SI500 SERIES CHASSIS
USER GUIDE

PB2900-9001-001

SYSTEM INDUSTRIES

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Milpitas, CA 95035, U.S.A.

WARNING

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1
INTRODUCTION

1.1 Manual Preface

SI500 Series Chassis User Guide explains how to install, operate, and maintain SI500 Series Chassis configurations. The manual contains the seven chapters listed in Table 1-1.

Table 1-1. SI500 Series Chassis User Guide Sections

SECTION	DESCRIPTION
Section 1: Introduction	Contains the manual preface, audience, related publications, conventions, terms list, and materials needed.
Section 2: SI500 Series Chassis	Describes the chassis components and their features, as well as the interface board, its requirements, and functions.
Section 3: Preinstallation Considerations	Discusses technical specifications, site concerns, and initial unpacking.
Section 4: Installation	Provides procedures for the installation of an SI 5.25-inch disk drive, interface board, power supply, and control panel into an SI500 Series Chassis.
Section 5: Operation	Explains the daily operation of the SI500 Series Chassis.
Section 6: Maintenance and Trouble-shooting	Provides system verification, basic maintenance, and troubleshooting procedures.
Section 7: Illustrated Parts Catalog	Contains a parts list table and illustration of components used in SI500 Series Chassis configurations.

1.2 Manual Audience

SI500 Series Chassis User Guide is intended for System Industries field engineers and self-maintenance customers. Familiarity with VMS, UNIX, RSX, or RSTS operating systems, along with understanding the fundamentals of DEC networks, computers, and disk drive operations, is required.

1.3 Related Publications

Additional information on the SI500 Series Chassis and its related configurations is provided in publications listed in Table 1-2.

Table 1-2. Related Publications

PUBLICATION NUMBER	TITLE
PB9700-9040	FCC DEC PRESITE GUIDE
PB6500-9001	THETA SERIES CABINET USER GUIDE
PB9904-9014	SIDOS USER GUIDE
PB9970-9001	QBUS CPA USER GUIDE
PB2920-9001	SI506 DISK DRIVE USER GUIDE
PB2940-9001	SI512 DISK DRIVE USER GUIDE

1.4 Manual Conventions

Refer to the following documentation conventions as a guide to using this manual.

- Typed computer entry is shown in **boldface.** Type all boldface characters exactly as they appear. For example:

  Type: **SHOW DEV**

- Screen messages are displayed in a different typestyle, as follows:

  Printer attached to terminal? (Y/N) [N]:

- Key names are bolded and shown in angle brackets. For example:

  <RETURN>
  <TAB>
  <CTRL> C

- Interactive sequences that include computer input and output are shown as follows:

  Printer attached to terminal? (Y/N) [N]: Y
  Initializing...

- Variable typed entries, or text you must replace, are shown in *italics*. In the following example

  Type: **COPY M*xxu*:*.*.*xxxxxx*::*/LOG <RETURN>**

  xx and ***xxxxxx*** are italicized and replaced with the actual device type and name.

- Three types of notes are used in this manual: a standard NOTE, a CAUTION note, and a WARNING note.

NOTE

The standard NOTE highlights important or additional information.

CAUTION

The CAUTION note is used for situations that are potentially dangerous or destructive to data.

WARNING

A WARNING note is required if system failure or bodily injury could be involved.

1.5 Terms List

The terms list provides definitions and usage information for System Industries and industry-standard terms and acronyms used in this manual.

ANSI	Acronym for the American National Standards Institute.
CFU	Cubic feet per minute.
CPA	Computer port adapter; the SI500 Interface Board.
CPU	Central processing unit
CRC	Cyclic redundancy check; verifies header fields.
DEC	Digital Equipment Corporation.
Density	Number of logical bits (0s and 1s) stored per unit length.
DMA	Direct memory access; method of data transfer that does not involve the CPU, thereby freeing the CPU for other tasks.

Direct Format	A disk drive format arrangement where one physical drive emulates one logical drive with a defined drive geometry that uses the large capacity of SI disk drives.
Dual Disk Format	A disk drive format where two physically daisychained disk drives emulate one logical drive with a defined geometry that uses the larger capacity of more than one SI disk drive.
ECC	Error correction code; means for repairing data fields.
EDC	Error Detection Code; a means for verifying integrity of data fields.
EMI	Electromagnetic Interference.
ESDI	Enhanced Small Device Interface, a device-level electrical connection and protocol specification defined by ENDL - Disk/Tape/Optical Revision F.1 January 31, 1989 by ENDL.
FCC	Federal Communications Commission; the organization responsible for regulating communications.
FIFO	First in, first out.
FRU	Field Replaceable Unit, the repair assembly level.
Gbyte	Gigabyte; a billion bytes of data (1,000 Mbytes).
I/O	Input/output; a data path.
LED	Light-emitting diode; an indicator light.
Mapped Format	A disk drive format arrangement where one physical drive emulates one or more logical drives of the same geometry as a DEC RM- or RP-type disk drive.
MByte	Megabyte; a million bytes of data.
MHz	Megahertz.
ms	milliseconds.
MSCP	Mass Storage Control Protocol.
MTBF	Mean time between failures; a measure of device reliability.
MTTR	Mean time to repair; a measure of responsiveness to failures.
NEMA	National Electronic Manufacturing Association; a professional standards organization.

NRZ	Nonreturn to zero.
PDU	Power distribution unit; a means of distributing AC power.
RFI	Radio Frequency Interference.
RTZ	Return to zero.
SCSI	Small Computer System Interface; standard interface for disk and tape drives.
SDI	Standard Drive Interface; referring to cables that support transfer of data and commands to and from a controller.
SI	System Industries.
SIDOS	System Industries Diagnostic Operating System; diagnostic program developed by System Industries for disk and tape subsystems.
SMD	Storage module drive.
VAX	Virtual Address eXtension; a DEC CPU.

1.6 Materials Needed

Installation procedures described in this manual require a standard tool box. Verification and repair procedures may require the use of System Industries diagnostic program SIDOS.

An RS232 terminal is required for some flaw management operations.

2
SI500 SERIES CHASSIS SUBSYSTEM

The SI500 chassis provides from 760 Mbytes up to 2.4 Gbytes of formatted disk storage for connection to DEC disk controllers (such as the HSC40, HSC50, and the HSC70), by using an embedded SDI to ESDI interface.

The chassis measures 5.25 inches x 19 inches and comes in a standard rack-mounted or tabletop assembly. Up to ten chassis are supported within the Theta 60 cabinet. Up to six chassis are supported within the Theta 42 cabinet. The SI500 Chassis does not require the Storage Director or DSI cards; this functionality is provided internally by the disk drive.

The chassis components include one to four 5.25-inch disk drives, one or two interface PC boards (an embedded controller), one power supply per two drives, a control panel for each logical drive, mounting plates, and cabling.

The exterior trim of the chassis consists of the existing Theta front cover. In tabletop configurations, the front panel is a conventional formed-metal panel.

FEATURES:

- Provides from ~580 Mbytes up to ~1.2 Gbytes of disk storage.
- Uses an embedded SDI to ESDI interface.
- Interfaces directly to DEC's HSC series and KDA/UDA controllers without a Storage Director or "D" box.
- Performs identically to other RA-compatible disk drives.
- An internal interface for formatting that prevents degradation of system-wide performance.
- Fully FCC compliant, requiring no transition panels (as a stand-alone unit).
- SI506 Disk Drive emulates a DEC RA70.
- SI512 Disk Drive emulates a DEC RA90.

2.1 Configurations

The SI500 Chassis configurations are listed below.

Mechanical Packages:

SI500 Tabletop Chassis
Standard 19-inch rack mount for 42-inch Cabinets
Standard 19-inch rack mount for 60-inch Cabinets

Disk Drives:

One to four 5.25-inch ESDI drives

Internal Interface:

One or two embedded SDI to ESDI interfaces

Host Systems:

VMS 4.4 - 4.7 and 5.0 - 5.2
Ultrix 32 3.0 - 3.1
UNIX BSD 4.3

Diagnostics:

SIDOS
Internal

Cabling:

Cable lengths up to 80 feet are supported.
Automatic and manual fail-over is supported.

2.2 SI500 Chassis Components

The SI500 Chassis has the following components:

- Chassis
- Tabletop Option
- Front and Chassis Panels
- Disk Drives
- Interface Board
- Power Supply
- One 4-inch DC fan
- One power module with EMI filter
- Cabling

Chassis Rack-Mountable Frame

The chassis frame uses 19-inch RETMA rails to rack mount in a 42-inch or 60-inch Theta Cabinet. The Chassis frame occupies 5.25 inches of vertical rack space and holds all the SI500 Chassis Subsystem hardware. A protective cover attaches over the chassis with seven screws.

Tabletop Option

The tabletop version for the SI500 Chassis contains the chassis hardware in a 5.25-inch high by 22-inch wide by 27.5-inch deep sleeve. The sleeve slides into the tabletop frame. No protective cover is used for the hardware in this configuration.

Disk Drives

The SI500 Chassis uses one to four industry standard 5.25-inch ESDI drives. These disk drives are high-capacity, high-performance random access storage devices using nonremovable disk platters as storage media. The configuration of two drives or four drives allows the chassis to support either one or two logical drives. For more information on the drives used in the SI500 Series Chassis, refer to the drive user guides listed in Table 1-2 "Related Publications."

Disk Drive Features

- 760 Mbytes to 2.4 Gbytes of formatted capacity
- 16 ms average access time
- Synchronization of spindle motors for parallel data transfer of multiple drives
- Rotary voice coil and closed loop servo system for fast access times, high reliability, and high-density functional packaging

2.3 SI500 Chassis Front and Control Panels

When installed in either a tabletop or cabinet, the SI500 Chassis front panel is a 19-inch wide, formed metal panel. This panel is held closed by a spring-loaded magnetic latch, or a 3M closure (Theta versions). To release it, lower the panel to access the chassis control panel.

The SI500 Chassis control panel contains five switches for run, fault reset, write-protect, SDI port A, and SDI port B; and three LEDs for unit number and error code, drive ready, port selected, write-protect, fault reset, and run. The control panel is shown in Figure 2-1.

