FST-2

SCSI-2 Host Bus Adapter

Hardware Reference

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Preface

This manual contains information regarding installation of the FST-2 Adapter. The technical contents have been written with the following assumptions in mind:

- You have a working knowledge of UNIX operating systems.

- You have access to full hardware and software documentation for your particular system.

- You are familiar with standard installation, power, grounding, and peripheral cabling procedures.

The information in this manual is organized into two chapters as follows:

Chapter 1 - Product Overview

This chapter explains the FST-2 Adapter system features, capabilities, specifications, power and interface requirements.

Chapter 2 - FST-2 Adapter Installation

The hardware procedures required to install and power-up the FST-2 Adapter are explained in this chapter.

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Product Overview

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Product Overview

Introduction

Zetaco's FST-2 Host Adapter is a high performance adapter designed for high-end disk and tape storage control for VMEbus systems.

The information contained in this section describes the physical and functional characteristics of the FST-2 Adapter. It does not include system or software characteristics.

For information regarding software, refer to your FST-2 Adapter Software Reference.

1.0 FST-2 Adapter Description

**General
Description**

The FST-2 is designed as an interface for connection of data storage and peripheral control devices in a closely coupled hardware configuration. Figures 1.0 and 1.01 show the Adapter board layout with some of its physical components. The FST-2 adapter occupies one slot within a 6U (double height) VMEbus subrack. A 6U to 9U adapter is also available for use in a 9U size subrack slot.

Mounted on the Adapter is one or two "daughterboards". Each daughterboard includes the NCR 53C710 SCSI processor, interface circuitry and a SCSI connector used to interface to the SCSI bus.

The Adapter comes with a front panel, for 6U applications, that covers the area around the SCSI connectors. The front panel is used to maintain FCC compatibility, guide airflow, and attachment for the handles.

The FST-2 Adapter is designed using the latest technology; off-the-shelf integrated circuits that provide optimum performance and versatility.

Zetaco's FST-2 Adapter provides a variety of features, including:

- Hardware Disk Mirroring

- Sustained fast-SCSI transfer rates of up to 10 M-bytes per second.

- VMEbus transfer rate of up to 30 M-bytes per second.

- Dual SCSI buses for control of up to 14 peripheral devices.

