device code is desired.

Figure 2.1 SCZ-2F Board Layout



Notes :

- With the SCSI terminator power jumper installed, the controller provides +5v out onto line 26 of the SCSI cable. This +5v source can be used to provide SCSI termination power for an external Single-end terminator or terminator power for the terminators installed in the last drive on the SCSI bus.

- The yellow led is extinguished when the SCSI */busy* signal is active.

Figure 2.2 ***Backplane Priority Jumpers & Cable Placement***

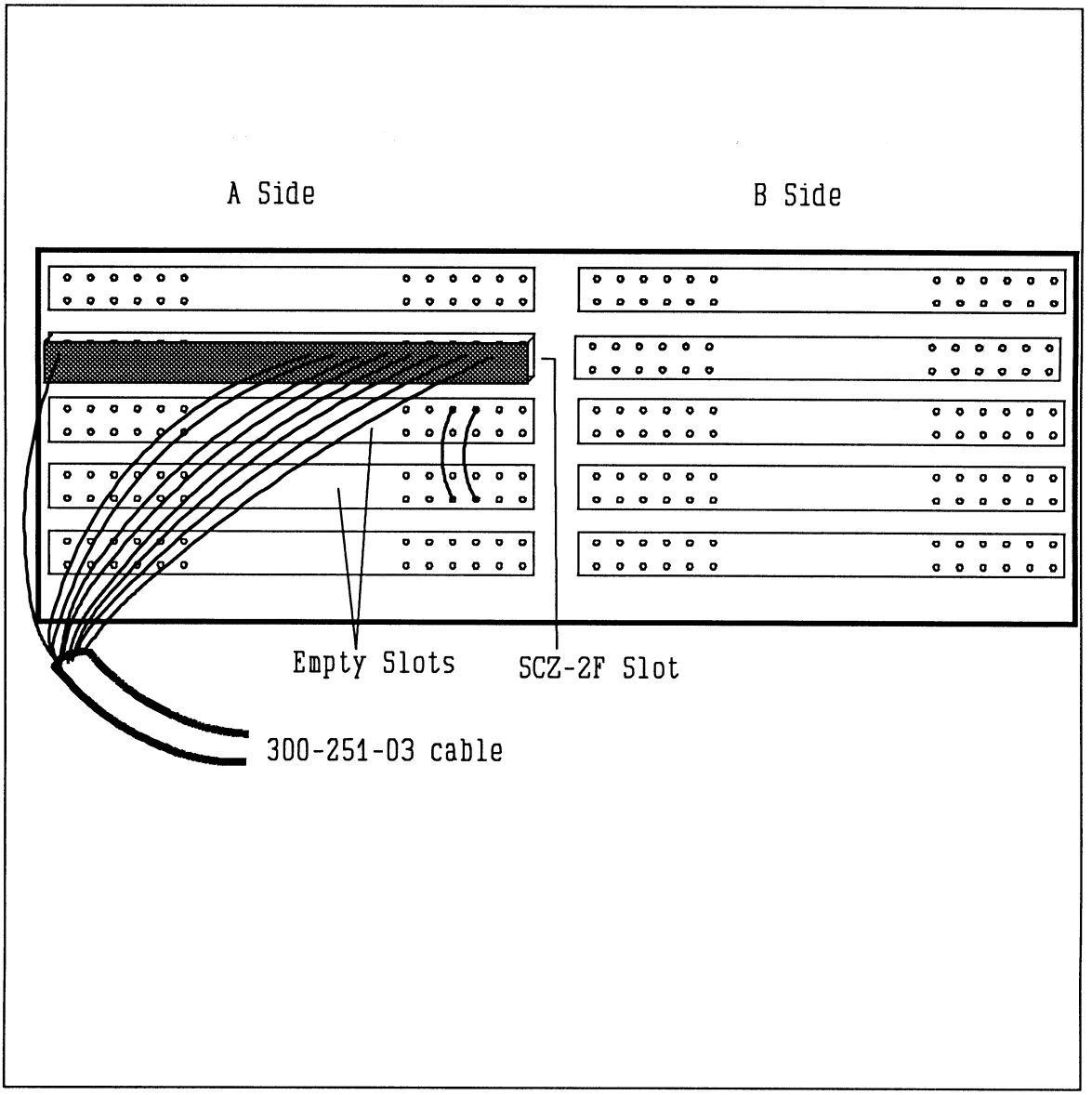
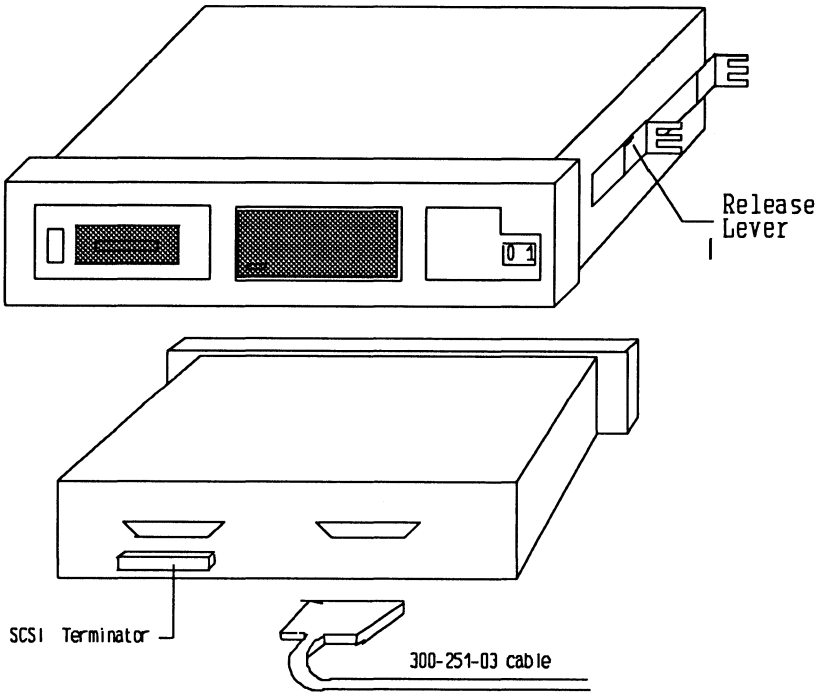


Figure 2.3 Disk Enclosure Slide Assembly & Terminator



2.5 Disk Drive Enclosure Installation

The hard and floppy drives of the SKZ-2221 subsystem are mounted in a rack-mountable enclosure. Installing the enclosure consists of mounting the slide assemblies onto the vertical rails of the equipment rack, then inserting the enclosure into the slides.

Determine the Slide & L-Bracket Orientation

There are two slide assemblies; one for the left side of the enclosure and one for the right. They are different and must be installed on the correct sides. When positioned correctly in the rack, the front slide release lever will be on the top side of each slide. See Figure 2.3. One end of each slide has four mounting holes in it. This end of the slide goes towards the rear of the equipment rack. An L-bracket mounts to the rear of each slide and provides a means of adjusting the slides to fit different rack types.

Determine Vertical Positioning

The front of each slide has two slots through which screws secure the slide to the front rail. When choosing the vertical position for mounting the slides, the following clearance should be maintained:

1. Allow approximately 1" distance from the lower mounting slot on the front of the rail to the top of the peripheral or rack cover directly below it.