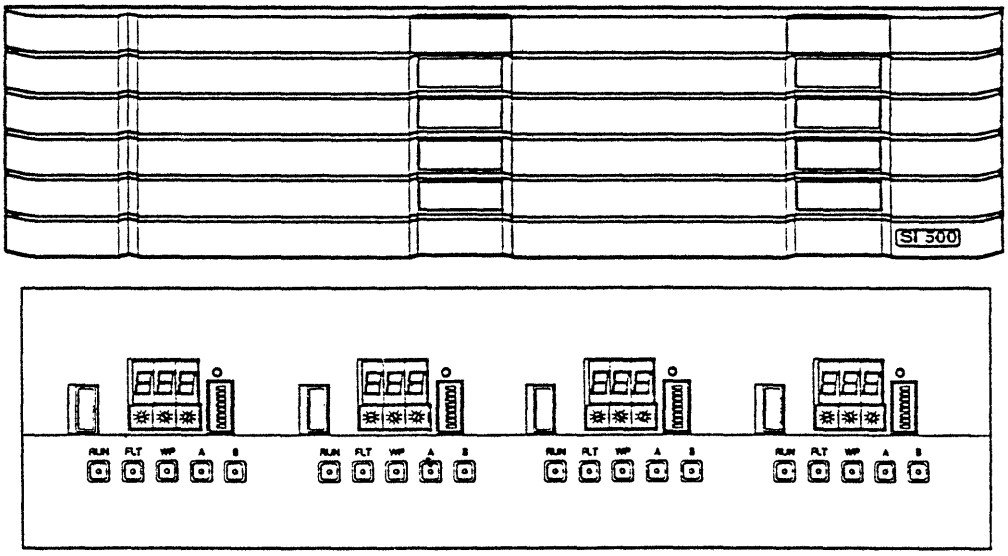

Figure 2-1. SI500 Series Chassis Panels

2.4 Chassis Interface Board

The Chassis Interface Board supports one or two ESDI drives as a single, logical SDI unit to the controller. This gives the SI500 Chassis the highest possible disk storage capacity on a single SDI connection (up to 1.2 Gbytes).

Through the interface board, ESDI protocols are converted to SDI protocols and vice versa. Data transfers (both read and write) pass through the board without degradation. The interface board is always mounted to the drive closest to the back of the chassis and measures 6 inches wide by 11 inches high by 0.6 inches deep.

Interface Board Jumpers and Connectors

The SI500 Interface Board has four jumpers and 13 connectors. Jumper and connector descriptions and locations are described below and shown in Figure 2-2.

There are four jumpers on the interface board, which are all installed at the factory.

W1 is a 3-pin jumper that enables the output of the oscillator. Default setting is IN.

W2 is a 3-pin jumper, with pin 1 being closest to a short edge of the board and pin 2 in the middle. W2 selects 6-MHz clock to the SDI control circuitry when a jumper plug connects pins 1 and 2. When pins 2 and 3 are connected, a 12-MHz clock is selected (default position).

W3 enables the Init Reset and Watchdog Timer Reset. The default setting is IN.

W4 is a reserved function. The default setting is IN.

Connector J1, J2, J3, and J4 (data connectors)

J1 - J4 are 20-pin connectors. The signals on each connector contain read or write data transfers between the drive and the interface board. The 20 pins are keyed to orient with odd numbered pins being closer to the key slot on the cable casing; pin 1 is marked with an arrow. The pin assignment is the same as defined in the ESDI standard. The ESDI drive attached to J1 must be set to unit number 4. With the multi-unit option, ESDI drives attached to J2 must be set to unit number 5.

Connectors J3 and J4 are not used.

NOTE

Drives normally are shipped from the manufacturer with the drive number set to 0. The drive number must be changed while the power is off.

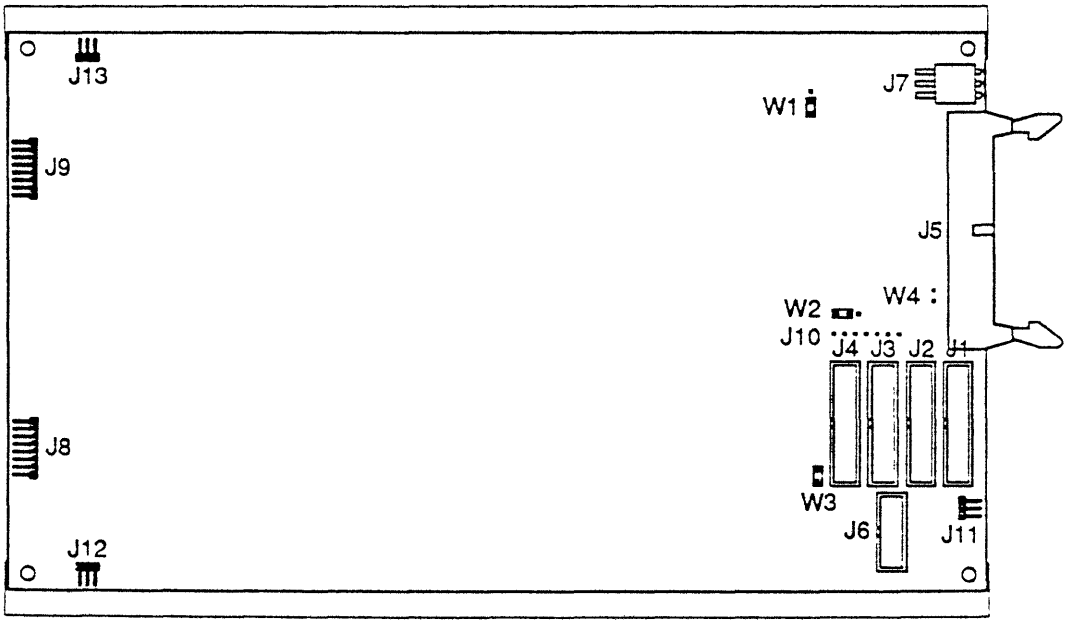

Figure 2-2. Interface Board Jumpers and Connectors

With the multi-unit option, all ESDI drives in the same logical unit must be the same type (i.e., same transfer rate, same number of read/write heads, and the same number of sectors configured per track).

The last unit on the control cable daisychain must be terminated, and the terminating resistors on the other drives must be removed.

Connector J5 (control connector)

J5 is a 34-pin connector. The signals on this connector control the drive and transfer drive status to the interface board. The 34 pins are keyed to orient with odd-numbered pins being closer to the key slot on the cable casing; pin 1 is marked with an arrow. The pin assignment is the same as defined in the ESDI standard.

Connector J6 (front panel connector)

J6 is a 10-pin connector. The signals on this connector control the display of unit number and status and the input from the operator switches. The 10 pins are keyed to orient with odd pin numbers being closer to the key slot of cable casing; pin 1 is marked with an arrow.

Connector J7 (DC connector)

J7 is a 3-pin connector. It carries +5 VDC and +12 VDC for the interface board. The three pins are oriented with pin 1 being closest to a long edge of the board and pin 2 in the middle. Pin 1 is 0 V, pin 2 is +5 VDC, and pin 3 is unused.

Connector J8 and J9 (SDI connectors)

J8 and J9 are 8-pin connectors. The signals on these connectors contain control, command, and data transfers between the interface board and host DSA controllers. J8 is designated as channel A of the dual SDI ports. J9 is designated as channel B of the dual SDI ports. The eight pins are keyed to orient with even-numbered pins closer to the board and pin 2 closest to the long edge.

The pin assignments and function are defined by SDI.

Connector J10 (UART connector)

J10 is a 7-pin connector. The signals on this connector contain two RS232 UART ports. The seven pins are numbered from 1 to 7, with pin 1 being closest to a short edge of the board.

Connectors J11, J12, and J13

J11 is a reserved function.

J12 connects the interface board to a telephone jack on the back inside chassis panel.

J13 connects the interface board to a second telephone jack on the back inside chassis panel.

2.5 Power Supply

The power supply is a switching input, rated at 150 W. Mounted horizontally on an adapter plate, the power supply mounts with four screws to the chassis bottom.

Power Supply Jumpers and Connectors

The power supply has one jumper, two connectors, and a fuse. Jumper J3 is used for power conversion, with the default setting at 110 V. Connectors J1 and J2 are used for cabling the power supply to the drives. The power supply jumper and connector locations are shown in Figure 2-3.

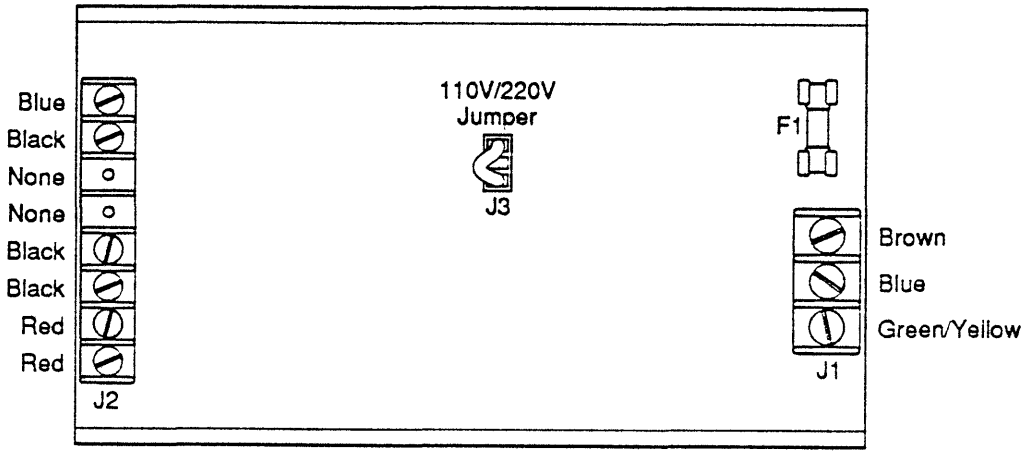

Figure 2-3. Power Supply Jumper and Connector Locations

Connectors used for the J1 connector have three cables that connect the power supply to the chassis. The brown and blue cables attach to the chassis back panel. The green/yellow cable is the grounding cable and attaches to the chassis bottom.

J2 connector is used to cable the daisychained drives to the power supply. One blue, two blacks, and a red cable attach to the power connector on each drive rear panel. With more than one drive, these cables are numerous but follow the same routine. The green/yellow cable is a grounding cable and attaches to the chassis bottom.