- Optional single-ended or differential SCSI configurations

- Single-ended and differential SCSI ports supported on one adapter.
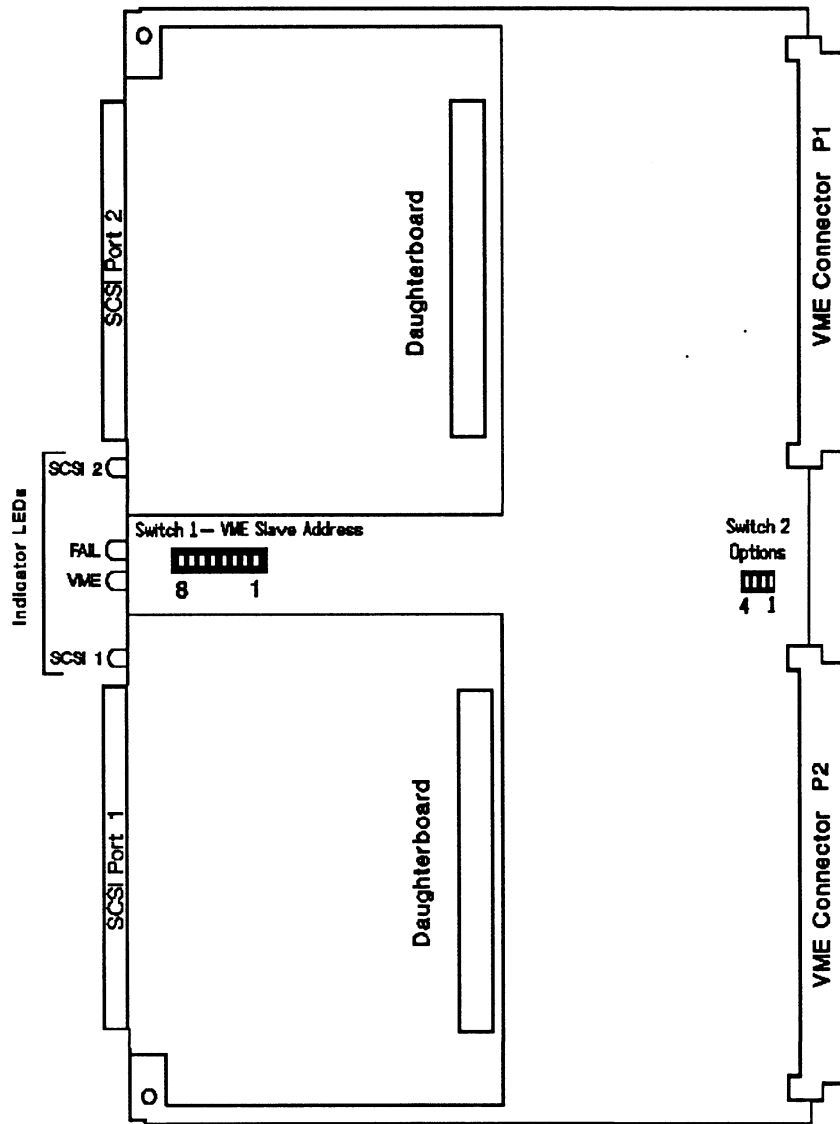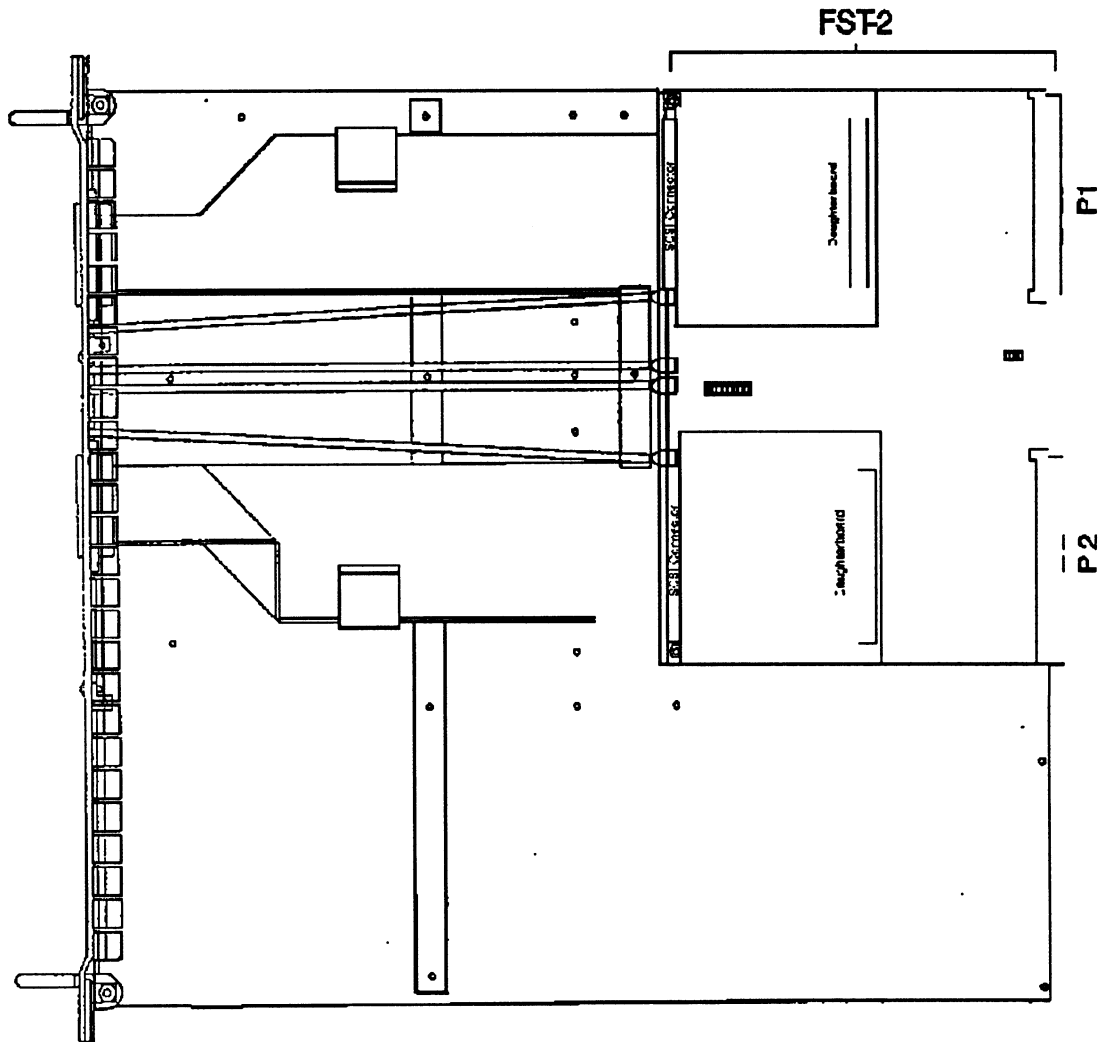
Figure 1.0 - FST-2 Layout