2. Allow approximately 5 1/4" clearance for the enclosure height within the equipment rack.

L-Brackets

First, fasten two 10-32 clip nuts onto each rail with the nut on the rear side. Next, secure each L-bracket to its rail with two 10-32 philips screws.

Slide Assemblies

Fasten two 10-32 clip nuts onto each front vertical rail with the nut on the rear side. Secure each slide to the rail with two 10-32 philips screws.

To secure the L-brackets to their slides, use two 10-32 slotted screws and two 10-32 hex nuts.

Install Enclosure onto Slides

First extend each slide out fully by pulling the inner member of each slide out until the rear slide release locks the slide in the extended position Next, lift the enclosure and guide the slide members attached to the enclosure into the extended slides; this may require two people. Once guided into the slides, the enclosure will lock when it encounters the front slide release. Unlock the release by pressing down on the release lever. To complete the enclosure installation, push the enclosure fully into the equipment rack.

Attach SCSI Data Cable

The cabling scheme for the SKZ-2221 Subsystem consists of a single cable: A 50 conductor cable with a 100 position block at one end and a 50 pin "Champ" connector at the other end. The 100 position block is to be installed across the pins of the computer backplane on the "A" side of the slot holding the SCZ-2F controller. The other end of the cable, with the Champ connector, can be connected to either mating Champ connector on the rear of the Disk Drive Enclosure. On the remaining Champ connector of the Drive Enclosure install the SCSI bus terminator (124-070-00) included with your Subsystem. See Figure 2.3

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

Locate the two rows of pins on the "A" side of the backplane for the slot containing the Controller. Ensure that no pins are bent. Position the "A" connector block of the 300-251-03 cable so that it covers all the pins on of the A side backplane (pins 1 through 100) and is oriented correctly. Press the connector securely over the pins, making sure all pins insert and do not bend, until the connector block is flush with the backplane. See Figure 2.2.

CAUTION

Component damage may occur if the connector block is misaligned. Make sure the connector block is not shifted right or left. Also, ensure 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.

2.6 Powering up the System

First switch on the drive enclosure and then the computer. When you press the computer's power switch, you will notice that the red LED on the SCZ-2F controller will be active momentarily, and then go out. This indicates a successful self-test. The yellow LED on the controller will be ON until the disk(s) become active. Also, the busy LED on the controller and disk activity LEDS on the drives will be OFF until the drives are activated.

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.)

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 3.1 for assistance.

2.7 Begin System Test

Your next step will be to boot the software support diskette and initiate the process of preparing your disk for an operating system.

Boot the Software Support Diskette

The software support diskette contains programs useful for testing the reliability of the subsystem and for preparing the disks of the subsystem for operating system installation

The bootstrap procedure for the software support diskette is:

1. Insert the diskette into the floppy drive.

2. Set the Switch on the enclosure to "boot floppy." This will select the diskette as DZ0 making it the boot device.

3. Perform a computer power-up cycle again or an IORESET. After doing an IOREST, wait a minimum of three seconds before executing a "program load".

4. Execute a "program load". The controller at this time is set for device 27, and must remain at this device code whenever booting this diskette.

5. When *filename?* appears, your choices will be:

   SCZ2R . A reliability program used for ensuring that your system is sound.

   SCZ2D . A diagnostic program used primarily by Zetaco personnel for troubleshooting.

   SCZ2F . The formatter program used to format your systems hard drives and diskettes.

   ZSDKINIT The disk initializer program used to prepare your hard drives and diskettes for holding operating system structure.

Before executing any of these programs, please review Section 3.3 for the details concerning these programs.

2.8 Verify the Installation

It is recommended that the Disk Reliability program be run for at least one pass, beginning at 500R, to ensure you have a reliable subsystem before beginning a system build. For assistance, you can refer to Section 3.3 and follow the sample dialog. If an occassional data error or address error should occur, reformat the disk using SCZ2F. If the problem was bad

media, this will correct the problem. Once this is done, run Reliability again to make sure the problem is resolved.

2.9 Initialize the Disk

The disk is now ready to be initialized for RDOS or ERDOS. Use Zetaco's initializer (ZSDKINIT) to perform this procedure. Each drive, be it a hard drive or a floppy diskette, must be initialized for operating system use. (Of course prior to this, the drive or diskette must be formatted.)

The sample dialogue found at the end of Section 3.3 will guide you through this procedure.

2.10 Store the Software Support Programs on System Disk

Once you have built your operating system on the hard drive, you can load the software support programs from the diskette using a sequence of basic RDOS commands:

1. In DZ0 (the hard drive), create the directory to hold these programs. Note - The switch on the enclosure must be set to "boot disk" in order to select the hard drive as DZ0.

2. With the software support diskette in the floppy drive do an "INIT DZ2" to allow the system to recognize the floppy.

3. Move into the DZ2 structure via "DIR DZ2".

4. Transfer the support programs to your desired directory using the following commands:

   MOVE/V YOUR DIRECTORY SCZ2-.SV
   MOVE/V YOUR DIRECTORY ZSDKINIT.SV

2.11 Floppy Drive Notes

The RDOS operating system sees the Floppy drive as a small Zebra emulation disk drive. Because of this, the user must keep some things in mind:

1. Backing up or moving files from the system disk to the floppy disk always first requires that the diskette be formatted, and then initialized with ZSDKINIT followed by INIT/F. If the diskette already contains RDOS structure, then all that is required is that INIT DZ0 or INIT DZ2 (depending on the position of the enclosure "boot" switch) be performed. The DISK command reveals that a diskette after INIT/F has 2,832,384 bytes of free storage space.

2. When moving files to a diskette the user must ensure that the diskette has ample room for the transfer. If the diskette runs out of space the system will respond with "FILE SPACE EXHAUSTED". If a DUMP command was being executed, the command will then be aborted and no information will have been transferred. If a MOVE command was being executed, each file will have been moved with the exception of the one that was being moved when the error occurred.

3. The floppy drive (under Zebra emulation) is not a standard option as a dump device in case of a system crash.

4. If a "LOSS OF READY" error for any drive ever occurs, a system reset (IORESET) or powerup sequence must be performed in order for the drive to be recognized once again by the system.

5. If RDOS is ever built and executed from a diskette, this diskette should remain read/write; setting the write protect switch to READ ONLY may result in system errors.

6. The proper power on sequence is: Apply power to the drive enclosure first and then power up the computer.

7. To make a bootable copy of RDOS on a diskette perform the following:

   - Start with your RDOS on the hard drive with the enclosure "boot" switch set to "boot disk".

   - Run format, ZSDKINIT and INIT/F on the diskette (DZ2).

   - Do MOVE/V DZ2 from the hard drive root directory to put the RDOS files on the diskette.

   - Now boot device 27 and respond to *filename?* with BOOT DZ2: SYSTEMNAME

   - Install the Bootstrap on DZ2 (diskette).

   - The diskette can now be booted by setting the enclosure "boot" switch to "boot floppy" and booting device 27.

8. After doing an IOREST, you must wait a minimum of three seconds before doing a "program load". This allows the controller the time it needs to perform on board intialization.