2.6 Cooling Fan

The cooling fan draws air from the front of the chassis, past the drives, and out the back panel. The fan is 100 CFM and 12 VDC. Power is provided to the fan by the power supply.

The fan is mounted to an adapter plate with four screws. The adapter plate is mounted to the back panel of the chassis with four screws.

2.7 SI500 Series Chassis Rear Panel

There are two ports on the back of the SI500 chassis; four Port As and four Port Bs. These are the SDI ports.

There are two modular telephone jacks (one left, one right) for terminal support for SI506/SI512 diagnostic and flaw management support.

The rear panel of the chassis also provides a 3-pin AC power input connector and an ON/OFF power switch for the chassis. The chassis rear panel is shown in Figure 2-4.

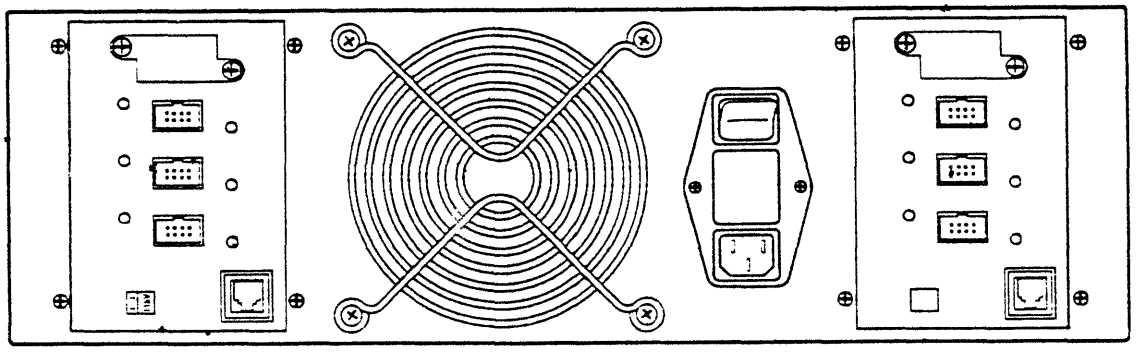

Figure 2-4. SI500 Series Chassis Rear Panel

2.8 Chassis Cabling

The cabling for the SI500 Chassis includes the internal chassis cabling and the external chassis cabling. The total maximum cable length for the SI500 Chassis is 18 feet (6 meters).

Internal Cabling

Each drive in the SI500 Chassis uses a 16-pin control cable and a 10-pin data cable. The data cables are connected in a radial fashion to connector J1 and J2 on the interface board. The control cable is daisychained between each drive, with the last drive terminated. Each cable on the drives is routed under the drive mounting plate.

The interface board attaches to port A and port B on the rear of the chassis.

External Cabling

The external cabling consists of an AC line cable, two SDI cables (per logical unit), and one RS232 cable (per logical unit).

If the SI500 Chassis is installed in a traditional cabinet, and a transition panel is installed, the SI500 Chassis requires two additional SDI cables and a transition panel box.

Drive Termination

When more than one drive is installed to the interface board, the last drive must be terminated. The drive's printed circuit board should have the termination resistor pack installed. The resistors should be removed on all other drives.

2.9 Front Panel Control Board

The control board on the SI500 Chassis front panel is connected to the interface board by a 10-pin cable (J1). Each logical drive has a front panel control board on the same side of the chassis as the drive. The control board has five switches with embedded LEDs for run, fault reset, write protect, port A, and port B; a three-panel LED for drive unit number and diagnostic display; and a drive-ready LED indicator

The control board also contains an RS232 port (J3) and an eight-switch block located next to the three-panel LED.

Control Board Connectors, Switches, and Jumper Settings

Jumper and connector descriptions and locations are described below and illustrated in Figure 2-5.

J1 Connector

J1 is a 10-pin connector. The signals on this connector control the display of the unit number and the drive status. The signals carry 5 VDC to the control board. They also carry operator commands from the switches to the interface board in order to change the drive unit number or run the diagnostic/formatter. The 10-pin connector

is keyed with the odd pin number being closer to the key slot of cable casing and pin 1 being closer to the run/stop switch (S4).

J3 Connector

J3 is a 3-pin connector. This is an RS232 terminal port, channel A, of the UART on the interface board. When a terminal is attached via this port, diagnostics and the formatter can be activated and status displayed with the terminal keyboard and console.

The three pins are numbered from 1 to 3, with pin 1 being closest to a edge of the board. This connector can be reversed for null modem terminal cables.

LED2 (Drive Ready Display)

When lit, this LED indicates the drive is spun up and ready. In order to configure the drive, it is spun up when power is first applied. The Run switch (S4) subsequently determines whether the drive can be spun up by the DSA controller via an SDI command.

U7, U8, and U9 (Unit Number/Diagnostic Display)

The three 7-segment LEDs are used for drive unit number/diagnostic display, with U7 being the most significant digit and U9 being the least significant digit.

The displays normally reflect the drive unit number in decimal as set in switches S1, S2, and S3 by the operator. The drive unit number is following the change of the number set in S1, S2, and S3 if it is less than 250 and the unit is not on-line to the DSA controller.

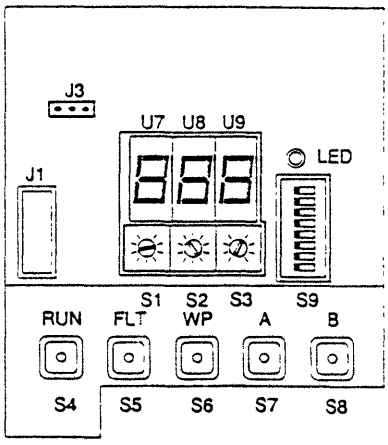

Figure 2-5. Control Board Connectors, Switches, and Jumpers

When error status is inquired from S1, S2, and S3, error codes that are accumulated in the error FIFO are displayed on U7, U8, and U9 in hexadecimal. Error code messages are described in "Maintenance and Troubleshooting."

When the diagnostics/formatter option is activated either from S1, S2, and S3 or from a terminal connected to J3, the cylinder number that is being formatted or diagnostic status is displayed on U7, U8, and U9 in hexadecimal. To activate the diagnostics/formatter, refer to "Maintenance and Troubleshooting."

S1, S2, and S3 (Unit Number/Diagnostic Switch)

The three 10-position rotatory switches set the drive unit number, start error status inquiry, or run diagnostics/formatter. S1 is the most significant digit, and S3 is the least significant digit. The switch setting is always in decimal.

If the number entered on S1, S2, and S3 is less than 250 and the unit is not on-line to the SDI controller, the interface board takes the number as a new unit number, reports it to the SDI controller, and displays it on U7, U8, and U9.

If the number entered on S1, S2, and S3 is 910, 911, or 876, with some special key combinations, diagnostic or formatter operations are entered. Special consideration is built in to prevent the operator from accidentally entering destructive operations (such as formatting a disk), but sufficient convenience is provided to do quick disk formatting or diagnostics without using keyboard terminal or computer systems.

S4 (Run/Stop Switch)

S4 is a latching switch. When pushed once, it latches in lock position (Run/Spin up). When pushed again, it releases in open position (Stop/Spin down). This switch controls the spin-up and spin-down operation by the operator. The switch has to be in Run position for controller to issue a Run command to spin up the drive.

After the switch is pushed in Run position and the drive is spun up, the LED on the switch is lit.

The LED on the switch is also on momentarily if the switch is in the lock position when power is applied. This is to verify that the switch and LED are functioning properly by the interface board.

S5 (Fault Reset Switch)

S5 is a momentary switch. It allows the operator to reset a fault condition detected by the interface board. When lit, the LED on the switch indicates some fault is detected by the interface board. If port switches A or B (S7 and S8) are pushed in and there is a controller connected to Port A or Port B, the controller is informed of the

fault condition and issues a command to clear the fault. However, this switch allows the operator to do the same manually.

If S9-8 on Option Switch Pack (S9) is on, S5 becomes a hard reset switch. The interface board goes through the start-up initialization sequences when S5 is pushed.

CAUTION

This is a factory test option and should not be set in normal operation.

S6 (Write-protect Switch)

S6 is a latching switch. When pushed in, the disk can only be used for read operations. When lit, the LED on the switch indicates the write-protect status is recognized by the interface board and write operations are inhibited. When the switch is pushed again and after the LED on the switch goes off, write-protect status is removed, and writes to the disk are allowed.

S7 (Port A Enable Switch)

S7 is a latching switch. When pushed in, it allows port A to receive commands from the controller connected on port A of the interface board. When S7 is released and drive is off-line to Port A, no communication takes place between the interface board and the controller connected on the port A of the interface board.

When lit, the LED on the switch indicates that communication is established between the controller and the interface board and the drive is on-line to the controller. During the time when the interface board is on-line to port A, it does not accept commands from port B, except when a command is received from port A to determine the access path.

S8 (Port B Enable Switch)

S8 is a latching switch. When pushed in, it allows port B to receive commands from the controller connected on the port B of the interface board. When S8 is released and drive is off-line to Port B, no communication takes place between the interface board and the controller connected on port B of the interface board.

When lit, the LED on the switch indicates that communication is established between the controller and the interface board and the drive is on-line to the controller. While the interface board is on-line to port B, it does not accept commands from port A, except when a command is received from port B to determine the access path.

If both port A and port B are pushed in, communications are established on either port. If the controller, which has the drive on-line, ceases to function and the access path has already been determined by the system, the drive automatically fails-over to the other port.

S9 (Option Select 8 Pole Switch Pack)

S9 is a 8-pole switch pack. All the switches are reserved. The only available switch is switch 8. When switch 8 is on, Fault Reset Switch (S5) becomes a hard reset switch. The interface board goes through the start-up initialization sequences when S5 is pushed.

CAUTION

During normal operation, all switches on S9 should be off.

3
PREINSTALLATION CONSIDERATIONS

Prior to unpacking the equipment or beginning the installation procedure, review the specifications and verify the site considerations and power requirements discussed in this section. Cautions and considerations during unpacking are also discussed.

3.1 Environmental and Physical Specifications

The following considerations must be met to maximize equipment life and reliability.