Figure 1.01 - FST-2 6U to 9U Adapter

Processors

FST-2 Adapter Processor

A Motorola 68EC030 microprocessor running at 25 MHz is used as the main Adapter processor. The 68EC030 is a powerful, yet cost-effective 32-bit microprocessor, containing internal instruction and data caches, and dual internal data and address busses for increased parallelism and performance.

The FST-2 contains 512KB on-board static RAM used for CPU data and instructions, SCSI scripts, and a secondary SCSI data buffer. All Adapter firmware is contained in a single socketed 128KB EPROM. Firmware is moved into SRAM at power-up to achieve 32-bit instruction fetches.

SCSI Processor

The NCR 53C710 SCSI processor, mounted on the daughterboard, is used to interface to the SCSI bus. One processor is used for each port. The NCR 53C710 is a third generation SCSI processor that offers advanced features such as "Fast" SCSI, with a transfer rate of up to 10M-bytes/second, and an embedded "Scripts" processor. The embedded processor executes instructions directly from memory and greatly reduces the overhead associated with controlling it directly from the microprocessor.

VMEbus Controller

The Cypress VIC068 VMEbus Controller is used for VMEbus control functions. In addition to control functions, it also supports high speed data flow control at rates exceeding 30-Mbytes per second.

VME Transfers

Three methods are used to pass information between the adapter and VMEbus - SLAVE transfers, Master single-cycle transfers, and DMA transfers. During SLAVE transfers the VME master accesses the adapter to read or write internal resources in the VIC controller or SRAM. In the Master single-cycle method the Adapter microprocessor reads or writes resources on the VMEbus directly. During DMA transfers data is passed at high speed rates between the VMEbus and one of the SCSI busses.

The Adapter is designed to handle a block mode VME transfer rate of up to 30-MBytes per second. However, the actual rate achieved is largely dependent on the speed of the VME memory being used.

VMEbus MASTER

As a VMEbus master, the FST-2 performs transfer of command lists, status information and data. In master mode the adapter supports:

- Block mode transfer rates up to 30-MBytes per second

- A16 (16-bit), A24 (24-bit), or A32 (32-bit) wide addressing

- Block transfer mode with programmable burst lengths of between 1 and 64 bus cycles (up to 256 bytes).

- A programmable interleave period (break count) between bursts

VMEbus SLAVE

As a VMEbus slave, the adapter allows the system CPU board to read and write registers and memory on the Adapter.

The SLAVE interface has the following characteristics:

- Exchanges basic commands and status with the controller.

- Maps the first 128 bytes to the internal registers in the VME controller IC and is accessible in 8-bit D8 (O) mode only.

- Maps the second 128 bytes to on board SRAM, accessible in D8, D16, or D32 mode.

- 16-bit (A16) addressing, using address modifier codes 29H, 2DH. One 8 bay switch is used to set the base starting VME address.

VMEbus
Interrupts

The Adapter has versatile capabilities as an Interrupter on the VMEbus, integrated into the VME controller IC. The Interrupter generates an interrupt request on the Priority Interrupt Bus and then provides STATUS/ID information when the Interrupt Handler requests it. The FST-2 Adapter can generate interrupts on one or more of the seven IRQ lines simultaneously, and drive a D8 STATUS/ID onto data lines D0-D7.

Byte & Word
Swapping

The FST-2 Adapter allows byte and word swapping of data or command structures. This feature is used to compensate for differences between system vendors. With neither byte or word swapping enabled, data is transferred between VME and SCSI using the most significant (D31-D24) byte first.

1.1 SCSI Bus Description

General Description

The FST-2 Adapter includes one or two SCSI bus ports, that are located on "daughterboards" for easy upgrade from one to two ports (figure 1.1).

Each SCSI interface has a bus width of 8 bits plus parity with a sustained Fast-SCSI transfer rate of 10-MBytes per second.