3

Trouble-shooting

3.0 Introduction

The SKZ-2221 Subsystem is supported by ZETACO in the following ways:

- Field proven disk drives with 100,000 hours MTBF
- Microprocessor-based self-test of over 70% of the controller each time it is powered up, with an LED status report.
- Reliability and Diagnostic program on an ED diskette and/or a 1600 bpi tape for use during installation and trouble-shooting.
- Zetaco Authorized Distributors provide support for their customers.
- Customer Support Hotline, manned from 8:00 a.m. to 5:00 p.m. (Central Time) to answer your questions. (612-890-5135)
- 48-hour turn around on most factory repairs or replacement.
- Up to a two year warranty on workmanship and materials.

3.1 Power/Spin-up Problems

Problem:
The Drive indicator leds show no activity when attempting a boot.

Solution:

1. Ensure the AC power cord is firmly seated in the power receptacle on the module.
2. Check the fuse. If replacement is necessary, use ONLY a 6 Amp Slo-Blo for 120 VAC.
3. Ensure the AC wall receptacle is "live."
4. Check that the red LED on the SCZ-2F is out.
5. Check that the data cable and terminator are attached properly.
6. Listen closely to the hard device to make sure it's spun up - which it should be once the computer is powered on.
7. Boot Zetaco's Reliability off tape and attempt to access drive. **Refer to section 3.4 before running program if your disk has valuable data on it.**
8. Call the ZETACO Hotline, or your maintenance organization.

3.2 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***

BLINK 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	Data read from RAM did not MEMORY compare with data written.
3	RAM TEST	Test patterns have determined that the buffer ram cannot support error free data handling.

3.3 Software Support Package

In addition to the diagnostic functions provided by the SCZ-2F Controller via on-board Self-test, ZETACO provides Reliability and Diagnostic software. The Software Support Package consists of these programs loaded on a 4 MB diskette or a 1600 bpi tape included with your subsystem.

Each of the programs on the Software Support Package has been written by ZETACO specifically for the SCZ-2F Controller. You should use this tape or diskette for loading Media Formatting, Disk Diagnostic and Reliability, and RDOS initializing. DATA GENERAL'S CORRESPONDING PROGRAMS MAY NOT WORK ON THIS CONTROLLER.

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 `courier typeface.` 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 in the normal typeface of this manual.

The Bootstrap Procedure for the Software Support Diskette and Tape are presented in Section 2.7.

Using the Software Support Package Diskette

Each of the ZETACO programs on the software support package is a stand-alone program. This means that they do not need, and cannot have, an operating system running when they are executed. Even after the programs have been transferred to your disk, retain the Software Support Diskette and/or Tape in case of disk subsystem problems.

The following sequence of events is recommended by ZETACO upon receiving your SKZ-2221 subsystem. Each step is described in greater detail in the subsequent sections of this chapter.

1. Boot the Software Support Diskette. This requires that the controller switches be configured according to the information in Section 2.3.

2. Select SCZ2F - Format the Media.

3. Select SCZ2D - Disk Diagnostics.

4. Select SCZ2R - 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 now rather than after you have loaded your data.

5. If the controller is to run in an RDOS system, now select ZSDKINT to initialize the disk.

6. You can load the programs from the diskette or tape any time after you have built your disk.

Disk Formatter

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

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]:
```

```
Set SWPAK as per "HELP" or hit <cr> to
continue.

Start Time? - MON,DAY,YR  HR,MIN

  UNIT    TYPE   HDS   CYLS    SEC/TRK
   0       0      5     48       24
   2       1     20    1008      32
```

This is a list of all the ready units connected to the SCSI cable, and the parameters assigned to them. This information will look like this if an enclosure containing 1 hard drive and 1 floppy drive is cabled to the SCZ-2F controller and both drives are ready. Unit 0 is the boot device - in this case it's the floppy; Unit 2 is the hard drive that is the drive you will want to prepare for loading on the operating system.

```
Enter Unit Numbers (0,1,2,3) to run:  2
```

Enter the unit numbers of the drive(s) you wish to have formatted. The drive(s) will be formatted one at a time consecutively.

```
Unit:  2

Enter type of disk:  1
```

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 2,
```

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 the hard drive (330 MB) is approximately 45 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.

Note that a couple of options exist when running Format.

Switch 2 position 1 defines the interleave. When down, no interleaving is done, sectors are addressed consecutively. When up, an interleave by 2 is performed. This option applies only to the WREN drives. The floppy drive will format with no interleave independent of the switch setting.

Switch 3 position 1 defines the Media defect handling strategy used when formatting. With this switch down, the drive will reallocate all sectors in the manufacturer's Primary list and any sectors which fail the Format verify phase. Any previous grown list will be erased. With this switch up, the drive will reallocate the same sectors as above (the Primary list and verify fail 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. Again, this switch applies only to the WREN drives. The floppy drive does not support media defect handling and this switch has no influence on the floppy drive.

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 indentify or help isolate any possible hardware problems.

Boot the software diskette or tape and request SCZ2D.

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 useful.

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

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

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

SET SWPAK AS "HELP" OR ENTER RETURN (CR)
TO CONTINUE.

TESTING UNIT 2
```

Will list the tests being run.

```
.
.
.

UNIT      HDS      CYLS      SEC/TRK

  0         5        48          24
  2        20      1008          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 otherwise, due to a problem with reading the selected characteristics from the controller.

```
.
.
.
```

Listing tests again.

```
See Diagnostic text at the end of the
manual for further details.
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 programs software SWPACK register to help determine whether or not the error is intermittent. This is done by hitting "3" on your keyboard, which prints out an error percentage.

If you answer "yes" to the question ""Do you want help?", you can get to the information that describes the meaning of the bits in the SWPACK register. Depressing the M key allows you to observe the contents of the register.

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 three drives. Boot the Disk Reliability Program from the Software Support Package Diskette or Tape by requesting SCZ2R.

Refer to "HELP" for envoking the command string interpreter.

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 "HELP" OR HIT (CR) TO
CONTINUE.

At this point enter a "CONTROL O."
"@" will be displayed. Enter "500R" and continue

ARE MAPS TO BE EXERCISED (YES/NO)?  YES
```

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

UNIT   TYPE  HDS  CYLS   SEC/TRK
  0      0    5    48      24
  2      1    20   1008    32

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

UNIT:  2

ENTER TYPE OF DISK:  1

TESTING UNIT 2
```

** Entering "W" on the keyboard will scroll up a list of data exchange and error information on the screen.

If you wish, you can also run Reliability on the floppy drive. To do this you must first boot the software support diskette and then remove it and replace it with a formatted ED diskette. When ENTER UNIT NUMBERS appears enter 0,2 to run both the floppy and hard drive.

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.

Loss of Ready

This error indicates the disk unit was not ready when a command was issued. If this error occurs, Check that the disk unit is still powered up and the cabling is intact on the disk unit. Once this is done you must Reset the computer or perform a power-on sequence of the entire system.

Data Errors and Address Errors

These may indicate bad media locations on the disks. If these should occur, reformat the disk. If they still occur after this, call for assistance.

ZSDKINIT - RDOS Disk Initializer

(ZETACO's version of DKINIT, referred to as ZSDKINIT, is supplied on the Software Support Package under the name ZSDKINIT.SV)

Initializing a SKZ-2221 Model disk (or diskette):

Before you load any RDOS system onto a disk in this subsystem, **you must initialize the disk by running ZSDKINIT**. This is a stand-alone program that performs all

the functions of Data General's DKINIT. Please refer to the Data General 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-2F controllers. If you are building your system from an RDOS release tape, do NOT run File #4 on the Data General tape after running ZSDKINIT. Data General's DKINIT cannot be run in expanded emulation on a SCZ-2F.

STEP 1 - LOADING

Loading from the Software Support Package:

Perform the steps described for booting the diskette or tape in Section 2.7.

Program displays:

```
FILENAME?
```

You respond:

```
ZSDKINIT
```

STEP 2 - DISK TYPE

Program displays:

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

DISK DRIVE MODEL NUMBER?
```

You respond:

```
SCSI
```

NOTE: SCSI will instruct the initializer to read the drive characteristics that are coded into the SCZ-2F firmware for the SKZ-2221 subsystem.

