



305-012
Issue 2

AT&T 3B2 Computer
SCSI Operations Manual

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Chapter 1: Overview

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Purpose of the SCSI Operations Manual

The purpose of this document is to provide information and procedures on the day-to-day administration and operation of the AT&T 3B2 Computer Small Computer Systems Interface (SCSI). A companion document, the *AT&T 3B2 Computer SCSI Installation Manual*, contains installation instructions for the different SCSI peripherals.

The information in this document is based on the following assumptions:

- That you are familiar with the fundamentals of the UNIX* operating system.
- That you have previously been a system administrator or an operator on another UNIX system.

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Introduction to SCSI Operations Manual

SCSI is an American National Standard Institute (ANSI) standard interface which provides the ability to add hard disk drives, quarter-inch cartridge tape drives, and 9-track reel-to-reel tape drives to the 3B2 computer system. SCSI is an expandable interface which means additional SCSI storage devices can be added as application needs increase.

The implementation of SCSI on the 3B2 computer provides all the hardware, software, and interconnection equipment to add this interface to any 3B2 computer operating on UNIX System V Release 2.0.5, Release 3.0 paging, or later.

This manual contains information that is needed by a system administrator to properly set up and maintain a 3B2 computer system using SCSI.

Manual Organization

The material in this manual is organized into 11 chapters with each chapter separated by a tab divider. The remainder of this manual is divided into the following chapters:

- Chapter 2, "System Description," briefly describes all the components that are available with SCSI.
- Chapter 3, "Administrative Information," contains background information on setting up and using the SCSI peripherals.
- Chapter 4, "Using SCSI Hard Disks," tells how to set up a SCSI hard disk drive for operation.
- Chapter 5, "Mirroring SCSI Hard Disks," provides information on how to set up one driver to write to two separate disk partitions at once, provided they are on the same computer.
- Chapter 6, "Using the SCSI Cartridge Tape," tells how to use a SCSI Cartridge Tape Drive.
- Chapter 7, "Using the SCSI 9-Track Tape," describes the use of SCSI 9-Track Tape Drives.
- Chapter 8, "Backup and Restore [Standard and Multiple Save Sets (MSS)]," provides information and instructions for performing multiple and standard file system backups and restores using SCSI devices.
- Chapter 9, "File System Management on SCSI Devices," contains general information on procedures that the system administrator can use to do file system maintenance.
- Chapter 10, "SCSI Shared Peripherals," describes the SCSI Shared Peripheral (SSP) feature for hard disks and methods to set up, operate, and administer the SSP feature.
- Chapter 11, "SCSI Trouble Clearing and Diagnostics," is a general guide to troubleshooting a problem with SCSI. This chapter also includes information on using diagnostics which can be used in troubleshooting.
- Appendix A, "Supplemental Information," provides information that should be used to supplement other 3B2 computer System Administration documentation. This section includes information on the naming conventions for SCSI device files, configuration chart,

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rewriting the physical description sector on the SCSI Hard Disk Drives, and additional hard disk partitions.

- Appendix B, "SCSI Error Messages," contains descriptions of the error messages that are displayed if a problem occurs with a SCSI device and the action to take (if any).
- Glossary defines the SCSI terminology used in this document.
- Index gives an alphabetical listing of topics, together with the page numbers on which they appear in this manual.

Conventions Used in This Manual

The following is a list of the conventions you will see in this manual:

- Commands are in **bold** type.
- File names and directories are *italicized*.
- References to other documents are in *italic* type.
- Light monospace type indicates computer output, and **bold monospace** indicates input from the keyboard.
- References to keys on the keyboard are boxed. The notation, Ctrl d, means that you hold down the control key and strike the specified alphanumeric key, in this case, the lowercase letter d.

This document contains sample displays which will help you understand the described procedures. The following conventions are used throughout this document to show your terminal input and system output.

This style of type is used to show system generated responses displayed on your screen.

This style of bold type is used to show inputs entered from your keyboard that are displayed on your screen.

These bracket symbols, < >, identify inputs from the keyboard that are not displayed on your screen, such as: <CR> carriage return, <CTRL d> control d, <ESC g> escape g, passwords, and tabs.

This style of italic type is used for notes that provide you with additional information. This style of type is also used to show variable inputs such as times and dates.

Note 1: The sample screen displays found in this document when compared to the displays on your terminal screen may differ slightly due to changes in the software after this document was printed.

Note 2: The example commands should be followed as closely as possible. Your device names may vary from those used in the examples. However, the format of the commands should be followed. That is, if exact device names (*/dev/rdisk/c##t#d0s0*) are used, you should use the exact device names for your system. Do not mix exact device names and alias device names (such as, */dev/rSA/qtape1*).