The FST-2 Host Adapter strictly adheres to the following SCSI standards:

Small Computer System Interface (SCSI-1), ANSI X3.131-1986

Small Computer System Interface-2 (SCSI-2)

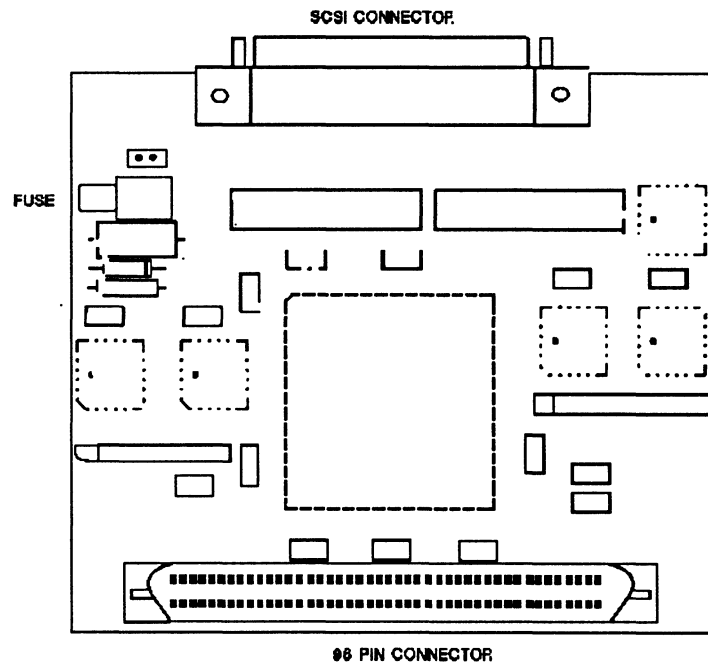Common Command Set, ANSI X3 Working Committee Document, X3T9.2/85-52 Rev 4a

Figure 1.1 - FST-2 Differential SCSI Daughterboard

SCSI Daughterboards

Mounted on the main Adapter are one or two daughterboards that contain the SCSI circuitry and connectors for each SCSI port. Each daughterboard contains a SCSI Processor (NCR 53C710), drivers and receivers, SCSI terminators, and SCSI connector. Each daughterboard also contains one 96-pin connector that mates with a connector on the main adapter to provide the electrical connection to the main Adapter.

Either one or two daughterboards can be installed on the FST-2 Adapter. This allows you to upgrade easily from one to two ports, switch between single-ended or differential, or mix single-ended and differential on the same FST-2 Adapter. All devices on a single SCSI bus must operate with the same interface type: single- ended or differential.

Single-Ended SCSI Daughterboard

Single-ended transmission is available by installing the appropriate daughterboard on the FST-2 Adapter. A single ended interface uses one line for each SCSI signal. All single-ended circuitry and bus terminators are located on the daughterboard.

Note: To operate reliably, operation at Fast SCSI (10M-bytes/sec) transfer rates may require the use of differential SCSI transmission only. This is based on industry reports and is not specified in the standard SCSI specification.

Differential SCSI Daughterboard

Differential transmission is selected by installing the appropriate daughterboard on the FST-2 Adapter. The differential SCSI interface uses two lines for each signal. This provides better noise immunity and allows a longer cable length. All differential circuitry and bus terminators are contained on the daughterboard.

Transfer
Protocols

The VME SCSI-2 interface supports asynchronous and synchronous transfer rates. Asynchronous supports up to 5-MBytes per second transfer rates. The actual rate achieved depends on the drive and cable length. Synchronous supports transfer rates of up to 5-MBytes per second and Fast-SCSI transfer rates of up to 10-Mbytes.

Terminator
Power

Terminator power, is provided on SCSI connector pins 25 and 26. A replaceable fuse is used to limit terminator power current. Replace the fuse with a 1.5 amp Littelfuse - part number 273-01.5.