If the disk type is not valid,

Program displays:

```
ILLEGAL DISK TYPE
```

Step 2 will be repeated until your response is acceptable.

STEP 3 - DISK UNIT

Program displays:

```
DISK UNIT?
```

You respond:

```
DZx, where x indicates drive number:  0,
1, 2, 3
```

At this point you may wish to initialize the hard drive at SCSI ID 0. With the switch on the drive enclosure set to "boot floppy", the hard drive is seen as DZ2. Therefore, enter DZ2.

A) If the disk unit is not valid,

Program displays:

```
ILLEGAL DISK UNIT DECLARATION
```

Step 3 will be repeated until your response is acceptable.

B) If the disk unit is valid,

Program displays:

```
# HEADS   # SEC/TRK   # CYLINDERS    MGB/BLK

   20         32          1008          330*

   * Megabytes if disk is >4000 blks;
   blocks if disk is <4000 blocks.
```

These are the assigned parameters for the hard drive 94181-385H.

STEP 4 - COMMANDS AND SUBSEQUENT OUTPUT

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

3.4 System Errors

If a system error occurs, refer to 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 Data General User's Manual. This information could help determine how to solve the problem.

Non-destructive Test Programs

This Section explains a test that can be done on a disk that has a system or system data on it without destroying that system or data. This provides an avenue for conditions requiring diagnostic testing, but where time does not permit the luxury of being able to rebuild a system.

This test 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. This puts the program in a Read Only mode and writes will not be done. 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.

3.5 Customer Support Hotline

ZETACO, Inc. provides a Customer Support Hotline (800-537-5292) 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.

3.6 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.

3.7 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.

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-2F controller and the CPU. This is the requirement of the SCZ-2F 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	FUNC	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:

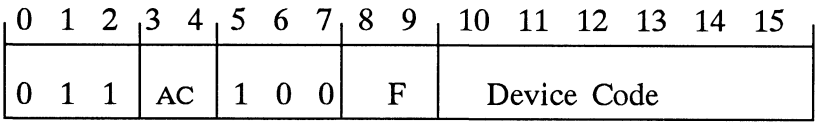
00 - Drive unit 0
01 - Drive unit 1
10 - Drive unit 2
11 - Drive unit 3

11-15 Extended Memory Address:

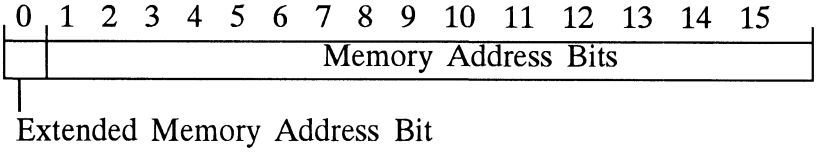
Not supported, intended for controllers with BMC.

DOB - Load Starting Memory Address

DOBF AC, DSKP



Accumulator

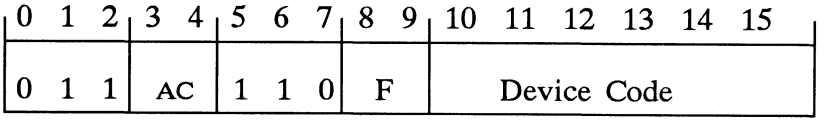


Execution of this instruction will load the controllers address counter with the contents of the specified accumulator and will be used as the starting memory address for a command that requires a DCH transfer operation.

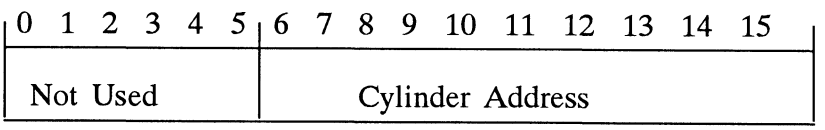
DOC - Load Drive Address

DOC - Specify Cylinder

DOCF AC, DSKP

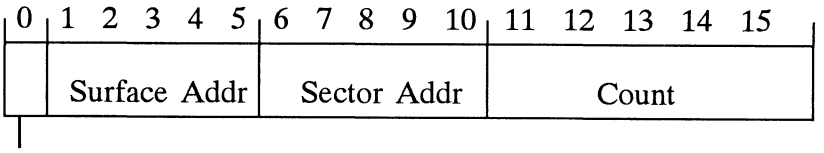


Accumulator (if previous DOA specified a Seek)



DOC - Read/Write Operations

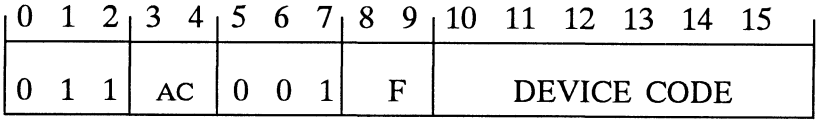
If the command implies a READ or WRITE type of operation, then the DOC is the starting surface and sector address, and the number of sectors to transfer in two's complement form.



Read Status - Non Alternate Mode

DIA - Read Data Transfer Status

DIAF, AC, DSKP



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, 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 SURF ADDR	CURRENT SECTOR ADDR	TWO'S COMPLEMENT OF # OF SECTORS REMAINING

Read Status - Alternate Mode One

Alternate mode one state is entered whenever the previous DOA has selected SET ALT MODE 1 in it's command field. A DIA can then be issued and will return the following data.

DIA - Read Current Memory Address

DIAF AC, DSKP

Accumulator

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

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

Read Status - Alternate Mode Two

Alternate mode two state is entered whenever the previous DOA has selected SET ALT MODE 2 in it's command field. A DIA or DIB can then be issued and will return the following data.

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, 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 that were coded into the SCZ-2F firmware for the SKZ-2221 subsystem. 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.

5

Theory of Operation and Circuit Descriptions

This discussion is applicable to schematics 700-452-00 for the SCZ-2F adapter. Note that the terms DG and host both refer to the host computer in which the SCZ-2F is installed.

Sheet 2: General Program I/O including Data channel priority signals.

Sheet 3: The bank of LS193's serve as counters for the Data channel memory address. A DOB latches in starting address and SNDADR/ increments the counters to point to the next DCH address. The 2912's are quad bus transceivers with the B lines as either input or ouput and the E lines as the output enable for sending data to the host computer.