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Introduction

This chapter briefly describes the different components that make up the AT&T 3B2 Small Computer System Interface (SCSI). This description includes information about the SCSI hardware and software, the interconnection of the SCSI equipment, and additional features provided through SCSI.

SCSI is an industry standard for interfaces that connect host computers and intelligent peripherals that have their own controllers. SCSI has received official sanction as a standard from the American National Standard Institute (ANSI). AT&T has cooperated with a number of vendors to define the Common Command Set (CCS) standard and made a public commitment to open architecture in the *AT&T SCSI Interface Definition* document. AT&T's *UNIX System V Interface Definition* is being paralleled with *SCSI Interface Definition* to provide a true open architecture for the 3B SCSI subsystems.

This layered architecture allows the actual device drivers to be independent of the machine for which they were written. Peripherals are the top layer of the structure, with the actual Host Adapter (HA) driver directly under them. The Host Adapter driver is device-specific, but the interface between the target drivers and the Host Adapter driver is standardized. This layered architecture allows devices and associated drivers to be moved from one 3B computer to another.

SCSI provides an open architecture across the 3B computer family that:

- Facilitates the development of third-party peripherals
- Allows quick integration of new peripheral technologies
- Provides the capability for more than 16 gigabytes of data storage on a supermicrocomputer
- Provides many new features which are described in this document.

Single-Ended SCSI and Differential SCSI

All of the capacity provided by the SCSI must be matched to the peripherals efficiently. This involves the speed of data transfer and the type of peripherals required. The SCSI standard provides two electrical specifications for the interface:

- A single-ended implementation of drivers and receivers that allows a maximum cable length of 6 meters (19 feet 8 inches).
- A differential implementation of drivers and receivers that allows a maximum cable length of 25 meters (82 feet).

Single-ended SCSI uses an asynchronous protocol providing peak data transfer rates of 1.5 Megabytes (MB) per second. It is a version of the SCSI bus designed to minimize cost and space. Most 5.25-inch devices use the single-ended, asynchronous implementation. The single-ended SCSI version is not compatible with the differential version of the SCSI bus.

Differential SCSI uses a synchronous protocol providing peak data transfer rates of 4 MB per second. The 300 MB differential, embedded 5.25-inch disks transfer at up to 4 MB per second. The differential SCSI version is not compatible with the single-ended version of the SCSI bus.

A new Host Adapter with differential bus interface is the second SCSI Host Adapter to be offered as part of SCSI-based peripherals for the 3B2 computers in Release 3 of SCSI. The original Host Adapter supports a single-ended SCSI bus interface, while the new Host Adapter has a differential SCSI bus interface and will not support a single-ended SCSI bus interface. The differential Host Adapter supports synchronous/asynchronous SCSI bus transfers with an improved bus bandwidth across the 3B2 computer Expanded Input/Output bus.

A daisy-chain common cable connects all SCSI devices together. More precisely, one SCSI-based peripheral is connected directly to a Host Adapter and the other SCSI-based peripherals are daisy-chained from it. Together they create the SCSI bus interface (Host Adapter plus SCSI bus). There is a terminator at both ends of the bus. All signals are common between all SCSI devices.

Another type of SCSI interface is the Enhanced Small Disk Interface (ESDI) bridge controller which is housed in the AT&T Disk Controller Module (DCM/4E). It is an intelligent, microprocessor-based circuit board (controller) that is physically separate from both the peripheral and the host computer. The DCM/4E provides the ESDI—SCSI translation.

The following table summarizes the currently supported peripherals.

AT&T SCSI-BASED PERIPHERALS SUPPORTED BY THE AT&T 3B2 COMPUTER		
PERIPHERAL	CHARACTERISTIC	INTERFACE
DCM/4E	ESDI-to-SCSI controller	single-ended
DM/147E	147-MB ESDI disk*	ESDI
DM/300E	300-MB ESDI disk*	ESDI
DM/300S	300-MB SCSI disk	single-ended
DM/300DS	300-MB SCSI disk	differential
XM/900S	900-MB with 3 ESDI drives	single-ended
TM/60S	60-MB, 1/4-inch tape	single-ended
TM/120S	120-MB, 1/4-inch tape	single-ended
9-track 1600	1600-bpi 9-track tape	single-ended [†]
9-track 6250S	1600-/6250-bpi 9-track tape	single-ended
9-track 6250DS	1600-/6250-bpi 9-track tape	differential

* Requires the use of the DCM/4E SCSI bridge controller.

† The 1600-BPI tape is only offered with a single-ended interface.

Note: Due to the way the **prtconf(1M)** command measures capacities, the reported capacity may differ from that shown in the peripheral name.

Read the *AT&T 3B2 Computer SCSI Product Overview* for additional background material.