Space

Space allocation includes actual physical space required by the unit and additional requirements for service clearance, as well as installation access.

Minimum service clearance is 3 feet in front and behind the cabinet. Connecting cables need ample slack to allow repositioning of components during service.

Temperature

Ideal computer room temperature is 68 to 70° F (20° C), with a range of 65 to 75° F considered acceptable. When adding a disk storage subsystem to an existing installation, determine the additional load on air conditioning.

Humidity

Humidity should be maintained in the range of 35 to 60% relative. Controlling humidity avoids the problems of static electricity or condensation.

Fire and Safety

Fire extinguishing systems should be in place. Confirm with the system manager that adequate fire precautions have been met.

Electrostatic Discharge

Static electricity is potentially dangerous to certain equipment. Static can be minimized with the use of special antistatic rugs or mats, chairs, and wrist-straps; maintaining humidity at 40 to 60%; and careful bonding of equipment frames.

The physical specifications for the SI500 Series Chassis are listed in Table 3-1.

Table 3-1. SI500 Series Chassis Physical Specifications

PHYSICAL SPECIFICATIONS		
Ambient Temperature		
Operating:	50-122° F(10-50° C), 18° F/Hour Change	
Nonoperating:	-40-140° F(-40-60° C), 18° F/Hour Change	
Relative Humidity (noncondensing)		
Operating:	8% to 80%	
Nonoperating:	5% to 100%	
Elevation		
Operating:	-1,000 to 10,000 Feet (-30 to 3,048 meters)	
Nonoperating:	-1,000 to 30,000 Feet (-30 to 9,144 meters)	
Shock		
Operating (all axes):	5 G for 11 ms, Half Sine Wave	
Nonoperating (all axes):	25 G for 20 ms, Half Sine Wave	
Vibration		
Operating (all axes):	0.55 G at 5-150 Hz, Sinusoidal 0.025 G at 200-500 Hz, Sinusoidal	
Nonoperating (all axes):	0.5 G at 2-200 Hz, Sinusoidal	
Power	**+5 VDC**	**+12 VDC**
One Interface PCB (two):	3.5 A (7.0 A)	
One Control PCB (two):	0.5 A (1.0 A)	
Two Disk Drives:	2.4 A	4 0 A (avg) 9 0 A (peak)
Capacity	**SI512**	**SI506**
Unformatted:	1.520 Gbytes	778 Mbytes
Formatted (MSCP):	1.170 Gbytes	585 Mbytes
Data Transfer Rate	≥ 15 MHz	
Drive Unit Number Range	001 to 255 decimal	
Data Reliability	Write — $\leq 1.0 \times 10^{7}$ bits Read — $\leq 1.0 \times 10^{10}$ bits (soft error) Read — $\leq 1.0 \times 10^{13}$ bits (hard error)	
Drive Specifications		
Average Seek:	≤16 ms	
Rotational Speed:	3600 RPM	
Average Latency:	≤8.3 ms	
Heat Dissipation	16 Watts	
MTBF	37,000 Power On Hours	
MTTR	30 minutes	

3.2 Power Requirements

DC Power

The SI500 Series Chassis requires DC power to operate.

AC Neutral

Be careful not to confuse AC neutral with protective or frame ground. Frame ground prevents the build-up of dangerous voltages on equipment and protects personnel. It ensures that any short circuit between a power phase and the cabinet draws enough current to trip the circuit's protective device immediately, rather than raising the potential of the equipment to a dangerous level. Additionally, it prevents spurious noise from entering the line. Never connect AC neutral to the frame of any equipment or the protective ground (except at the building's main electrical service entrance).

Neutral and safety ground are often connected together by the NEMA receptacles or at the circuit breaker neutral bus bar. Try to isolate neutral from safety ground in the circuit breaker box, and ensure that conduit pipes are also isolated from other possible ground connections. Ideally, the equipment frame ground is isolated from neutral and other ground sources all the way back to the building main grounding rod.

AC Earth Ground

Be sure to maintain an adequate earth ground. If there is any question, perform an impedance test to ensure ground potential is less than 10 ohms. Refer to a grounding reference for measurement and grounding methods.

Typically, an earth ground suitable for computer equipment and peripherals consists of a 0.625-inch diameter copper rod driven into the earth to a depth of at least 12 feet. Since soil is quite variable in conductivity, chemicals such as salt or magnesium sulfate are added to the soil surrounding the rod to a depth of 2 feet. Periodic watering and chemical replenishment ensure an ongoing proper ground.

3.3 Unpacking

Inspect doorways, passageways, and elevators to verify that the shipping containers can be safely moved from the receiving dock to the computer room. Cut the metal straps and remove the shipping cartons. Unpack and inventory the contents against the shipping order.

Keep the shipping containers and packing materials. To avoid questions of liability, if a container arrives damaged, do not open it except in the presence of the shipping agent or representative. Do not sign for a container that has severe damage.

After opening a container, inspect the drive for damage. If anything is damaged or missing, contact System Industries immediately. Return drives to System Industries in their SI shipping containers only. The original containers provide maximum protection during transport.

Allow the equipment to normalize to the computer room temperature before applying power.

3.4 Site Preparation

Use the checklist on the following page to confirm the site specifications and requirements discussed earlier in this section. The checklist pulls out for convenience.

SITE PREPARATION CHECKLIST

SITE NAME
PREPARER'S NAME
DATE

CHECK (✓) EACH ITEM WHEN COMPLETED.

GENERAL REQUIREMENTS

- ☐ Notified facilities.
- ☐ Notified system manager.
- ☐ Provided access to equipment.
- ☐ Provided access to telephone.

SITE PREPARATION

- ☐ No obstacles to impede equipment delivery.
- ☐ Sufficient space for equipment and working area.
- ☐ Environmental requirements.
- ☐ Fire and safety precautions.
- ☐ Voltage and frequency requirements.
- ☐ Power routing and cable lengths.
- ☐ Static control.

Notes: _____

_____

_____

4
INSTALLATION

Procedures for the installation of the SI500 Series Chassis Subsystem in a standard SI cabinet, installing additional disk drives, interface board, control panel, and an additional power supply are provided in this section.

For removing and/or replacing subsystem components during service, refer to "Maintenance and Troubleshooting."

4.1 General Precautions

Follow the precautions listed below to prevent injury to yourself or the equipment:

- Power down the drive before performing any work on it.

WARNING

Never remove or install any printed circuit board or disconnect any connector, plug, or wire while power is on it; doing so could induce failures.

- When removing connectors, do not pull on the cable; hold the connector firmly by its sides and pull out.
- Do not remove any parts not specified in the replacement procedure.
- When working near printed circuit boards, ground yourself with an anti-static strap.
- Package printed circuit boards in electrostatic-free envelopes.
- Read through the entire procedure before starting.

Stabilizing Cabinet

Before starting any installation procedure that requires extending a chassis from a System Industries cabinet, stabilize the cabinet using either the stabilizer feet (60- or 42-inch cabinets) or the stabilizer bar (Theta cabinets). Refer to the cabinet manual for instructions.

Inspection

Before starting installation or operation, make sure of the following:

- Inspect the equipment, verifying that it is complete and undamaged.
- Verify that all cabinet internal cabling is seated.

Preliminary Power-on Checks

Before starting installation or operation, make sure the following is done:

- With the circuit breakers off at the main power supply, connect the power cord from the chassis or cabinet to the source.
- Power-on the chassis and verify that it attains ready status.
- Power-off the equipment and proceed with the installation.

4.2 Fixed Chassis Installation

The chassis mounts into a Theta 42-inch or 60-inch cabinet with a two-piece slide rail and a rear flange, shown in Figure 4-1. These components and their mounting hardware are shipped with the chassis. A fourth component, the chassis slide mount, is installed on each side of the chassis at the factory before shipment.

When installed in a cabinet, the chassis has a hinged front panel that is secured to the front of the cabinet. The front panel varies depending on the cabinet used, but the installation is the same.

Procedure

The following procedure explains how to install and secure the slide rail in the cabinet, mount the chassis, and then secure the chassis front panel. Refer to Figures 4-1 and 4-2 when doing the procedure.

1. Secure the top cover of the chassis with the four screws provided.

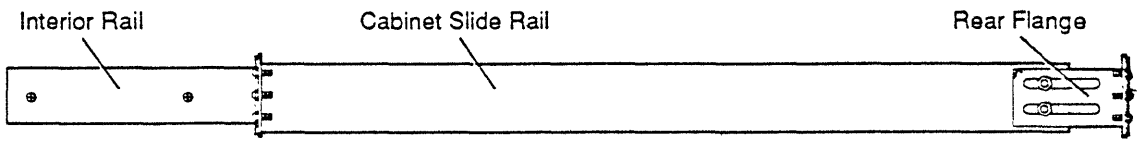

Figure 4-1. Fixed Chassis Mounting Hardware

2. Secure the front of each cabinet slide rail on the chassis to the cabinet's front vertical rails with the nut bar and two 10-32 screws provided. Make sure the nut bar is positioned to attach the fasteners on the ears.
3. A flange is already attached to the rear of each slide rail on the chassis. Facing the rear of the cabinet, secure the extruded portion of the flange to the cabinet's interior vertical rail with two 10-32 screws.
4. Facing the front of the cabinet, slide the interior rails into the cabinet slide rails just mounted. Stop when they lock into position. (The rails extend about half way out of the cabinet.)
5. Lift the chassis and fit the extruded interior rails into the slide mounts bolted to the exterior of the chassis, and slide the chassis back in until it locks. The releases on each side of the bolted chassis slide mounts fit into holes in the extruded interior rails.
6. The chassis's front panel has a mounting bracket on each side. Secure the front portion of each bracket to the cabinet's vertical rail with the nut bar and two captive fasteners provided, as shown in Figure 4-2.