Sheet 4: The throttle control section serves to allow a specific number of Data channel transfers per each Data channel request. SW1 is set to give the proper 2^n throttle setting. This setting determines which line of the 8 to 1 decoder is examined. To begin a DCH transfer, SDCHO/ or ACKA/ goes active, setting the DCH Sync flop. This releases the flop at C9 which sets on request enable. On the next request enable, the DCH req flop sets which releases the clear on LS393 counters, in addition to making DCHR/ active. With each DCH ack, SNDADR enables the next DCH addresses on the DG bus and also increments the LS393 counters. When the designated number of DCH acks (ie. transfers) have been made, the corresponding low of the LS393 is passed through the LS151 decoder which releases the DCH sync flop. This results in DCH Req/ being released, making it necessary to start the request cycle over again to begin another 2^n number of transfers.

Sheet 5: The leftmost LS374s serve as receiving latches for data sent from DG to the SCZ-2F RAM. The two sets of LS374s on the right are used to latch data from the RAM to be sent to DG memory. Note that BDCHO clocks data sent from the host computer and BDCHI enables data out to be received by the host. SW2 (switch 2) positions 3-8 are not used in this version of the SCZ-2.

Sheet 6: The green LED signals that the SCZ-2F is busy. This LED is lit when DST/ is pulsed and extinguished when a R/W done occurs. An interrupt request occurs if busy is not set and mask is not set when one of two events occur: A read/write done takes place, or a unit attention done takes place (either unit 0,1 or 2). Note that the though the hardware supports 4 devices, the SCZ-2F firmware supports only 3. The control full flop is set when an I/O pulse is sent and is cleared when the Recal, seek etc. has been completed which then informs the firmware to send STBATTDN/.

Sheet 7: At the bottom of this page is the device code switch and a comparator. When the device code sent equals the switch setting and selftest is done, then the comparator outputs a low. DIACK/ enables the switch setting onto the DG bus for an interrupt acknowledge. On the top of the page, the command latch latches in the command on a DOA and holds the command while the command prom performs the decode. The poll status register file is a 4 X 4 file used during the idle loop to keep an updated status of four data bits from each drive unit. Bit 0 = seek error, bit 1 = drive busy, bit 2 = write protect, bit 3 = drive ready. For more information see the firmware definition file for the SCZ-2F.

Sheet 8: The LS193s are used to latch in the DOC information sent from DG. The format is in Zebra single DOC format and includes the transfer count bits (2's complement of the number of sectors), the starting sector address and the starting head address. Note - if the DOC is accompanied by a seek command, then our accumulator data will not be loaded into these counters.

Sheet 9: This page's circuitry applies only to cylinder addresses. A DOC followed be a seek command will latch the cylinder address into the LS174s and a short time later will write this same data into the LS670 register file specified by the drive unit number that was sent with the seek. In this way, four seperate cylinder addresses can be sent to four different drives to enable overlapped seeks.

Sheet 10:

This page contains 4 to 1 and 2 to 1 muxes used to send status information concerning the SCZ-2F, the data transfer and the drive to the host computer. DIA reads in the data transfer status. DIB reads in the drive status. Alternate mode 1 DIA reads in current memory address. DIC reads in current head, sector address, and sector count. Alternate mode 2 DIA reads in the ECC bits 16-23.

Sheet 11:

The SCZ-2F's Z80 microprocessor is displayed on this page along with the E^2PROM (2732A) which contains the firmware. Also displayed are two 1 of 8 decoders which are used by the firmware to generate 14 control signals used throughout the board.

Sheet 12:

ISTAT/, in the upper left, is one of the firmware generated signals from sheet 11. This is used to read into the Z80 the status lines of IC J6 and pins 12 and 14 of IC J7. RCYLUP/ reads in the remaining status lines of IC J7. LDSPCF/ loads the special function register with data used to control events in the DG <-> RAM <-> Drive transfer of data. SRTXFER sets the REQA flop on page 16 which by way of ACKA/ generates the first Data channel request of a transfer. ACCESS is used by the firmware as a way to clear things out and realign the state of some flops once an error occurs. It is also used on page 14 as an enable to allow the microprocessor direct entry into RAM memory 8000-87FF. This is necessary for the Z80 so SCSI commands can be deposited in the RAM for the drive to read and also so that the status deposited in the RAM by the drive can be read up by the Z80.

SCSIPP (SCSI ping pong) is used to point to the proper bank of RAM during transfers. If SCSIPP = 0, then during a data transfer addressing is to RAM address 0 - FF. If SCSIPP=1 then the RAM addressed is 100 - 1FF. DGPP works in the same manner, the difference between the two is that SCSIPP is active during transfers from the RAM to the drive and DGPP is in use during host memory to SCZ-2F RAM transfers. SBank is used by the Z80 to access RAM used for the SCSI status and command blocks. Also on this page is the selftest done flop and the power-on-clear circuit.

Sheet 13:

This page contains three sets of 8 bit registers used as latches to hold various statuses until they are read in by the host computer. The upper group of status lines are for Data transfer status (read in by a DIA), the middle group is a bogus ECC word read by the host with a DIA ALT mode 2, and the

bottom group is for the drive status and is read with a DIB. In the lower left is a group of flops used to zero out certain bits (unused) during a DIB.

Sheet 14:

In the upper left are two 8304Bs which allow data to be passed in either direction between the Z80 and RAM. Note that RD/ determines the direction of data transfers and the output enables of these ICs are controlled by the PAL. The LS244 is used in conjunction with access to give the Z80 a direct link to the RAM address bus. The LS153 is a dual 4 to 1 mux and the select signals, ACCESS and MUXDG/ determine which signals will be passed to gain control of the upper RAM address bits. Note the possible combinations:

1. ACCESS = 0 , MUXDG/ = 0: This occurs during a data transfer from the host to the SCZ-2F RAM. BANK 1 = 0 and BANK 0 is driven by DGPP which will determine if the block of data will go into the ping or pong RAM locations. (The RAM is logically divided into quarters. Ping and pong exist in the lower half.)

2. ACCESS = 0 , MUXDG/ = 1: If we are in a data transfer phase (ie. not a command or status phase) then SCSIPP will be passed to BANK 0 to allow access to the ping and pong portions of RAM during transfers to/from the drive. SBANK will be passed to BANK 1 and will be equal to 0 due to the firmware. If we're in the command phase (the SCSI drive is in the process of retrieving the command from our RAM), then CMD is 1 and both BANK 0 and BANK 1 will also be equal to 1. This results in the drive accessing the upper 1/4 of RAM where the firmware had previously stored the SCSI command block. If firmware is in the read status phase (reading from RAM a status block previously written there by the drive), then SBANK = 1 and SCSIPP = 0 resulting in RAM address 200 - 2FF being read by the micro.

3. ACCESS = 1, MUXDG/ = 0: BANK 0 = 0 and BANK1=0: This configuration is not used.

4. ACCESS = 1, MUXDG/ = 1: In this configuration, A10 bocomes BANK 1 and A9 becomes BANK 1 and the Z80 has entry into any of the four blocks of RAM it chooses. When A10 = 1 and A9 = 0 the block of RAM accessed holds the SCSI sense information that was returned from the drive after we had sent a request sense command. (A request sense command is sent in response to receiving a check condition in the status byte at the completion of a SCSI command. This sense information is therefor acessible by the firmware so we can determine what kind of error occured to send the check

status in the first place. If both A10 and A9 arre equal to 1, then we are accessing the portion of RAM used to hold the command block. The Z80 (firmware) assembles the command block as instructed to by the host's request and then deposits this code into this bank of RAM. When the SCSI drive enters the command phase, this RAM data is read by the drive and then decoded. The command is then executed by the drive.