SCSI Device Identification

SCSI provides increased storage capability to the 3B2 computer by its ability to access many storage devices via the common SCSI bus. However, the more peripheral devices that are added to a SCSI bus, the more difficult it becomes to keep track of the individual devices.

Therefore, it is strongly recommended that the system administrator makes certain that each device is properly identified at the time of installation. This identification information needs to be placed on the summary label on each peripheral device. (Refer to the *AT&T 3B2 Computer SCSI Installation Manual* for more information.)

The following is an example of the type of information that needs to be on each SCSI device:

SCSI Bus = 1

Host Adapter Slot Number = 1

SCSI Target Controller ID = 3

Logical Unit (LU) ID = 2

System Administration Name = disk5

Specific identification information for each SCSI device is given in the following descriptive sections.

SCSI Hardware Description

The major hardware components for a 3B2 SCSI subsystem are the following:

- Host Adapter
- Disk Controller Module
- Disk Modules
- SCSI Expansion Module
- SCSI Cartridge Tape Module
- 9-Track Tape
- Peripheral Power Controller.

As shown in Figure 2-1, the SCSI components are daisy-chained from the Host Adapter in the 3B2 computer via the SCSI bus, with the exception of the Disk Modules (DMs) which connect to the Disk Controller Module (DCM).

Note: Figure 2-1 depicts Disk Modules such as DM/147E and DM/300E that require a Disk Controller Module (DCM/4E). The Disk Controller Module is a SCSI-to-ESDI controller with a single-ended interface.

Disk Modules that contain an embedded controller such as the DM/300S (single-ended) or the DM/300DS (differential) are now available. These DMs eliminate the need for the DCM/4E bridge controller.

Since the list of SCSI devices will grow as new devices become available, this chapter does not deal specifically with the individual devices that are currently available but rather describes the device types (Disk Module, Tape Module, etc.). Where appropriate, examples of specific devices will be included.

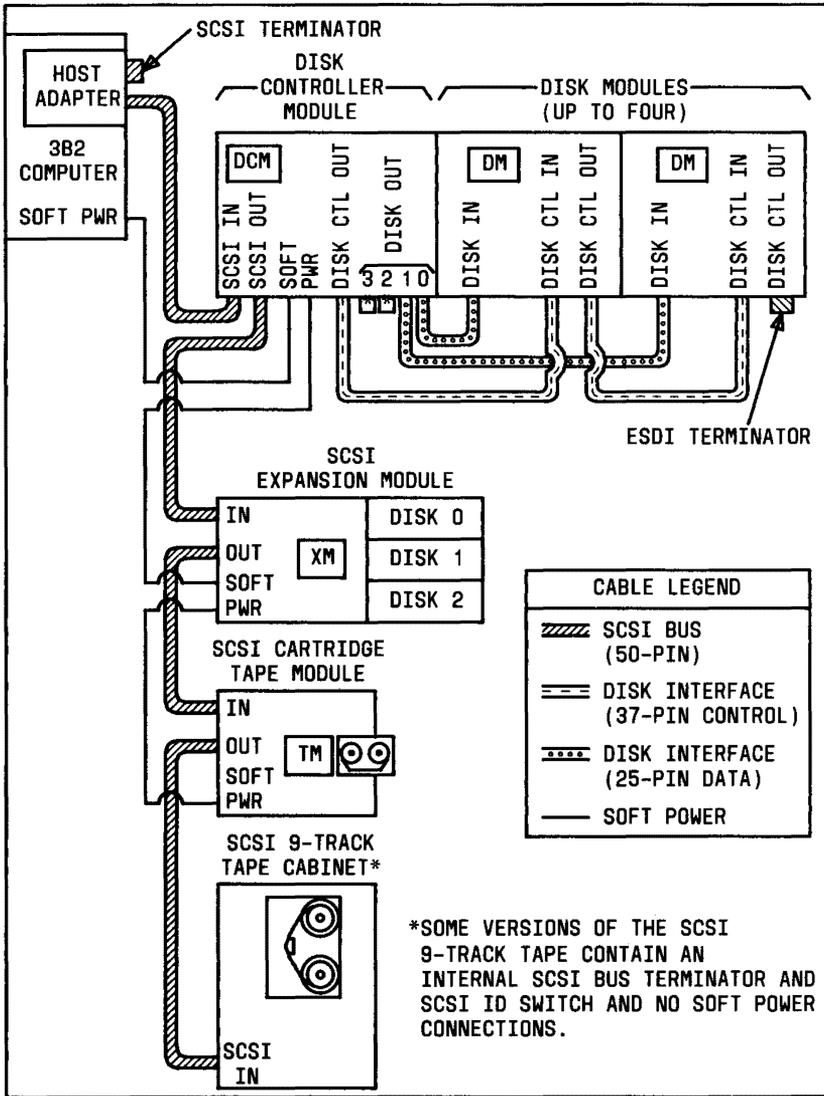


Figure 2-1: Example Layout of a SCSI Bus and Devices

Naming Conventions

The SCSI peripheral modules follow a standard naming convention to help you understand what each module contains.