1.2 Specifications

Physical	Dimensions: 6U adapter - 9.2" x 6.3" x .659" (occupies one double-height, single width slot in the VME chassis)
Electrical	Electrical specifications of the VME interface conform to ANSI/IEEE STD1014-1987 Voltage: +5 volts DC Current: 3.0 amps maximum
Capacity	Up to 14 SCSI devices
Cable Requirements	External cables should use a 120 ohm impedance shielded cable that meet the specifications found in ANSI SCSI-1 and/or SCSI-2 specifications.
Environmental	Operating Temperature: 0 to +55 ° C Humidity: 10% to 90% (non-condensing) Non-Operating Temperature: -45 to +115 ° C Humidity: 10% to 90% (non-condensing)
Bus Interface	ANSI/IEEE STD1014-1987 VMEbus Specification
Device Interface	ANSI X3.131 - 1991 SCSI-2 Specification

2

FST-2 Adapter Installation

2

FST-2 Adapter Installation

Introduction

Installation of the FST-2 Host Adapter is divided into two parts – hardware and software installation. This chapter explains, step-by-step, how to install the FST-2 Adapter hardware. You may want to read through all of the information before actually installing the hardware. Installation of the software is covered in the FST-2 Adapter Software Reference Guide.

2.0 Installation Overview

Installation Steps

The installation process described in this chapter is designed to proceed in a logical fashion and provide methods for you to verify results. After all the hardware is in place, the checklist and power-up sequence provides a partial confirmation of success.

Installing the FST-2 Adapter involves the following steps:

1. Unpacking the FST-2 Adapter

2. Getting Your Installation Tools Ready

3. Setting the switches on the main Adapter

4. Installing the daughterboard

5. Selecting a slot for the Adapter in the computer chassis

6. Installing the FST-2 Adapter into the computer chassis

7. Connecting the external cables

8. Powering Up the Adapter & Observing the LEDs

Note: Each FST-2 Adapter is shipped with the appropriate daughterboard(s) already installed. As a result, you can skip step number four. However, later on, if you decide to change the type of daughterboard or install a second one, you can refer to the instructions included in this section.

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2.1 Unpacking the Adapter

**Inspecting Your
Shipment**

Immediately after receiving the Adapter, and before you unpack it, inspect the shipping carton for any evidence of damage or mishandling. The warranty does not cover shipping damages. Therefore, if the shipping carton(s) are water stained, or otherwise damaged, contact the carrier or shipping agent before you open it, with information on the damage. If necessary, request that the carrier's representative be present during the receiving inspection.

For repair or replacement of any Zetaco product damaged in shipment, call Zetaco at (612) 890-5135 for return instructions and an authorization number.

CAUTION
OBSERVE PRECAUTIONS
FOR HANDLING
**ELECTROSTATIC
SENSITIVE
DEVICES**

Before you remove the FST-2 adapter from its shipping carton, it's a good idea to use a wrist band and strap. The Adapter is a sensitive piece of electronic equipment. Using a wrist band and strap is a good precaution to take to prevent damage caused by static electricity.

The FST-2 Host Adapter is shipped in one carton and contains the following:

* (1) FST-2 Host Adapter wrapped in an anti-static bag. Either one or two SCSI daughterboards will already be installed depending on what you ordered.

* Optional cabling

* (1) FST-2 Hardware Installation Guide

* (1) FST-2 Software Installation Guide

* (1) Installation Software on 1/4" cartridge tape.

If any of these items are missing from your shipment, contact your Zetaco representative.

The serial number of your Adapter is engraved on the bottom of the main adapter.

2.2 Installing the Adapter

Getting Ready

After you've unpacked the FST-2 Adapter and inspected it for damage, obtain the tools listed below to assist you in installing the Adapter (consult your specific computer hardware installation manual for other tools that may be required). Tools you will need for installation include:

- A small straight-blade screwdriver
- A set of needlenose pliers

In addition, you may need a Phillips and a large straight-blade screwdriver for use with your computer system. Get out your computer system installation guide to use as a reference also.

Setting the Switches

The FST-2 Adapter has two switches located on the main adapter (Figure 2.2). Switch 1 is used to set the VME Slave address. Switch 2 is used to set other Adapter options.
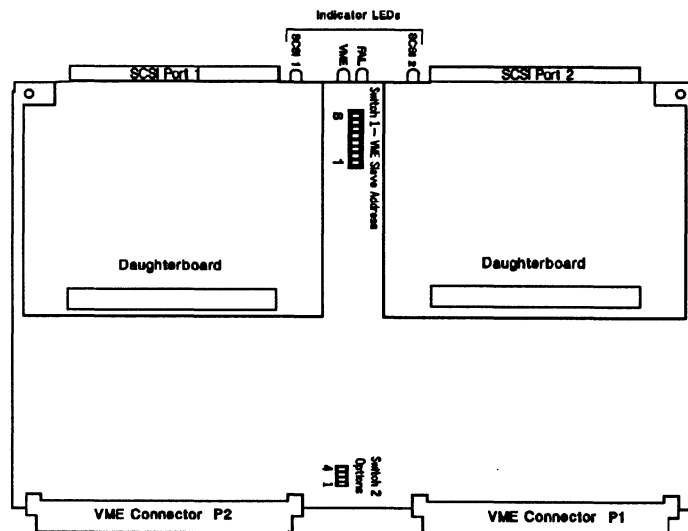
Figure 2.2 - Switch Locations