The scratch pad RAM (Z68B10) is mapped into memory locations FF80 - FFCF and is used for a number of purposes. Among it's uses are the statuses for Units 0 - 3, drive fault, read/write fault, and two six-word blocks used for assembling and temporarily storing the command blocks that will then be sent to the buffer RAM from where they are then read by the SCSI drive.

The RAM control PAL generates many of the signals used to control data transfers. Details given on the Sheet 16 discussion.

Sheet 15:

Here we have two sets of counters, a set of muxes and the 2149 buffer RAM. The buffer RAM, as stated before, is addressed as four sections - ping, pong, status, and command. The ping and pong are the banks through which the 256 word data blocks are passed between the host and the SCSI drive. The LS393 counters are used as the RAM address counters for data transfers between the RAM and the drive. These counters are cleared out either by ACCESS or CMDCMPLT which goes active when the SCSI interface line C/D is driven high, indicating that the drive is done reading the command and is entering the data phase. To increment these counters, ACKB is pulsed once for every two SCSIREQs. (Two 8 bit SCSI words are packed into each 16 bit RAM word.) The upper bit of these LS393 counters, BADD7, is used to clock a flop when these counters turn over, which generates the signal SCSIXFERCMP to signal the completion of a data transfer.

The LS161 counters are used during the transfer of data between the host and the RAM. ACKA/ becomes MUXDG/ which clocks the counters and also gates these counters through to the RAM address bus. At the end of a 256 word transfer, both LASTWD and STBCMPLT go active. LASTWD shuts down any further data channel activity and STBCMPLT signals the Z80 that we are done with the transfer.

With the muxes, note that ACCESS active removes the output enable from the muxes, allowing the Z80 sole use of the address bus via PA0 - PA7.

Sheet 16:

This page displays the majority of the discrete SCSI control circuitry. Because the SCZ-2F supports only 1 initiator, does not allow disconnects, and supports only asyncronous transfers, the SCSI control consists primarily of phase handling for the sake of RAM addressing and turning around SCSI requests to SCSI acknowledges. A couple of examples are given to explain the circuit operation.

The type of data transfers consist of: Host<->RAM, SCSI<->RAM, and concurrent Host<->RAM SCSI<->RAM. Host<->RAM transfers use only the ACKA circuitry while SCSI<->RAM transfers use all logic on this page except for the ACKA circuit.

For RAM to Host transfers (occur when reading data from a drive), the Data Channel events are set underway by pulsing SRTXFER. This is done under firmware control. This event sets the REQA flop which in turn allows ACKA and ACKA/ to go active on the 4 Mhz clock rising edge. These two signals will then:

1. Send out the first DCHREQ/ on sheet 4.
2. Enable the LS161 counters on the address bus on page 15.
3. Feedback to clear out the REQA flop.
4. Generate CELO/ and CEUP/ via the PAL on page 14 to put the data from RAM address 0 onto the data bus.
5. Generate MEMSTBA/ via the same PAL which is used to latch RAM data into the registers on page 5. Now when BDCHI/ comes along from the host computer, it will read this data into the address given it from the address counters on page 3 and clock the REQA flop on page 16 to generate another ACKA to start the cycle over again. Note that when ACKA/ goes inactive, it clocks the RAM address counters on page 15 so our next RAM data read will be from address 1.

A Host to RAM transfer (occurs during writes to a drive) proceeds in a similar fashion and will not be discussed.

Transfers between RAM and the SCSI drive are somewhat more involved. For a RAM to SCSI drive transfer the process proceeds as follows:

1. A command is sent from the host computer (in this case a write) and is received by the SCZ-2F.
2. Using the DOB, DOC, and DOA information, the firmware assembles the SCSI command block and writes it into the upper quarter of the RAM.
3. The firmware then selects the drive it wants to transfer to by sending out that drive's unique ID and asserting SCSISEL on page 18.

4. After being selected, the drive then begins the transfer by first asking for the command block. The drive sets C/D to indicate a command phase is in progress and activates SCSIREQ on page 18.
5. CMD on page 18 is passed through the muxes on page 14 so that both BANK 0 and BANK 1 are high. Therefor the command block is the first data to be read by the drive.
6. When SCSIREQ is received by the SCZ-2F, a series of transfers from the RAM to the drive take place. When all 6 words of the command block are received by the drive, the drive changes C/D to indicate that the command phase is over.
7. From C/D is derived two additional signals, CMDCMPLT which resets the address counter used during a SCSI transfer, and CMD which releases both BANK 0 and BANK 1 from both being high to whatever they will be used for during the data phase portion of the transfer.
8. The drive then enters the data phase. The first SCSI request from the drive clears CMDCMPLT allowing the LS393s (page 15) to clock on each acknowledge. Data presented on the outputs of the RAM are then latched into the 2952s on pg 17. ENUPPER/ and ENLOWER/ are alternately activated to drive an 8 bit word onto the SCSI bus. SCSI ack is then sent to indicate to the drive the data bus is valid.

Concurrent Host<->RAM and SCSI<->RAM transfers are the most involved. During the transfer of data to/from the drive the RAM acts as a ping/pong buffer having data alternately written into one bank and then read from another. At the start of a data transfer, a sectors worth of data is first written into RAM from either the host or the drive involving one of the sequences described above, and then the SCZ-2F begins these concurrent transfers with the Data channel and SCSI bus active at the same time. The RAM address mux is swapped nearly every other 16 bit word to first access the RAM bank used by the host and then to access the bank used by the SCSI drive. Once both sides have completed their operations with their respective banks, the firmware swaps the banks and kicks off another round of data channel transfers and sends the outstanding acknowledge to the SCSI bus. The bank swap ensures the bank to be read is now full with valid data and the one to be written contains data already read.

Sheet 17:

In addition to the 2952s already mentioned, this page contains the parity generating and parity checking logic. During writes to SCSI, data is routed through the 2952s and enabled onto the SCSI bus a byte at a time. This byte is also routed to the

inputs of the F280 parity generator/checker IC and the even output of this chip drives a logic level such that all 8 bits plus the parity have an odd number of logic 1's. When receiving data from the SCSI drive, the data arrives at the inputs of the F280 via the LS240. This F280 again generates a parity bit, this time also using the parity bit sent along with the data. The F280 output becomes the LS74 data input and on the rising edge of SCSIREQ the LS74 flop output is either set or clear depending on the F280 output. SCSIREQ also clocks the data into the 2952s enroute to the RAM.

Sheet 18:

In the course of selecting a drive, the drive ID is clocked into the LS175 with a pulse on SCSIID/. At the time of selection, STBATTN/ is pulsed with SDB7 = 1 to enable the ID onto the SCSI bus. Once the drive is selected, the SCZ-2F disables the ID from the bus by pulsing ACCESS.

The control signals for the SCSI bus are also located on this page. Refer to most any SCSI drive manufacturer's manual for a thorough description of the SCSI interface.