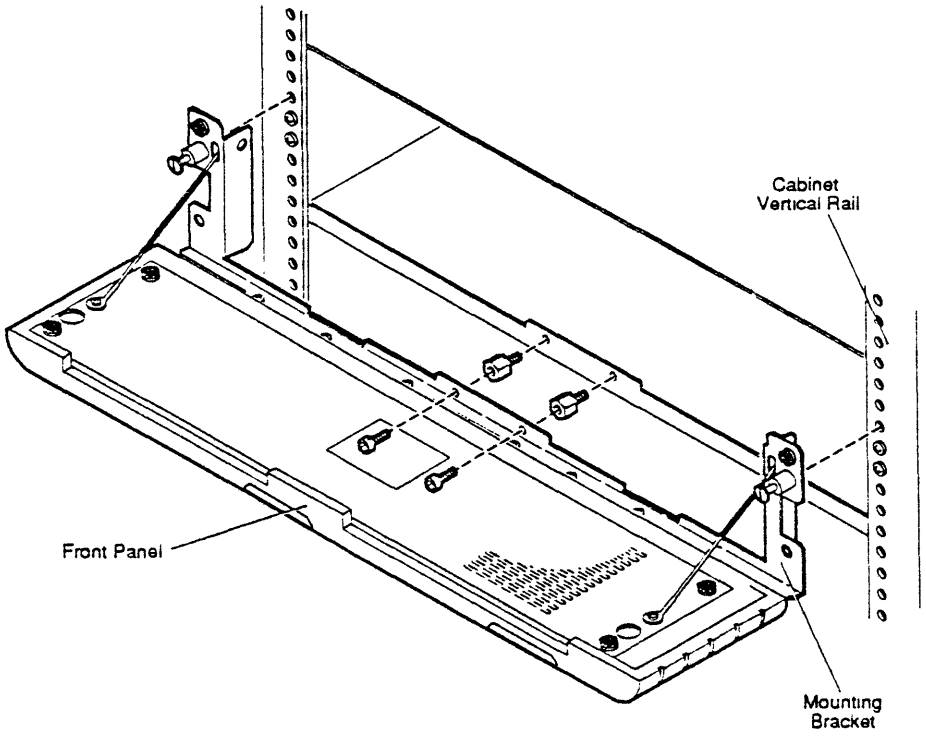

Figure 4-2. Fixed Chassis Front Panel Mounting

Tabletop Installation

The tabletop version for the SI500 Chassis contains the chassis hardware in a 5.25-inch high by 21-inch wide by 28-inch deep sleeve. The sleeve slides into the tabletop frame. No protective cover is used for the chassis hardware in this configuration.

The sleeve is attached to the tabletop frame with six screws. Three screws are attached to each side of the frame.

4.3 SI500 Chassis Component Installation

To replace SI500 Chassis components to an already installed chassis, refer to "Maintenance and Troubleshooting." To install new SI500 components, follow the steps below.

Since no service loop is available with this chassis, all external cabling must be removed before installing new components to the chassis.

SI500 Chassis Switch and Jumper Setting Configurations

The switch and jumper settings for both the interface board and the control board are described in "SI500 Chassis Components." Refer to this section when installing SI500 Chassis components.

For adding a second SI512 set of drives, the third and fourth drives must have a unit ID of 4 and 5. Set jumper CNH6 on the third drive to ON for pins 7-8. For the fourth drive, set jumper CNH6 to ON for pins 9-10.

Control Panel Installation

Before installing any other components in the SI500 Chassis, the control panel and its cable need to be installed. This allows the cabling to be inserted underneath the drives mounting plate before connecting to the interface board.

Procedures:

1. Extend the chassis out from the cabinet by first pushing it partly out from the rear or grasping it underneath in front, and then gently pulling it out from the front until it locks into position.
2. Remove the chassis top cover, and place on a flat, stable surface. Save the screws removed.
3. Remove front panel of chassis.
4. Attach control panel by snapping it into place.
5. Attach 10-pin connector (J1) on control board and feed through top slot on back of chassis front panel.

Disk Drive Installation

To replace a disk drive to an already installed chassis, refer to "Maintenance and Troubleshooting." To install a new disk drive, follow the steps below. Disk drive installation is shown in Figure 4-3.

Procedures:

1. Make sure the termination connector is attached to the last drive in the daisychain.
2. Secure the first drive to a mounting plate with screws.
3. Secure the second drive to a mounting plate with screws.
4. Attach control, data, and control panel cables to the bottom of the chassis under both drive mounting plates.
5. Connect one end of the data cable to connector J1 on both drives.
6. Connect one end of the power cable to the drive.
7. Connect one end of the control cable to connector J5 on the first drive. Connect one end to connector J5 on the second drive.
8. Attach both drives and mounting plates to chassis bottom with screws.

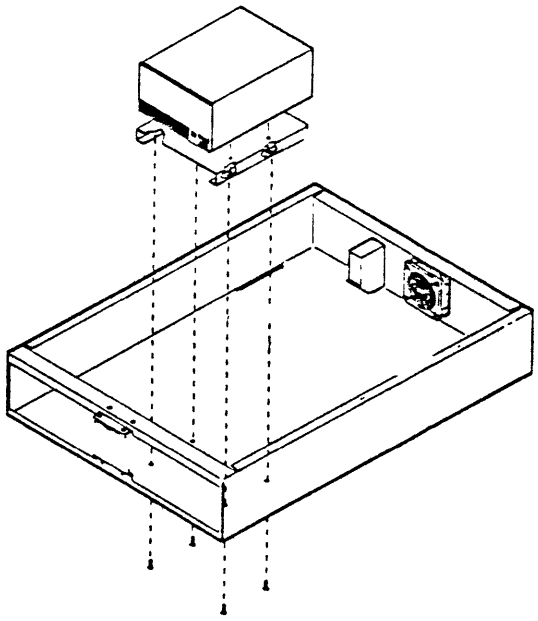

Figure 4-3. Disk Drive Installation

Interface Board Installation

After installing the drives to the chassis, the interface board is mounted to the drive closest to the back of the chassis. Installation for the interface board is shown in Figure 4-4.

Procedures:

1. Attach interface board to first drive (back of chassis) with four screws.
2. Connect data cable from connector J1 of first drive to connector J1 on interface board.
3. Connect data cable from connector J1 on second drive (front of chassis) to connector J2 on interface board.
4. Connect the third end of the control cable to J5 on the interface board. This cable daisychains the two drives together.
5. Attach 10-pin connector from J6 on interface board to control panel on front of chassis.
6. Attach 3-prong connector from power supply to connector J7 on interface board.
7. Attach 3-prong connector from telephone jack on back of chassis to connector J12.

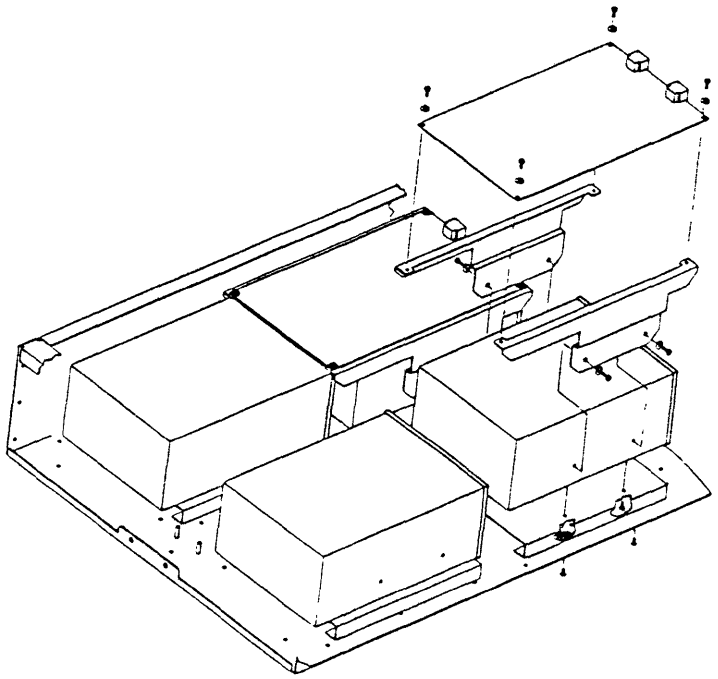

Figure 4-4. Interface Board Installation

Power Supply Installation

After installing the drives and the interface board to the chassis, the second power supply is mounted to the chassis.

Procedures:

1. Attach power supply to mounting plate with four screws.
2. Cable power supply according to procedures in "SI500 Chassis Subsystem."
3. Attach power supply cover to mounting plate with four screws.
4. Attach mounting plate to chassis bottom with four screws.
5. Attach power cable connectors to first and second drive.

Installation of Covers, Cable, and Power-up

After installing the chassis components, complete the following procedures to reattach previously removed parts.

Procedures:

1. Reattach the chassis cover with the screws previously removed.
2. Reattach cables from host system to chassis rear panel.
3. Gently push the chassis back into the cabinet until it aligns with front of cabinet.
4. Power-up the chassis. Refer to "Operation" for these procedures.

4.4 Error Status Inquiry

Upon power-on and during operation, the interface board constantly monitors the ESDI drive status, SDI controller interface, and the transfers in-between. Errors detected are reported back to the controller and logged in the host computer error log. At the same time, the error code is also pushed onto a 20-byte error FIFO. Thus the last 20 errors are saved and can be displayed on U7, U8, and U9.

If S1, S2, and S3 are set to 910 and the drive is not on-line, then the last error logged is displayed on U7, U8, and U9.

CAUTION

Be sure to return switch setting to orginal unit number afterwards.

If S1, S2, and S3 are set to 911 and drive is not on-line, then up to the last 20 errors logged are displayed on U7, U8, and U9 with non-zero error codes flashed at a 1 second interval until the last error code is displayed. For more information on diagnostics and error codes, refer to "Maintenance and Troubleshooting."

Activating Diagnostics/Formatter from Switches

If S1, S2, and S3 are set to 876, the drive is not on-line, neither port A switch (S7) or port B switch (S8) is pushed in and write-protect switch (S6) is pushed in, then "diA" and "For" are alternately flashed on U7, U8, and U9 for 30 seconds. If the operator releases the write-protect switch (S6) while LED is flashing, then diagnostics and formatter are entered.

The operator has 30 seconds to release the write-protect switch (S6), and to enter the diagnostics and formatter tests. However, if the operator does not wish to enter the diagnostics and formatter test, then simply wait until "diA" and "For" no longer are flashing. The operator must then change back the unit number or release the write-protect switch (S6).