Switch 1 - VME Slave Address

Switch 1 is an 8 position switch used to set the Adapter's VMEbus slave address. This address must be a unique value within the VMEbus system. An A16 (16-bit) address is used; the switch determines the upper-most 8 bits. An ON switch represents a binary 0, and an OFF switch a binary 1. Table 1 below gives a description of each switch position. Table 2, on the next page, shows example settings for various slave addresses.
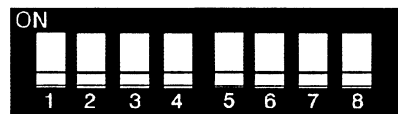
Figure 2.21 - Switch 1 - VME Slave Address

Table 1 - Switch 1: Slave VME address positions

Position	Name	Description
1	SLVADR8	VME slave address bit 8
2	SLVADR9	VME slave address bit 9
3	SLVADR10	VME slave address bit 10
4	SLVADR11	VME slave address bit 11
5	SLVADR12	VME slave address bit 12
6	SLVADR13	VME slave address bit 13
7	SLVADR14	VME slave address bit 14
8	SLVADR15	VME slave address bit 15

Table 2 - Example VME Slave Address Settings

Switch 1 Positions								
7	6	5	4	3	2	1	0	Adapter Base Address
ON	ON	ON	ON	ON	ON	ON	ON	0000
ON	ON	ON	ON	ON	ON	ON	OFF	0100
ON	ON	OFF	ON	ON	OFF	ON	ON	2400
ON	ON	OFF	OFF	ON	OFF	ON	OFF	3500
OFF	OFF	ON	ON	OFF	OFF	OFF	ON	CE00
OFF	ON	OFF	ON	OFF	ON	ON	ON	A800
OFF	ON	ON	OFF	OFF	ON	OFF	OFF	9B00
OFF	OFF	ON	OFF	ON	OFF	OFF	ON	D600
ON	OFF	OFF	OFF	ON	ON	ON	ON	7000
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	FF00

Switch 2 - Option Switch

Switch 2 is used to set the following Adapter options (see Table 3).

Position 1 - Loop on Self-Test

Position 1 is used to force the Adapter to loop on self-test upon power-up and must be set to OFF for normal operation.

Position 2 - Reserved

Switch position 2 is reserved and must be set to the OFF position.

Position 3 - Extended Self-test

When set to ON, the Adapter runs extended tests on VME memory at power up. Set this switch to OFF for normal operations.
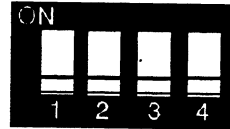
Figure 2.22 - Switch 2 - Options

Table 3 - Switch 2 option positions

Position	Name	Description
1	LOOPSELF	On = Loop on self-test (Must be Off)
2	Reserved	Must be set to the OFF position
3	EXTSELF	ON = Run extended self-test OFF = Run short self-test (Must be OFF for normal operation)
4	Unused	

Installing the
Daughterboard

The following instructions are provided to assist in the installation or replacement of daughterboards on the Adapter by qualified field service personnel. Make sure you have your wrist band and strap attached before proceeding.

Make sure you are installing the correct daughterboard type for your application (normally, when shipped, each daughterboard is already installed). The interface type must match that used for all peripherals on the SCSI bus. To identify whether you have a differential or a single-ended daughterboard look for the word DIFFERENTIAL or SINGLE-END engraved on the solder-side of the daughterboard.

☐ **Remove the Faceplate**

1. In order to install either a single-ended or differential daughterboard, the FST-2 faceplate must be removed. Carefully remove all three screws and nuts from the top of the Adapter (see Figure 2.23), using a small straight-blade screwdriver. There are three screws and nuts that attach the Adapter to the faceplate.