6

SCZ-2F Adapter Signal Names

References to sheet numbers apply to schematics with part number 700-452-00. Note that these schematics are used for other versions of the SCZ-2. For a thorough description of these signals in relation to the adapter's operation, refer to the firmware listing (not included in this manual) for the SCZ-2F. (P338xx)

Data General Interface

Signal Name	Sheet #	Definition
DCHMO	4	Data channel mode. Asserted by the interface logic when the DCH SEL flip-flop is set to inform the processor of the type of data chanel cycle to be performed. If active then it will be a data channel in (read type command), if inactiv3e then it will be a data channel out (write type command).
IRQ	6	Interrupt request. Adapter is requesting program interrupt service. (rd/wrt done or seek end on unit 0,1 or 2).
DCHI	2	Data channel input. Signal sent by CPU requesting data channel input (DCHMO=1). Adapter will place a word of data onto data bus (DATA 0-15) at this time.
DCHO	2	Data channel output. Signal sent by CPU for data channel output (DCHMO=0). Adapter uses this signal to latch data on data bus (DATA0-15).
DCHREQ	4	Data channel request. Asserted by the adapter when it requires data channel service.
RQEN	2	Request enable. Set by CPU to synchronize program interrupt and data channel requests.

DIB	2	Data in B. Asserted by the CPU during the execution of a DIB instruction. If selected by DS 0-5, the adapter places drive status onto the data bus. (zeros if ALT MODE 1, the ECC syndrome if ALT MODE 2).
DIA	2	Data in A. Asserted by the CPU during the execution of a DIA instruction. If selected by DS 0-5, the adapter places rd/wrt done status onto the data bus. (ending memory address if ALT MODE 1, the ECC syndrome if ALT MODE 2).
DIC	2	Data in C. Asserted by the CPU during the execution of a DIC instruction. If selected by DS 0-5, the adapter places the ending disk address onto the data bus.
DOA	2	Data out A. Asserted by the CPU during the execution of a DOA instruction. If selected by DS 0-5, the adapter loads the command and drive address register from the data bus.
DOB	2	Data out B. Asserted by the CPU during the execution of a DOB instruction. If selected by DS 0-5, the adapter loads the memory address register from the data bus.
DOC	2	Data out C. Asserted by the CPU during the execution of a DOC instruction. If selected by DS 0-5, the adapter loads the starting disk address register if rd/wrt type of command or the cylinder address register if a seek command.
CLR	2	Clear. A function (F) decode of an I/O instruction, used to abort a rd/wrt command (clears both the done and busy flip-flops) and to clear status fault register.
START	2	Start. A function (F) decode of an I/O iinstruction, sets the busy flip-flop on the adapter telling it to start the rd/wrt command specified by the previous DOA.
IOPLS	2	I/O pulse. A function (F) decode of an I/O instruction, sets the control full flip-flop on the adapter telling it to send the position command (recal or seek) to the drive.
DS<0-5>	7	Device select. These lines carry the device code specified by the I/O instruction. Only the interface whose device code corresponds to that carried on these lines should respond to the control signals (DOA,DIA etc.) generated by the host CPU.

SELD	2	Selected done. Adapter places state of done flip-flop on this line if selected by DS 0-5. Generally used by the skip I/O instructions.
SELB	2	Selected busy. Adapter places state of busy flip-flop on this line if selected by DS 0-5. Generally used by the skip I/O instructions.
DCPIN	2	Data channel priority in. Seen asserted by the first data channel interface on the host I/O bus, and transmitted in series through each interface. If active, data channel service for the adapter is granted.
DCPOUT	2	Data channel priority out. This line is used by the adapter to pass priority to the next device in the chassis if it is not requesting the data channel.
DCHACK	2	Data channel acknowledge. Issued by the CPU at the beginning of a data channel cycle. The adapter places the memory address of the data to be transferred onto the data bus during this time.
IORST	2	I/O reset. Asserted by the CPU during a powerup, when reset switch is depressed, or with the execution of an IORST instruction. Will clear all the adapter registers. If the reset switch is depressed it will clear the microprocessor and the SCSI interface.
MSKO	2	Mask out. Asserted by the CPU during the execution of a MSKO instruction. If DATA 7 is a one the interrupt mask flip-flop will set on the adapter preventing an interrupt request.
DATA<0-15>	3	Data bus. A sixteen bit bus that carries the data during the execution of a programmed I/O type of instruction (DOA, DIA etc.) or data channel activity.
INT PRI	2	Interrupt priority in.
INT PRO	2	Interrupt priority out.

Output Signal Definitions

Sheet 2 Output Signals

Signal Name	Definition
DDIA	Device data in A
DDIB	Device data in B
DDIC	Device data in C
DCLR	Device clear
DDOA	Device data out A
DDOB	Device data out B
DDOC	Device data out C
DSRT	Device start
BMSKO	Board mask out
BDCHACK	Board data channel acknowledge
REQEN	Same as RQEN
BDCPIN	Board data channel priority in
BDCLR	Board clear
IORSTB	I/O reset buffered
BIACK	Board interrupt acknowledge
BDCHO	Board data channel out
BDCHI	Board data channel in
IOPULSE	Device I/O pulse
IOPLSB	Device I/O pulse buffered

Sheet 3 Output Signals

Signal Name	Definition
DGR <0-15>	DG data bus received
DGS <0-15>	Data to be sent to DG data bus
A1DIA	Alternalte mode 1 and device DIA

Sheet 4 Output Signals

Signal Name	Definition
L+FWD	Last word or format last word
STBREQ	Strobe request. DCH flip-flop toggle.
DDCH SEL	Device data channel selected.
SNDADR	Send address. Send memory address to the DG data bus during a DCH acknowledge.
DGXFERCMP	DG transfer complete. A sector of data (256 16 bit words) has finished transfering via the data channel.
DSK REQ	Disk request. Same as the data channel sync flip-flop.
DCHREQ	Data channel request
DCHMO	Selects the direction of a DCH xfer
DEFER	Selects deferred seek if open - i.e. seek won't occur until a rd/wrt command.
POLL	Selects polling by targets if open, polling by LUN's if closed. The SCZ-2F requires this switch to be up even if running just a single drive system.

Sheet 5 Output Signals

Signal Name	Definition
INTLV	2:1 interleaving of sectors if up, 1:1 if down. Doesn't apply to the floppy drive.
OVLAP	Overlap seeking of drives in a target. Not used in the SKZ-2221. Should be set down.
MC0,MC1,MH0,MH1 MS0,MS1	Not used in the SKZ-2221, set down. Originally used to select drive size.

Sheet 6 Output Signals

Signal Name	Definition
R/WDN	Read/Write done.
CNTRLFULL	Control full. Set active by IOPULSE accompaning seek or recal.
FULL	Full. Control full or busy, DIA status bit 0.
TIMEOUT	Busy flip-flop set for more than 4 seconds.
DBUSY	Device busy.
XDBUSY	Same as device busy.
SND<0-3>	Seek end <0-3>. Unit 0-3 seek complete attention interrupt flags.
DSKINT	Disk interrupt. From the interrupt request flip-flop.
CSTAT	Clear status.
INT	Interrupt. Microprocessor interrupt, command abort. Busy flop cleared by BCLR, DCLR or PROCLEAR.
DIAK	Device interrupt acknowledge.