Procedures:

1. Make sure drive is not on-line to the controller (i.e. port A and port B connectors are off), and the drive is spun up and ready (i.e. RUN switch in and RDY LED lit).
2. Release port A (S7) and port B (S8) switches.
3. Push in write protect switch (S6).
4. Set S1, S2, and S3 to 876. Select the number 8 LAST.
5. Notice that "diA" and "For" are alternately flashing on U7, U8, and U9.
6. To terminate diagnostics/formatter mode at this point, wait until U7, U8, and U9 no longer flashing (about 30 seconds), then go to the last step.
7. While U7, U8, and U9 are flashing, release write-protect switch (S6).
8. Notice that the LED on S6 goes off, and the diagnostic menu appears on the terminal screen within 2 seconds.
9. Run the diagnostics/formatter of your choice to finish.
10. Set S1, S2, and S3 to the proper unit number, S7 and S8 to proper port connection, and S6 to enable or disable write-protect. This allows the unit to become available again to the controller.

NOTE

The write-protect switch must be pushed in **BEFORE** the unit number switches are set to 876.

5
OPERATION

This section describes the SI500 Chassis operations after installation. For error codes and troubleshooting during operation, refer to "Maintenance and Troubleshooting." The procedures for operation are divided into three sections:

- Set the front panel for diagnostic mode
- Initiate the formatter
- Exit the diagnostic mode

5.1 Diagnostic Mode

After the drive is cabled up correctly, make sure that all the switches on the front panel are out (LEDs are off). The procedures below initiate the diagnostic mode to the chassis.

Procedures:

1. With the power off, push in the RUN switch.
2. Power-up the unit and wait until the drive has come ready, indicated by the READY LED next to the right-hand, seven-segment display.
3. Push in the WRITE PROTECT switch, and ONLY THEN dial in "876" on the thumbwheel switches.
4. "DIA" and then "FOR" flashes until the WRITE PROTECT switch is released.
5. About 2 seconds later, the diagnostic menu appears.

NOTE

If you power-up the unit with 876 already dialed into the thumbwheel switches and write protect already ON, DIA/FOR does not flash, and the fault light is lit. The fault light is lit because a unit number greater than 251 was set at power-up. Should this happen, dial from 876 to 875 and then back to 876. "DIA/FOR" should then be displayed on the front panel board.

5.2 Formatter

When the diagnostic menu appears, choose either the FULL (F) format or the QUICK (Q) format. SI suggests FULL format unless time is critical. The FULL format both formats and verifies, while the QUICK format only formats and does not verify the surface.

Both formats use the manufacturers defect list, but the FULL format also checks for defects that do not show up on the defect list. The procedures below initiate the formatter to the chassis.

Procedures:

When either F or Q is selected, the user must reconfirm that formatting is to take place. When the confirmation is keyed in, formatting takes place and decrements down from the highest cylinder to cylinder 0.

When the formatter is finished (the front panel displays 000), there may be a delay of up to 2 minutes as the bad blocks are being computed. Then the display flashes the blocks as they are revectored, beginning at the highest revector and decrementing to the lowest revector.

Upon completion, the front panel displays the success code of the formatting operation. A success code of "AA" is normal completion, while any other code is an error condition. Exit the formatter back to the diagnostic menu.

5.3 Exit Diagnostics

Press the "ESC" key to exit the diagnostics back to emulation. The drive is ready to use.

6
MAINTENANCE AND TROUBLESHOOTING

This section provides system verification, maintenance, troubleshooting, and removal and replacement procedures for field replaceable units (FRUs) in the SI500 Series Chassis. These units, along with their part numbers, are listed in the "Illustrated Parts Catalog."

6.1 Preventive and Routine Maintenance

The chassis is designed for long-term, error-free operation and allows for user-initiated maintenance. Comprehensive self-diagnostics are an integral part of the chassis and are easily invoked by the user.

Maintenance on the chassis consists primarily of isolating troubles and replacing FRUs. Most troubleshooting is accomplished by use of the front panel.

6.2 Troubleshooting and Diagnostics

Diagnostics indicate the state of the system and identify any malfunctioning areas. The following diagnostic functions are supported:

Set ESDI Drive Number
Incremental Seek Test
Butterfly Seek Test
Random Seek Test
Initiate ESDI Drive Diagnostics
Deselect ESDI Drive
Front Panel Test
Add Bad Block
Continuous Seek Test
Full/Quick Format
Read Disk Diagnostic Region
Write-Verify Disk Diagnostic Region
Factory Tests

Diagnostics Main Menu

When the diagnostics are activated using the CRT terminal, the main diagnostics menu appears on the screen. Selecting an individual test or format procedure is done by entering the individual test code on the keyboard. After selecting an individual diagnostic, the operator is given a submenu to prompt test entries.

When any diagnostic is finished, the main menu reappears, and any further diagnostic can be selected.

```
 -- 0 --   SET ESDI DRIVE NUMBER
 -- 1 --   INCREMENTAL SEEK TEST
 -- 2 --   BUTTERFLY SEEK TEST
 -- 3 --   RANDOM SEEK TEST
 -- 4 --   INITIATE ESDI DRIVE DIAGNOSTICS
 -- 5 --   DESELECT ESDI DRIVE
 -- 9 --   FRONT PANEL TEST
 -- B --   ADD BAD BLOCK TO DEFECT LIST
 -- C --   CONTINUOUS SEEK TEST
 -- F --   FULL FORMAT
 -- Q --   QUICK FORMAT
 -- R --   READ DISK DIAG REGION
 -- W --   WRITE VERIFY DISK DIAG REGION
 -- Z --   FACTORY TESTS
--ESC--   EXIT TESTS

ENTER DRIVE OPTION : 0
```

Set ESDI Drive Number - Option 0

To set the ESDI drive number and receive all the ESDI parameters, select option 0 from the diagnostics menu. All ESDI drive tests first read the general configuration of the drive and drive parameters and then output them to the screen.

Incremental Seek Test - Option 1

The Incremental Seek Test reads the number of cylinders from the ESDI drive and incremental seek up from cylinder 0 to the maximum cylinder, and then seek down from the maximum cylinder to cylinder 0. On completion, the number of seek errors is reported.

Butterfly Seek Test - Option 2

The Butterfly Seek Test reads the number of cylinders from the ESDI drive, and seeks from cylinder 0 to the maximum cylinder; it then seeks from cylinder 1 to the maximum cylinder -1. At each iteration, the drive increments the lower cylinder up and decrements the upper cylinder down. On completion, the number of seek errors is reported.

Random Seek Test - Option 3

The Random Seek Test reads the number of cylinders from the ESDI drive, and randomly seeks anywhere up to the maximum cylinder, for a maximum of 4000 seeks. Upon completion, the number of seek errors is reported.

Initiate ESDI Drive Diagnostics - Option 4

The Initiate ESDI Drive Diagnostics issues a command to the ESDI drive, which causes the drive to execute its own internal drive diagnostic.

NOTE

This is an optional command in the ESDI Specifications and is not supported on some ESDI drives.

Deselect ESDI Drive - Option 5

This diagnostic deselects the ESDI drive and renders it unavailable for operation.

Issue Individual ESDI Commands - Option 6

If an ESDI drive develops a problem, individual commands can be issued to the drive in order to isolate the drive problem. These commands are used to reset a drive if a drive fault has occurred. These commands are interactive, and most require additional input in order to complete.

INDIVIDUAL ESDI COMMANDS

-- 0 -- SEEK DRIVE
-- 1 -- RECALIBRATE DRIVE
-- 2 -- REQUEST STATUS
-- 3 -- REQUEST CONFIGURATION OF DRIVE

-- 4 -- SELECT HEAD GROUP
-- 5 -- CONTROL COMMAND (START/STOP/RESET)
-- 6 -- DATA STROBE OFFSET
-- 7 -- TRACK OFFSET
-- 8 -- INITIATE DIAGNOSTICS
-- 9 -- SET BYTES PER SECTOR
-- A -- EXIT ESDI COMMANDS

Response Out/Command In Tests - Option 7

The Response Out/Command In Diagnostic tests the internal logic and the SDI Interface. When Option 7 is called up, a submenu appears, prompting the user for a subtest number. In order to run subtest 2, 3, 6, 7, A, or B, a "loopback" plug is required.

INDIVIDUAL RESPONSE TESTS

-- 0 -- CPU CLKS, NO CHECKING
-- 1 -- CPU CLKS, CHECKING - INTERNAL LOOPBACK
-- 2 -- CPU CLKS, CHECKING - PORT A
-- 3 -- CPU CLKS, CHECKING - PORT B
-- 4 -- CRYSTAL CLKS, NO CHECKING
-- 5 -- CRYSTAL CLKS, CHECKING - INTERNAL LOOPBACK
-- 6 -- CRYSTAL CLKS, CHECKING - PORT A
-- 7 -- CRYSTAL CLKS, CHECKING - PORT B
-- 8 -- DRIVE CLKS, NO CHECKING
-- 9 -- DRIVE CLKS, CHECKING - INTERNAL LOOPBACK
-- A -- DRIVE CLKS, CHECKING - PORT A
-- B -- DRIVE CLKS, CHECKING - PORT B
-- C -- AUTOMATIC MODE
-- D -- EXIT RESPONSE TESTS

Control Out/In Tests - Option 8

This is a factory-only test and is used as a scope loop.

Front Panel Tests - Option 9

Option 9 tests the front panel displays, the five switches, and the five associated LEDs in the switches.

When the front panel test is selected, a front panel submenu appears for the selection of the appropriate test.

-- 1 -- FOR RIPPLE TEST
-- 2 -- FOR SWITCH TEST
-- 3 -- FOR CHECKSUM
-- X -- to exit

Issue Read/Write Tests - Option A

This is a factory-only test and is used as a scope loop.

Clock Switch Tests - Option B

This is a factory-only test and is used as a scope loop.

ESDI Drive Formatter - Option F

The Built-In Formatter can be entered via the diagnostics menu, which is itself entered by using the Unit Number Switches (S1, S2, and S3). When in the Diagnostics Menu, the following formatter-related functions can be selected:

Q Quick format using manufacturer's defect information only
F Full formatter using manufacturer's defect list as well as any other bad blocks found during the read verify pass
V Read Check for header and data

The 'Q' and 'F' options select the built-in formatter. Once the formatter is selected, the drive is automatically formatted, with no further operator intervention required until the formatter displays '0AA' on the front panel to denote successful completion.