There are two basic types of SCSI modules: SCSI device module (Disk Module and Cartridge Tape Module) and controller module (Disk Controller Module).

Device Module

The following is an example of the naming convention used for SCSI peripheral device modules:

DM/300E
where: DM is the device type (Disk Module)
300 is the formatted storage capacity (in megabytes)
E is the interface type (E - ESDI)

The following table gives the different entries that are possible in the naming convention for SCSI peripheral devices.

Device Type	DM - Disk Module TM - Tape Module SCSI XM - Expansion Module
Storage Capacity (formatted)	megabytes
Interface Type	E=ESDI S=Single-ended SCSI DS=Differential SCSI

Controller Module

In the case of a SCSI target controller, such as the Disk Controller Module which controls up to four Disk Modules, the capacity number is the maximum possible Disk Modules that can be connected to the controller.

The following is an example of the naming convention for a SCSI DCM:

DCM/4E

where: **DCM** is the Disk Controller Module
4 is the maximum Disk Modules
E is the interface type (E - ESDI)

SCSI Bus

The SCSI bus is an industry standard peripheral bus that interconnects the SCSI components as shown in Figure 2-1. The SCSI bus is a daisy-chained arrangement originating at the Host Adapter card and interconnecting up to seven intelligent peripheral controllers on the bus.

SCSI Bus Cable

AT&T supplies SCSI cables for single-ended and differential configurations. The single-ended bus has a maximum cable length of 6.0 meters (19 feet 8 inches). The differential bus may have a maximum cable length of 25.0 meters (82 feet).

The appropriate SCSI bus cables and terminators are supplied with the Host Adapter. There can be a maximum of two SCSI buses and two single-ended Host Adapter cards in each Version 2 3B2 computer. These two buses are designated as buses "1" and "2." Version 3 3B2 computers can have up to eight Host Adapters. Additional differential configurations are described later.

Warning: All connections on a SCSI bus must be properly made. If a SCSI bus cable or bus terminator is incorrectly connected, irreparable damage may occur to the SCSI hardware.

SCSI Bus Terminators

Each SCSI bus requires two bus terminators; one at each end of the bus. The single-ended Host Adapter feature card normally requires an internal single-ended SCSI terminating resistor for the card and an external single-ended SCSI terminating resistor for the other end of the SCSI bus. The differential Host Adapter feature card normally requires an internal differential

SCSI terminating resistor for the card and an external differential SCSI terminating resistor for the other end of the SCSI bus.

SCSI Bus Addressing

There can be up to eight controllers on each SCSI bus, including the Host Adapter. Each controller has a different SCSI address (0 through 7) which is set by a SCSI ID switch located on the controller. The SCSI address establishes the bus priority with device "7" having the highest priority. The SCSI ID switch for the Host Adapter is on the feature card and is factory preset to "0." The SCSI ID switches for the peripheral controllers are located on the rear panels of the controllers. The controller SCSI ID switches are usually set in sequential order (starting from the Host Adapter), meaning the first controller on the bus would be set to "1," the next set to "2," and so on. It is recommended that the SCSI ID for the SCSI 9-Track Tape unit be set to "7," whether it is set manually or automatically.

SCSI Host Adapter With Single-Ended Bus Interface

The original 3B2 SCSI Host Adapter provides the 3B2 computer with an interface to the SCSI single-ended bus. The single-ended Host Adapter is equipped with two 50-pin connectors and can support up to seven peripheral controllers via the interface bus cables. Usually, the SCSI cable connects to one of the two connectors on the Host Adapter card and a single-ended external bus terminator connects to the other connector.

The Host Adapter feature card is a single-width 3B2 computer feature card that can be installed in the next available Input/Output (I/O) slot of the 3B2 computer cabinet. The feature card is approximately 0.8 inch high by 6.0 inches wide by 7.0 inches deep, with a printed circuit side and a component side that uses surface mount technology. (See the *AT&T 3B2 Computer SCSI Installation Manual* for more information on installing the Host Adapter feature card.)

The major components of the single-ended 3B2 SCSI Host Adapter card are the following:

- 80186 Microprocessor operating at 8 megahertz
- ✓ ■ NCR 5385E SCSI Protocol Controller Chip
- SCSI Address Switch
- 128 kilobytes of dynamic Random Access Memory (RAM)
- 32 kilobytes of Electronic Programmable Read-Only Memory (EPROM)
- External Direct Memory Access (DMA)/First In, First Out (FIFO) Unit between SCSI and 3B2 I/O bus
- 3B2 computer common I/O interface.