Sheet 7 Output Signals

Signal Name	Definition
ECCEN	Same as dip switch 3 position 1. See Appendix A.
RETRY	Same as dip switch 3 position 2. See Appendix A.
DOAVAL	Signifies a valid DOA was issued.
CMD(0-3)	Command. Command bits from the DOA register.
DRV(0-1)	Drive. Unit address bits from the DOA register.
ALT1	Alternate mode 1. Command decode.
ALT2	Alternate mode 2. Command decode.
SEEK CMD	Seek command. Command decode.
OFF CMD	Offset command. Offset forward or reverse command decode. Not supported in SCSI.
RECAL	Recalibration. Command decode.
FMT CMD	Format command. Command decode.
SND DIB	Send DATA in B. Drive status DIB only no alt mode.
DSK SEL A	Disk selected A. Device code of adapter matched device select bits.
DSK SEL B	Same DSK SEL A.

Sheet 8 Output Signals

Signal Name	Definition
EDA(0-14)	Extended disk address. Head, sector, count.

Sheet 9 Output Signals

Signal Name	Definition
None	

Sheet 10 Output Signals

Signal Name	Definition
SEND	Enable transfer of data (DIA,DIB or DIC) to DG data bus.
DGS<0-15>	Data General Send bus. Bus directed out to DG host.

Sheet 11 Output Signals

Signal Name	Definition
4MHZ	Four MegaHertz clock.
PROC CLR	Processor clear. Active during power up/down or I/O reset switch.
A<0-11,15>	Microprocessor address bus.
RD	Read. Generated by the micro during an external byte read operation.
WR	Write. Generated by the micro during an external byte write operation.
MRQ	Memory request. Generated during a micro read or write operation.
SDB<0-7>	System data bus. Used by the micro to transfer data externally.
MCLEAR	Maintenance clear. Micro address decode used to clear the SCSI parity error flip-flop.

ZIACK	Micro interrupt acknowledge. Micro address decode used to clear the abort interrupt flip-flop.
SDCHO	Start data channel out. Micro address decode used to kick-off the data channel for a write command.
RCYLUP	Read cyclinder address upper. Micro desires upper cylinder address as specified by the DOC.
RCYLLO	Read cylinder address lower. Micro desires lower cylinder address as specified by the DOC.
RD MUX	Read Multiplexor.
POLL STAT	Poll status.
STBECCB3	Strobe ECC byte 3.
LD SPCF	Load special function register.
STB ATTDN	Strobe attention done.
INC EDA	Increment ending disk address.
STB R/W S	Strobe read/write status. For DIA.
STB DSTAT	Strobe drive status. For DIB.
SCSIID	Strobe SCSI target ID.
ISTAT	Strobe various onboard status's into the micro.

Sheet 12 Output Signals

Signal Name	Definition
LOW VOLTAGE	+5v is at a level too low for proper operation of logic (VCC).
SLF DN	Self test done.
SBANK	Status bank. Direct the data flow from SCSI to the status bank of the buffer.

DGPP	Data General ping-pong. Direct which buffer bank the data should flow to or from the data channel.
SCSIPP	SCSI ping-pong.
SRTXFER	Start transfer.
READ	Read command.
ACCESS	Microprocessor needs access to the buffer for status bank or command bank operations.

Sheet 13 Output Signals

Signal Name	Definition
OFFSET	Offset command active. For DIB status bit 5.
DRVFLT	Drive fault. For DIB status bit 15.
WRTFLT	Write fault. For DIB status bit 14.
CLKFLT	Clock fault. For DIB status bit 13.
UNS	Unsafe. For DIB status bit 11.
DCFLT	DC fault. For DIB status bit 10.
ILL CMD	Illegal command. For DIB status bit 9.
ILL ADR	Illegal address. For DIB status bit 8.
R/W FLT	Read/write fault. For DIA status bit 15.
VERR	Verify error. For DIA status bit 12.
HDRERR	Header error. For DIA status bit 11.
CYLERR	Cylinder address error. For DIA bit 10.
BADSECT	Bad Sector flag. For DIA bit 9.

ECCERR	ECC error detected. For DIA bit 8.
ILLSECT	Illegal sector. For DIA bit 7.
PARERR	Parity error. For DIA bit 6.
ECC(16-23)	ECC word for ALT MODE 2 DIB (lower word).

Sheet 14 Output Signals

Signal Name	Definition
WE	Write enable. For the buffer RAM.
CEUP	Chip enable upper. For buffer RAM.
CELO	Chip enable lower. For buffer RAM.
MEMSTBA	Memory strobe A. Used for strobing data to the data-channel-in registers from buffer.
OEDGREG	Output enable DCH register. Used to enable the DCH data from the CPU to the buffer.
OESCSIREG	Output enable SCSI register. Used to enable the data from the SCSI interface to the buffer.
BANK(0-1)	Address lines 8 and 9 for the buffer RAM.
PA(0-7)	Processor Address. Address generated by the micro to be used to reference the buffer RAM.

Sheet 15 Output Signals

Signal Name	Definition
RAM(0-15)	RAM buffer data bus.
MUXDG	Multiplex DCH. Used to select the DCH address counter (ACK A) to the RAM address bus.

FLSTWD	Format Last Word.
BADD7	B Address 7. Most significant address of SCSI address counter (ACK B). Used to set SCSI transfer complete.
LASTWD	Last word. The last word of the current data channel buffer was transfered.
STBCMPLT	Strobe complete. Most significant address of the data channel address counter.

Sheet 16 Output Signals

Signal Name	Definition
ACKA	Acknowledge A. The data channel currently has access to the buffer.
ACKB	Acknowledge B. The SCSI interface currently has access to the buffer.
SCSIACK	SCSI bus acknowledge.
EN LOWER	Enable lower. SCSI send/receive register.
SCSI I/O	Select SCSI bus input or output.
PACK	Enable either upper or lower SCSI receive register (active only on receive).
SCSI XFER CMP	SCSI transfer complete. An entire block (sector) of data has been transferred to or from the buffer.
EN UPPER	Enable upper. SCSI send register.

Sheet 17 Output Signals

Signal Name	Definition
BUSPAR	Bus parity. A parity error was detected during the transfer of data on the SCSI bus.
"A" backplane lines	SCSI data bus and parity line.

Sheet 18 Output Signals

Signal Name	Definition
SCSI REQ	SCSI request.
SCSI BSY	SCSI busy.
SCSI SEL	SCSI select.
CMD	SCSI command.
CMD CMPLT	SCSI command complete. Set when C/D line of SCSI is driven high by the drive.

Appendices

Appendix A

Controller Configuration Options

SCZ-2F 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. (DOWN position).
3	not used	Switch should be DOWN.
4	not used	Switch should be DOWN.
5	POLL MODE	Recognize muliple targets if UP, or recognize single target and multiple logical unit numbers if DOWN. UP is required in all cases.
6-8	THROTTLE	The three throttle setting switches for controlling the number of data channel words per request.

Throttle Burst Rate is defined as the (DCH) 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.

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

* Standard Setting. **NOTE: UP=open DOWN=closed**

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. (Available for Wrens only)
2	not used	Switches should be DOWN.
3-8	not used	Switches should be DOWN.

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. (Available for Wrens only.)
2	RETRY	Report SCSI media related retries to the system if the switch is UP. This switch should be normally DOWN. It is only used during the 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_8.

	Switch Position					
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.

If, at a later date, you wish to change the device code for the SKZ2221, 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.

Appendix B

Soft Switch Settings for Zetaco Utilities

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