General Formatter Operation

The Formatter goes through four steps:

1. Initializes the disk drive and obtains the drive geometry from the drive. The results are output to the terminal. If the drive has been properly set for hard sectoring, bit 1 of the GENERAL CONFIGURATION word should be 1, and bit 2 should be 0.
2. The formatter then seeks to the outermost cylinder, or outermost cylinder minus 8, if required, to obtain the defect information. The defect list is then read and output to the terminal.

   If the defect information has been wiped out (for example, if the disk has been used with another disk controller that overwrote these cylinders), the formatter prints the message

   "NO DEFECT INFO, ASSUMING GOOD SURFACE H"

   where H is the head for which the defect information has been wiped out. If the defect information has been wiped out, it is strongly suggested that the Full Format option should be used instead of the Quick Format.
3. The formatter computes the drive geometry and outputs the DSA-equivalent values in hexadecimal.

   The bad sectors in the defect list are then output. The Physical Block Number (PBN) of each defective sector is listed in descending order.
4. Actual formatting operations are begun. The DBN, XBN, and RCT areas are initialized only, and formatting of the Logical Block Number (LBN) area is begun.

   Defective sectors found during this process are added to the ones found in the defect list, and the RCT is periodically updated. At the end of the format process, the RCT is dumped, displaying the LBN that has been replaced and the RBN to which the defective LBN has been revectored.

Quick Format

The Quick Format uses the manufacturer's defect information, which is located on Sector 0 of the maximum cylinder and is repeated on maximum cylinder minus 8. The Quick Format should take approximately 40 minutes on a single 760-Mbyte capacity drive.

At the end of the format operation, the unit number display should read "0AA." If any other number is displayed, the format operation aborted while formatting the cylinder number displayed. A more detailed message is displayed on the terminal.

Full Format

The only difference between the Quick format and the Full format is that the drive verifies each sector in the user area (LBN area) and adds it to the list of sectors that is replaced if that sector is found to be defective. Defective sectors are repeatedly checked to ensure that they are truly defective.

A Full format operation takes about 2.75 hours on a 760-Mbyte capacity drive. At the end of the format operation, the unit number display should read "0AA." If any other number is displayed, the format operation aborted while formatting the cylinder number displayed. A more detailed message is displayed on the terminal.

Formatter Option Error Messages

1) "!!! FORMATTER ABORTED !!! DRIVE INIT PROBLEMS"

The ESDI drive failed to initialize properly. Run ESDI drive diagnostics from the diagnostic menu. If everything else works, read the ESDI drive configuration, and make sure the drive is set for hard-sector operation.

2) "!!! FORMATTER ABORTED !!! MFR DEFECT LIST READ ERROR"

The ESDI drive either failed to seek properly, or there is a hardware problem on the board, which prevented the READ operation. Seek failures are separately reported, and can be checked by running ESDI drive diagnostics.

If the drive can seek properly in the diagnostic mode, there is a problem with the interface board or with the short A and B cables connecting the drive and the interface board.

Run the WRITE VERIFY DISK DIAGNOSTIC REGION test from the diagnostics menu (Option C) to verify that the interface board can read and write from the disk. Note that the disk does not have to be formatted to run this test.

3) "TRANSFER TIMEOUT !!! SECTOR - S"

A read or write operation failed on the disk, while doing a data transfer on sector S. The problem is in the read/write path of the interface board, the ESDI drive, or the ESDI cables. Use the diagnostics to isolate the problem.

4) "MORE THAN 255 DEFECTS - IGNORING REST !!"

The formatter found more than 255 defects on the defect cylinders.

Read Disk Diagnostic Region

This diagnostic only passes on a preformatted disk. The diagnostic flashes the cylinder number of the Diagnostic Read Only Cylinder until testing is complete. After it finishes it displays one of the following error codes:

0AA	Success code
062	Hardware error on the interface board or ESDI drive cables
063	Drive is unformatted or incorrectly formatted. If the accompanying message on the terminal is "Bad EDC - Expected 3086, Read 5555", there was no Sync Found, and nothing was read from the disk. If the Read value is other than 5555, the drive could be unformatted, especially if the WRITE VERIFY diagnostic passes.
01A	Mispositioning error. The drive is either unformatted, particularly if the WRITE VERIFY DISK DIAGNOSTIC REGION test passes.

Write Verify Disk Diagnostic Region

This test writes a test pattern "AA" on the disk diagnostic area, reading and comparing the written data. The diagnostic works on an unformatted disk and should be run immediately once the basic ESDI drive diagnostics have been run. This establishes that the interface board can communicate with the drive and that the drive has been properly set up. The following completion codes are displayed at the end of the test:

0AA	Successful completion code
062	Hardware error on interface board or ESDI drive cables
06A	Write verify failed. If the compare operation fails, the bytes in error are output to the terminal. Check the cables, since the basic read/write control path tests satisfactorily. The ESDI cables, drive, and interface board should be exchanged one after the other, in that sequence.

Add a Bad Block to the RCT/Dump the RCT

This option is used to look at the bad block list (the RCT) or to add a block to the bad block list. Note that the RCT only contains bad block entries corresponding to blocks in the user visible area (i.e., host application LBNs or RBNs). Therefore, not all blocks show up in the RCT. Multiple defects might also map into the same sector.

6.3 Error Codes

Error codes that are detected by the interface board are reported back to the controller and logged in the system's error log. The interface board also keeps the last 20 errors in a 20-byte FIFO. These errors can be displayed on S1, S2, and S3.

The following are error codes and fault conditions.

Error Code	Condition
07	Message frame sequencing error
08	Message checksum error
09	SDI message framing error
0A	Invalid operation code parity for a message
0B	Invalid operation code for a message
0C	Invalid command length for a message
0D	Status error byte nonzero while attempting to execute a command
0E	Group select code nonzero while attempting to execute a command
0F	Write-protect switch in the PROTECT position while attempting to write-enable the drive
1A	Seek command contains a invalid cylinder address
1F	Sector pulse detected during execution of sector read or write
20	Parity error detected on controller realtime state line
21	Two or more pulses of same polarity detected on controller realtime state line (ctl pulse err)
22	Two or more pulses of same polarity detected on controller write command data line (data pulse err)
29	Invalid error recovery level specified
2A	Invalid subunit specified
2B	Invalid region specified in a diagnostic command

2C	Seek or recall command attempted while spindle not spinning
2D	Invalid command timeout value given
2E	Controller flags detected prohibiting drive spin-up
2F	RUN/STOP switch in stop position while attempting run command
30	ESDI drive write fault
39	ESDI drive write gate fault
40	Invalid Read/Write region specified
41	SDI controller response timed out
42	Drive not in an on-line state while attempting seek command
43	Read/Write READY not set while attempting realtime command
47	Disconnect command contains incorrect TT bit
48	Write memory offset or byte count invalid
49	Invalid command while in topology mode
4A	Drive disabled by DD bit
8B	Drive SDI interface not ready to start
B0	ESDI drive attention error
B5	Invalid ESDI command
B7	ESDI command parity error
D0	Load attempt failed
E0	Random seek error
E1	ESDI drive seek error

6.4 General Precautions

Follow the precautions listed below to prevent injury to yourself or the equipment:

- Power-down the drive before performing any work on it.

WARNING

Never remove or install any printed circuit board or disconnect any connector, plug, or wire while power is on it; doing so could induce failures.

- When removing connectors, do not pull on the cable; hold the connector firmly by its sides and pull out.
- Do not remove any parts not specified in the replacement procedure.
- When working near printed circuit boards, ground yourself with an anti-static strap.
- Read through the entire procedure before starting.

Stabilizing Cabinet

Before starting any removal and replacement procedure that requires extending a chassis from a System Industries cabinet, stabilize the cabinet using either the stabilizer feet (60- or 42-inch cabinets) or the stabilizer bar (Theta cabinets). Refer to the cabinet manual for instructions.

Preliminary Power-off Checks

Before starting removal or replacement, make sure the following is done:

- With the circuit breakers off at the main power supply, connect the power cord from the chassis or cabinet to the source.
- Power-on the chassis and verify that it attains ready status.
- Power-off the equipment and proceed with the removal and replacement.

6.5 SI500 Chassis Component Removal and Replacement

To install new SI500 components, refer to "Installation." To replace SI500 Chassis components in an already installed chassis, follow the steps below.

Extend the chassis from the cabinet by first pushing it partly out from the rear or grasping it underneath in front, and then gently pulling it out from the front until it locks into position.

Remove the chassis top cover, and place on a flat, stable surface. Save the screws removed.

Since no service loop is available with this chassis, all external cabling must be removed before replacing components to the chassis.

SI500 Chassis Switch and Jumper Setting Configurations

The switch and jumper settings for both the interface board and the control board, are described in "SI500 Chassis Components." Refer to this section when replacing SI500 Chassis components.

Control Panel Removal and Replacement

To replace the control panel on an SI500 Series Chassis, refer to the following procedure.

Procedures:

1. Remove front panel of chassis.
2. Remove the control panel by popping it off the clip stands.
3. Disconnect 10-pin connector.
4. Attach new control panel by pushing it into the clip stands.
5. Reattach 10-pin connector (J1) to control board.
6. Close front panel of chassis.

Disk Drive Removal and Replacement

To install a new disk drive, refer to "Installation." To replace a disk drive in an already installed chassis, follow the steps below. SI500 Disk Drive removal and replacement is shown in Figure 6-1.

Procedures:

1. Remove the cables from the back of the drives.
2. Remove the interface board from the first drive (closest to rear of chassis).
3. Remove four screws attaching drives and mounting plates to chassis bottom.
4. Remove four screws attaching drives to mounting plates.
5. Secure the first drive to a mounting plate with screws.

6. Secure the second drive to a mounting plate with screws.
7. Make sure the control, data, and control panel cables are attached to the bottom of the chassis under both drive mounting plates.
8. Attach both drives and mounting plates to chassis bottom with screws.
9. Connect one end of the data cable to connector J1 on both drives.
10. Connect one end of the control cable to connector J5 on the first drive. Connect one end to connector J5 on the second drive.
11. Connect one end of the power cable to the drive.
12. Make sure the termination connector is attached to the last drive in the daisychain.
13. Reattach the interface board to the first drive with four screws.