2. Carefully pull the Adapter away from the faceplate, being careful not to damage the LEDs which extrude into the face plate.

3. Remove the cover over the faceplate opening in which the new daughterboard will be installed.
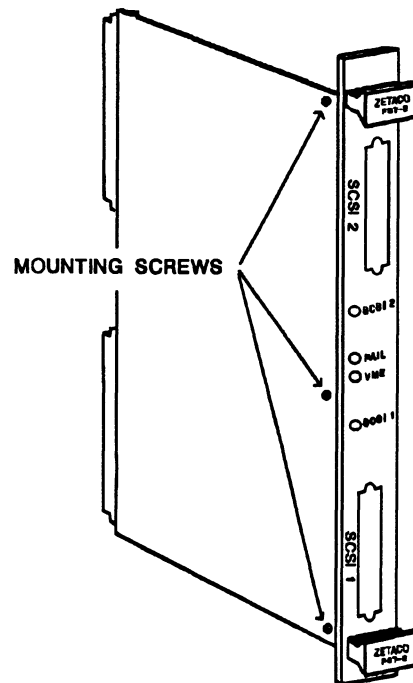
Figure 2.23 - Adapter Faceplate & Mounting Screws

☐ Check Jumper JP4

Check that the TERM power jumper JP4 is IN. Jumper JP4, located near the SCSI connector on the daughterboard, should normally be IN. When installed, the adapter will provide or receive terminator power from the SCSI cable, maintaining a properly terminated bus in case power is removed from another terminated device on the bus. If you must remove this jumper, place it over one post for storage.

☐ Install the Daughterboard

All components on the daughterboard are mounted on the bottom, or inside, to achieve the proper clearances.

1. Lay the main Adapter, with its component side facing up, on an anti-static surface.

2. Grasp the daughterboard by its edges and

carefully mate the 96-pin connector with the connector on the main Adapter.

3. Press the daughterboard down firmly. pushing on the connector area, until it is properly seated. This provides the electrical connection as well as secures it to the Adapter board.

4. If you are installing the daughterboard in an Adapter attached to a 9U adapter, use the standoffs and nylon screws included with the add-on daughterboard to secure the SCSI connector to the main Adapter .

☐ Reinstall the Faceplate

1. Carefully position the main Adapter against the faceplate and push gently so that the LEDs extrude slightly through the faceplate.

2. Next, fasten each of the three screws and nuts you previously removed into the faceplate. You may need a small needlenose pliers to hold the nuts into place while turning each screw. Or, you can hold the nut in position with your thumb while turning the screw.

Each daughterboard has its own termination fuse. If it becomes necessary to replace the termination fuse be sure to replace it with an exact equivalent. Use a fuse manufactured by Littelfuse, part number 273-01.5 If you replace the termination fuse with a value lower or higher, you risk continued problems or damage to the adapter.

Installing the FST-2 into the Computer Chassis

You are now ready to physically install the Adapter into the computer chassis. (Make sure you are wearing a wrist band and grounding strap during the installation.) Review the general guidelines listed below and refer to your computer system hardware installation guide for detailed information.

1. Make sure power to your computer is turned off. Make sure power to all other components, including computer, monitor and peripherals is turned off also.

2. Remove the computer system's cover and determine which slot within the computer chassis can be used. Choose any free VME slot for the adapter. Again, refer to your computer system hardware installation guide for any specific requirements.

3. Depending on your system, you may need to prepare the slot for installation. This could involve removal of the IACKIN/INACKOUT jumper, as well as the four BGIN1-4/BGOUT1-4 jumper, for the slot you've chosen. If you remove any jumpers, place them in a storage position over one terminal if possible.

4. Hold the FST-2 Adapter by its corners, and avoid contacting any of the components on the surface of the Adapter. This will prevent the discharge of static electricity through components on the board, which could damage it.

5. Align the FST-2 Adapter with the board guides in the computer chassis for the slot you have chosen. Be sure you have the correct orientation of the J1 and J2 VME connectors.

6. Firmly press the Adapter into the connectors on the backplane. You should feel it give slightly as you press inward.

7. Fasten the small screws located at each end of the FST-2 Adapter to the computer chassis.

8. Replace your computer chassis cover.

Connecting the External Cables

Before starting with the power-up procedures be sure to connect the external cables. Use the cables supplied with your FST-2 Adapter. These cables have high density shielded connectors.