SCSI Host Adapter With Differential Bus Interface

The differential 3B2 SCSI Host Adapter provides the 3B2 computer with an interface to the SCSI differential bus. The differential Host Adapter is equipped with two 50-pin connectors and can support up to seven peripheral controllers via the interface bus cables. Usually, the SCSI cable connects to one of the two connectors on the Host Adapter card and a differential external bus terminator connects to the other.

The Host Adapter feature card is a single-width 3B2 computer feature card that can be installed in the next available I/O slot of the 3B2 computer cabinet. The feature card is approximately 0.8 inch high by 6.0 inches wide by 7.0 inches deep, with a printed circuit side and a component side that uses surface mount technology. (See the *AT&T 3B2 Computer SCSI Installation Manual* for more information on installing the Host Adapter feature card.)

The major components of the differential 3B2 SCSI Host Adapter card are the following:

- 80186 Microprocessor operating at 8 megahertz
- Fujitsu 87030 SCSI Protocol Controller Chip
- SCSI Address Switch
- 64 kilobytes of static RAM
- 64 kilobytes of EPROM
- External DMA/FIFO Unit between SCSI and 3B2 I/O bus
- 3B2 computer common I/O interface.

Host Adapter Configuration Limitations

The different types of Host Adapters have certain limitations that are listed as follows:

- The differential Host Adapter is currently only supported on Version 3 3B2 computers due to the power requirements of the feature card.
- Any combination of differential and/or single-ended feature cards may be configured in a Version 3 3B2 computer, as long as the total number of Host Adapters is eight or less.

- The maximum number of single-ended Host Adapter feature cards allowed in a Version 2 3B2 computer is two.

Single-Ended Cabling

Cabling to the single-ended Host Adapter involves two SCSI bus connectors which are located on the Host Adapter feature card inside the 3B2 computer cabinet. Typically, the SCSI single-ended bus cable connects to one of these two connectors while a single-ended Host Adapter terminator (sometimes called a terminating resistor) connects to the other.

Caution: Do not connect a differential bus or differential terminators to the single-ended Host Adapter card.

Warning: All connections to the single-ended Host Adapter must be properly made. If a SCSI single-ended bus or single-ended SCSI terminator is connected incorrectly, irreparable damage may occur to the SCSI hardware. Once SCSI has been installed, caution should be used any time other work is being done in the area of the single-ended Host Adapter (for example, adding or making additional connections to other feature cards). This precaution will help prevent disturbing the SCSI single-ended bus connections to the Host Adapter. It is a good practice to always check the connections to the Host Adapter once any activity has occurred in that area.

Refer to the *AT&T 3B2 Computer SCSI Installation Manual* for more information on proper connections to the single-ended Host Adapter.

Differential Cabling

Cabling to the differential Host Adapter involves two SCSI bus connectors which are located on the Host Adapter feature card inside the 3B2 computer cabinet. Typically, the SCSI differential bus cable connects to one of these two connectors while a differential Host Adapter terminator (sometimes called a terminating resistor) connects to the other.

Caution: Do not connect a single-ended bus or single-ended terminators to the differential feature card.

Warning: All connections to the differential Host Adapter must be properly made. If a SCSI differential bus or differential SCSI terminator is connected incorrectly, irreparable damage may occur to the SCSI hardware. Once SCSI has been installed, caution should be used any time other work is being done in the area of the differential Host Adapter (for example, adding or making additional connections to other feature cards). This precaution will help prevent disturbing the SCSI differential bus connections to the differential Host Adapter. It is a good practice to always check the connections to the Host Adapter once any activity has occurred in that area.

Refer to the *AT&T 3B2 Computer SCSI Installation Manual* for more information on proper connections to the differential Host Adapter.

Host Adapter SCSI Bus Address

The Host Adapter feature card provides a dial switch which is used to set the SCSI bus address. This switch establishes the bus priority and is factory preset to position "0." This means that the Host Adapter is address 0 or the first tap (lowest priority) on the bus.

Disk Controller Module

The Disk Controller Module (DCM) performs the interface conversion between the SCSI bus and the Extended Small Disk Interface (ESDI) of the Disk Modules. The DCM contains a SCSI target controller, which supports up to four Disk Modules, and a controller power supply. The DCM is supported by the 3B2 SCSI Disk Controller Utilities (described in the "Software" section of this chapter).

Figure 2-2 shows the front and rear views of a Disk Controller Module (DCM/4E). The front cover of the DCM contains the "Power" switch and recessed label areas for SCSI identification labels. The rear of the DCM contains connections to the SCSI bus, the Disk Modules, AC power, and "soft-power" control.