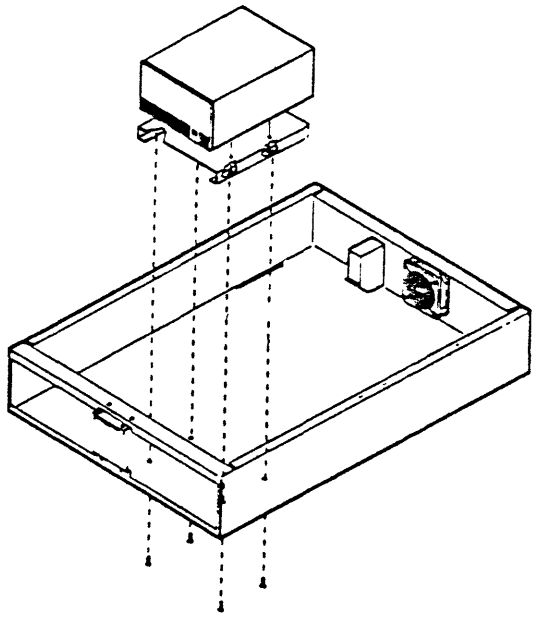

Figure 6-1. Disk Drive Removal and Replacement

Interface Board Removal and Replacement

To install a new interface board, refer to "Installation." To replace an interface board in an already installed chassis, follow the steps below. Removal and replacement for the interface board are shown in Figure 6-2.

Procedures:

1. Remove cables attached to interface board.
2. Remove four screws connecting the interface board to the drive.
3. Attach new interface board to first drive (back of chassis) with four screws.
4. Connect data cable from connector J1 of first drive to connector J1 on interface board.
5. Connect data cable from connector J1 on second drive (front of chassis) to connector J2 on interface board.
6. Connect the third end of the control cable to J5 on the interface board. This cable daisychains the two drives together.
7. Attach 10-pin connector from J6 on interface board to control panel on front of chassis.
8. Attach 3-prong connector from power supply to connector J7 on interface board.
9. Attach 3-prong connector from telephone jack on back of chassis to connector J12.

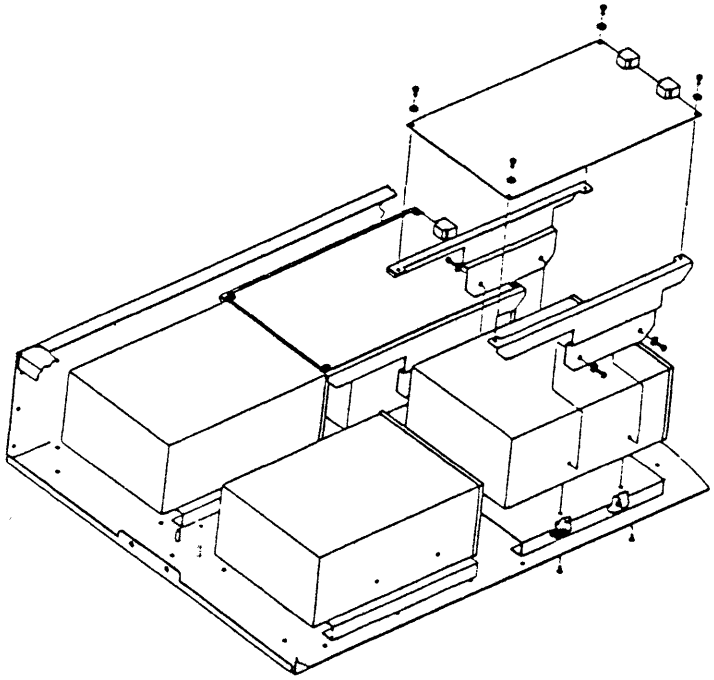

Figure 6-2. Interface Board Removal and Replacement

Power Supply Removal and Replacement

To install a new power supply, refer to "Installation." To replace a power supply in an already installed chassis, follow the steps below.

Procedures:

1. Remove cables from power supply.
2. Remove four screws attaching power supply to chassis bottom.
3. Remove four screws attaching mounting plate to power supply.
4. Attach new power supply to mounting plate with four screws.
5. Cable power supply according to procedures in "SI500 Chassis Subsystem."
6. Attach power supply cover to mounting plate with four screws.
7. Attach mounting plate to chassis bottom with four screws.
8. Attach power cable connectors to first and second drive.

Installing Covers, Cables, and Powering-up

After replacing the chassis components, complete the following procedures to reattach previously removed parts.

Procedures:

1. Reattach the chassis cover with the screws previously removed.
2. Reattach cables from host system to chassis rear panel.
3. Gently push the chassis back into the cabinet until it aligns with front of cabinet.
4. Power-up the chassis. Refer to "Operation" for these procedures.

7
ILLUSTRATED PARTS CATALOG

The SI500 Series Chassis field replaceable units (FRU) are listed in Table 7-1. The SI500 Series Chassis subassembly components are shown in Figure 7-1.

Table 7-1. SI500 Series Chassis Field Replaceable Parts

ITEM	NO. INCLUDED	PART NUMBER
SI500 Subassembly	1 each	
SI506 Disk Drive Assembly	1 each	2900-7007
SI512 Disk Drive Assembly	1 each	2900-7008
Interface Board	1 each	2900-7016
Control Panel	1 each	2900-7017
Power Supply Assembly	1 each	2900-7006
Mounting Plate 5.25-inch Drives	1 each	2900-7001
SI500 Mounting Hardware Kit	1 each	2900-1006
Power Entry Module w EMI Filter	1 each	312-0056
Cooling Fan	1 each	370-0024
Cable Assembly	1 each	2900-7011
6-inch SDI Cable	1 each	2900-7001
2-feet SDI Cable	1 each	2900-7002
Control Panel Cable	1 each	2900-7013
Data Cable - short	1 each	2900-7015
Data Cable - long	1 each	2900-7021
Control Cable (1 drive)	1 each	2900-7022
Control Cable (2 drives)	1 each	2900-7014
SI500 Tabletop Assembly	1 each	2900-7005
SI500 Theta Assembly	1 each	2900-7003
SI500 Standard Cabinet Assembly	1 each	2900-7004
Power Conversion Kit	1 each	820-0079
SI506 Disk Drive Upgrade Kit	1 each	2900-7009
Transition Panel Assembly	1 each	8700-7051
35-feet SDI cable	1 each	8700-7083

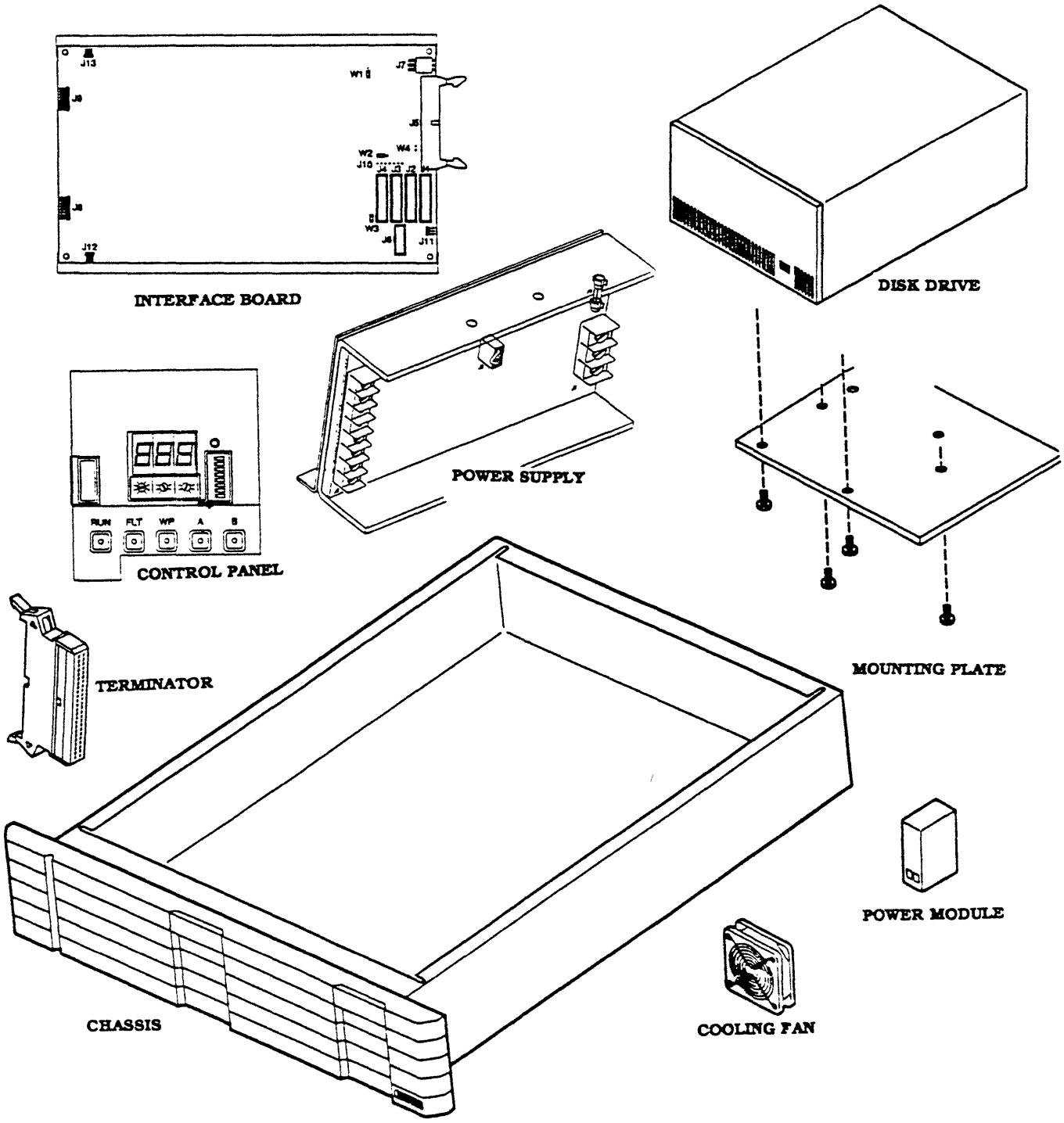

Figure 7-1. SI500 Series Chassis Subassembly Components