Note: A single-ended bus must not exceed an overall cable length of 19.8 feet (6.0 meters). A differential SCSI bus must not exceed a cable length of 82.5 feet (25 meters).

The FST-2 is installed and you are now ready to power on the Adapter. Continue on to section 2.3 - Powering Up the FST-2 Adapter.

2.3 Powering On the FST-2 Adapter

Power-Up Procedures

Before installing the FST-2 software, you must make sure the hardware is working and properly connected. The best way to test for initial problems is to turn on the power and observe the LEDs on the Adapter faceplate.

Each adapter, as well as the CPU, disk and tape drives, and other system devices go through a power-up self-test when your system is first turned on.

The FST-2 Adapter has four LEDs (Figure 2.3). Two LEDs identify the status of the two SCSI Processors, one LED indicates the status of the VME bus, and the other LED indicates if the self-tests failed.

Apply power to the computer and observe the Adapter LEDs. The amber FAIL LED should go on and remain on for approximately 40 seconds, indicating a self-test is in progress. Upon successful completion of the self-test, one or both of the SCSI LEDs should flash on briefly, indicating the presence of the corresponding daughterboard.
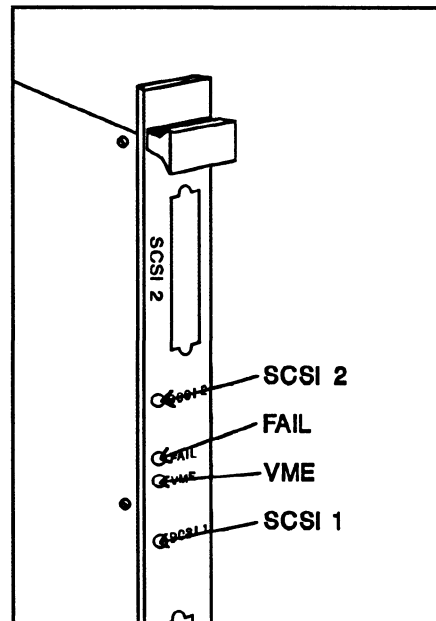
Figure 2.3 - FST-2 LEDs

All LEDs should then go off. If the self-test detects a failure in the Adapter hardware, the FAIL and SCSI LEDs will begin to flash. Observe the number of times the LEDs flash and then refer to Table 4 for a list of self-test error codes.

LED Status Indicators

LED	STATUS
SCSI 1 & 2	These LEDs turn ON to indicate that the respective SCSI port is busy.
VME	This LED turns ON to indicate data transfer activity by the Adapter over the VME bus.
FAIL	The amber FAIL LED will come on for approximately 40 seconds during self-test at power-up. If it flashes or does not go out, then double check to see that all the installation steps were completed properly. If you are still unable to determine the problem, contact your Field Service Representative.

If your system did not power-up correctly, refer to the Power-Up Checklist on page 21 to see if there were any steps or items that were omitted. If each step appears to have been completed correctly, and you are still having problems then call your FST-2 supplier.

Table 4 - Self-Test Error Codes

Error Code	Failure
1	RAM Test
2	Interrupt Test
3	VIC VME Controller Register Test
4	53C710 SCSI Controller Register Test
5	FIFO Test
6	53C710 Memory Move Test
7	FIFO-53C710 Data Transfer Test

The remaining errors apply to Extended Self-tests which require proper VME memory mapping to run. If they occur, Option Switch 2, position 3 is ON. Set position 3 to OFF to bypass the extended tests.

8	VME Master Single Cycle Test
9	VME Master Single Cycle Pattern Test
10	VME Block Move Test

Power-Up Checklist

☐ Make sure switches 1 & 2 are set correctly. Make sure that the Loop-On-Self-test and Extended Self-test switches are set to OFF.

☐ Check to see that the Adapter is firmly seated into the computer chassis.

☐ Check to see that each daughterboard is properly seated into the main Adapter.

☐ Check to see that the termination fuse on the daughterboard is good.

☐ Make sure the Adapter is positioned at the end of the SCSI bus.

☐ Check that SCSI terminators on all devices, except the last device on the FST-2 SCSI bus, are removed.

☐ Check that the appropriate jumpers in the VME slot are removed. (Refer to your system hardware documentation.)

☐ Check to see that all internal and external cables are properly connected.

If your system powered up correctly, then proceed to the Software reference guide for information on installing the FST-2 software.