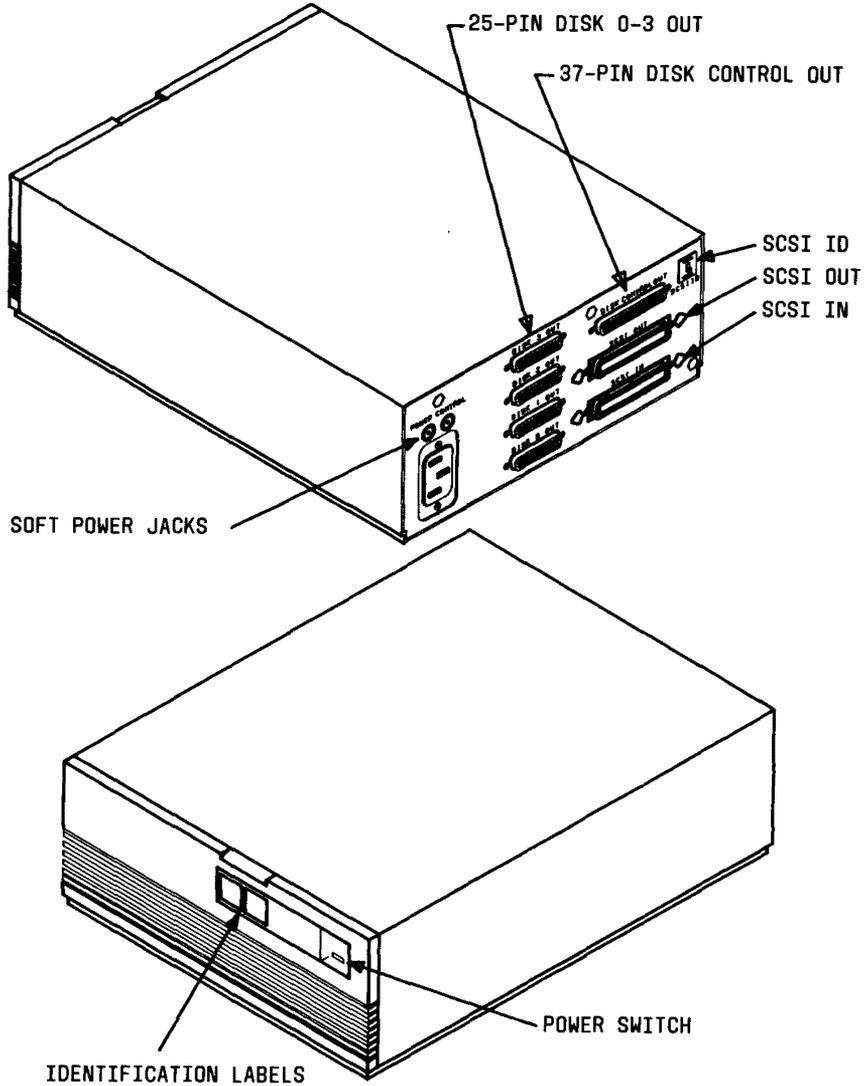


Figure 2-2: SCSI Disk Controller Module

DCM Cabling

Cabling to the DCM (Figure 2-2) for ESDI disks (designated with a "/nE") involves the following connectors:

- Two 50-pin connectors (SCSI IN and OUT)
- One 37-pin connector (Disk Control Out)
- Four 25-pin connectors [Disk (0 through 3) Out]
- Two soft-power jacks
- AC power receptacle.

As shown in Figure 2-1, the SCSI cable from the Host Adapter connects to the 50-pin SCSI IN connector on the DCM. The SCSI OUT connector on the DCM contains a SCSI bus terminator or a cable to another device on the SCSI bus.

The 37-pin Disk Control Out connector on the DCM is the ESDI bus control interface for the SCSI Disk Modules. Up to four Disk Modules can be daisy-chained off of the ESDI bus. The last Disk Module on the ESDI bus requires a terminator.

The four 25-pin Disk (0 through 3) Out connectors on the DCM provide the individual ESDI Disk Module data interfaces. Each 25-pin connector interfaces a single SCSI Disk Module. No terminators are required on any of the 25-pin interfaces.

The soft-power jacks provide power control for the DCM from the 3B2 computer. Soft-power control for the Disk Modules is incorporated in the 37-pin control cable.

DCM SCSI Bus Address

The SCSI ID push-button switch on the rear panel of the DCM should be set to an appropriate setting for a peripheral device controller (1 through 7). This setting establishes the priority of the DCM on the SCSI bus. It is recommended that the DCM have a priority (SCSI ID) that is lower than the SCSI Cartridge Tape or SCSI 9-Track Tape Drive.

The two recessed label areas on the front cover of the DCM are for identification. The left square will contain the number of the SCSI bus that the DCM is on (1 through 8). The right square will contain the SCSI address number which should be the same as the setting of the rear-panel SCSI ID switch.

The summary sheet inside the front cover should be filled out to include SCSI device information. The following is an example of the type of information that is needed.

SCSI Bus = 1

Host Adapter Slot Number = 1

SCSI Target Controller ID = 3

Notes = Names of connected Disk Modules (disk2, disk3, etc.).

Disk Module for ESDI Disks (Disk Controller Module Required)

In this section, Disk Module refers to peripherals such as DM/147E and DM/300E that use ESDI. The Disk Module, which is normally stacked on top of its respective Disk Controller Module, contains a hard disk drive, associated interface cabling, and a power supply. The Disk Module provides additional disk storage which can be used for file system and data base applications.

Figure 2-3 shows the front and rear views of a Disk Module. The front panel cover of the Disk Module contains two recessed label areas for device identification stickers and an opening to access the "Power" switch. The rear of the Disk Module contains the ESDI connectors for cabling to the Disk Module, the LU ID (Logical Unit Identification) switch for addressing, and an AC power receptacle.

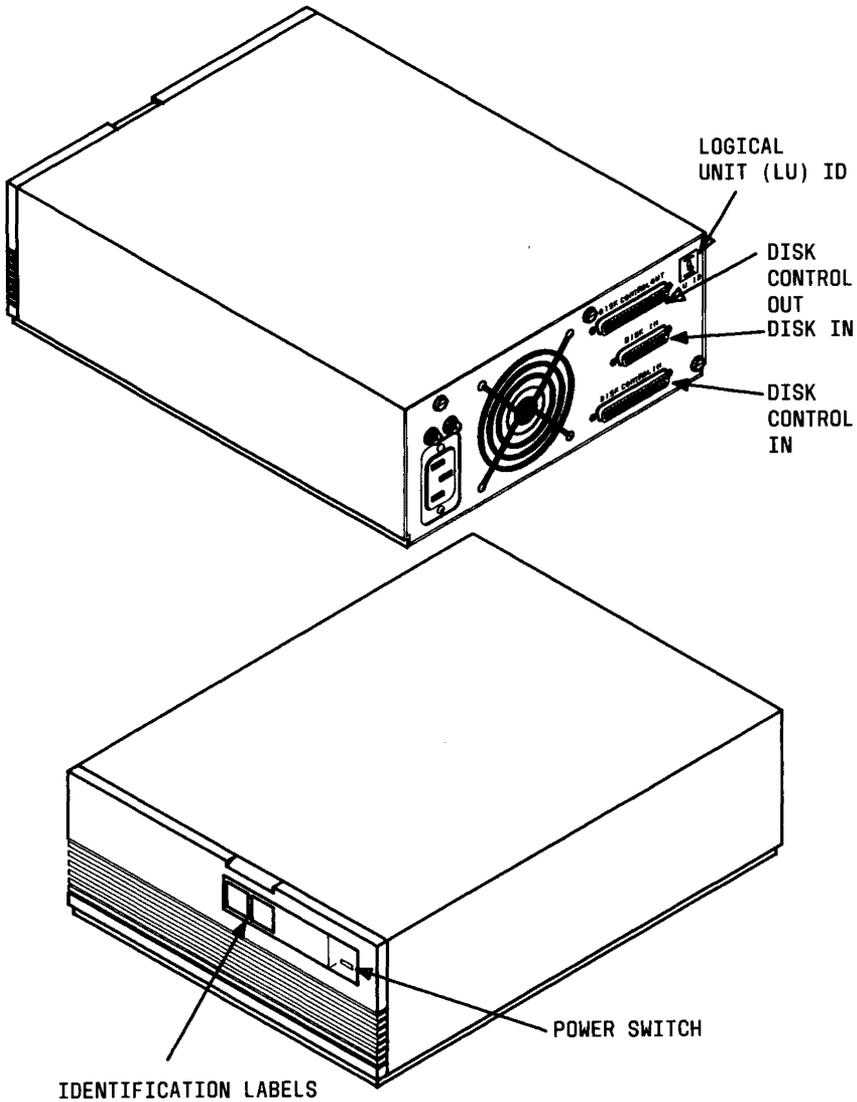


Figure 2-3: SCSI Disk Module for ESDI Disks

DM Cabling for ESDI Disks

Cabling to the DM involves the following connectors:

- Two 37-pin ESDI control interface connectors (Disk Control In and Disk Control Out)
- 25-pin ESDI data interface connector (Disk In)
- AC power receptacle.

The 37-pin ESDI control cable starts at the Disk Controller Module and is daisy-chained through the Disk Control In/Out connectors of each Disk Module. The last Disk Module on the ESDI bus requires a terminator on the Disk Control Out connector.

Each Disk Module has a separate 25-pin data cable from the Disk Controller Module to the Disk In connector. No terminators are required at either end of the 25-pin cables.

DM Logical Unit Number for ESDI Disks

The LU ID switch on the rear panel of the Disk Module should be set to match the label (Disk *x*) of the 25-pin data connector on the back of the Disk Controller Module. Set the switch by pressing the "-" or "+" push button to increment or decrement the displayed number. For example, a Disk Module connected to the Disk 2 Out connector on the DCM must have its LU ID switch set to "2."

The two recessed label areas in the front panel of the Disk Module are for device identification. The left square contains a symbol for a hard disk and the right square contains the unique device number given in the System Administration menus (for example: disk1, disk2, disk3, etc.).

The summary sheet inside the front cover should be filled out to include SCSI device information. The following is an example of the type of information that is needed.

SCSI Bus = 1

Host Adapter Slot Number = 1

SCSI Target Controller ID = 3

Logical Unit (LU) ID = 2

System Administration Name = disk5

Disk Module for SCSI Disks With Embedded Controller

The Disk Module for SCSI disks houses an embedded controller which eliminates the need for a DCM/4E bridge controller. The embedded controller improves reliability in the subsystem, reduces the low end entry cost, and improves performance. The DM/300S Disk Module houses the 300 MB 5.25 inch embedded SCSI disk drive with single-ended SCSI bus interface. The DM/300DS Disk Module houses the 300 MB 5.25 inch embedded SCSI disk drive with differential SCSI bus interface.

The DM/300S and DM/300DS packages are similar except for the single-ended or differential options of the disk. Only the disk device itself is different. Both packages consist of a cabinet containing a power supply and a single 5.25 inch form factor embedded SCSI disk drive. The formatted capacity of the drive is 300 MB, the same as the DM/300E. The DM cabinet is approximately the same as the Disk Module for ESDI Disks.

DM Cabling for SCSI Disks

Cabling to the DM/300S or the DM/300DS involves the following connectors:

- Two 50-pin connectors (one labeled SCSI IN and one labeled SCSI OUT)
- Two soft-power jacks

- 50-pin SCSI terminator
- AC power receptacle.

The DM/300S or the DM/300DS can be connected to the 3B2 SCSI Host Adapter or another SCSI tap via a 50-pin SCSI external cable. The rear panel of the DM/300S and the DM/300DS will have two 50-pin connectors, one labeled "SCSI IN" and one labeled "SCSI OUT." The 50-pin cable may be daisy chained between the DMs. There are also two soft-power jacks to provide the soft-power control for stacking the DMs. The 50-pin SCSI terminator is on the last device attached to the SCSI bus. The soft-power cable will connect to the rear of the DM from the 3B2 computer or other DMs or XMs.

DM Logical Unit Number for SCSI Disks

You have to set the Disk Modules ID by pressing the "-" or "+" push button until the appropriate number (1-7) is displayed for each disk module. The push-button switch is located on the rear panel of the Disk Module and labeled "SCSI ID."

The front of the Disk Module cabinet contains a recessed area that accommodates two labels. One label identifies the DM location node on the bus (1-7); while the other label identifies the SCSI bus (1-8).

The summary sheet inside the front cover should be filled out to include SCSI device information. The following is an example of the type of information that is needed.

SCSI Bus = 2

Host Adapter Slot Number = 2

SCSI ID = 4

System Administration Name = disk5

SCSI Expansion Module (SCSI XM)

Note: Though physically similar, the SCSI Expansion Module should not be confused with the XM cabinet available with the 3B2 computer.

The SCSI Expansion Module (SCSI XM) is a mass storage SCSI device which contains three hard disk drives in a single cabinet. For example, an XM/900S contains three 300-megabyte drives for a total formatted storage capacity of 900 megabytes. The SCSI XM provides additional disk storage which can be used for file system and data base applications.

Along with three disk drives, the SCSI XM contains a SCSI target controller and power supply for all three drives. The SCSI XM is supported by the 3B2 SCSI Disk Controller Utilities (described in the "Software" section of this chapter).

Figure 2-4 shows the front and rear views of the SCSI XM (XM/900S). The front panel contains an area for identification (XM900S) and a power indicator. The rear panel of the SCSI XM contains the SCSI bus connectors, SCSI ID switch, AC power receptacle, and soft-power jacks.

The three drives in the SCSI XM are listed as three separate "disks" in the System Administration menus (for example: disk2, disk3, disk4).

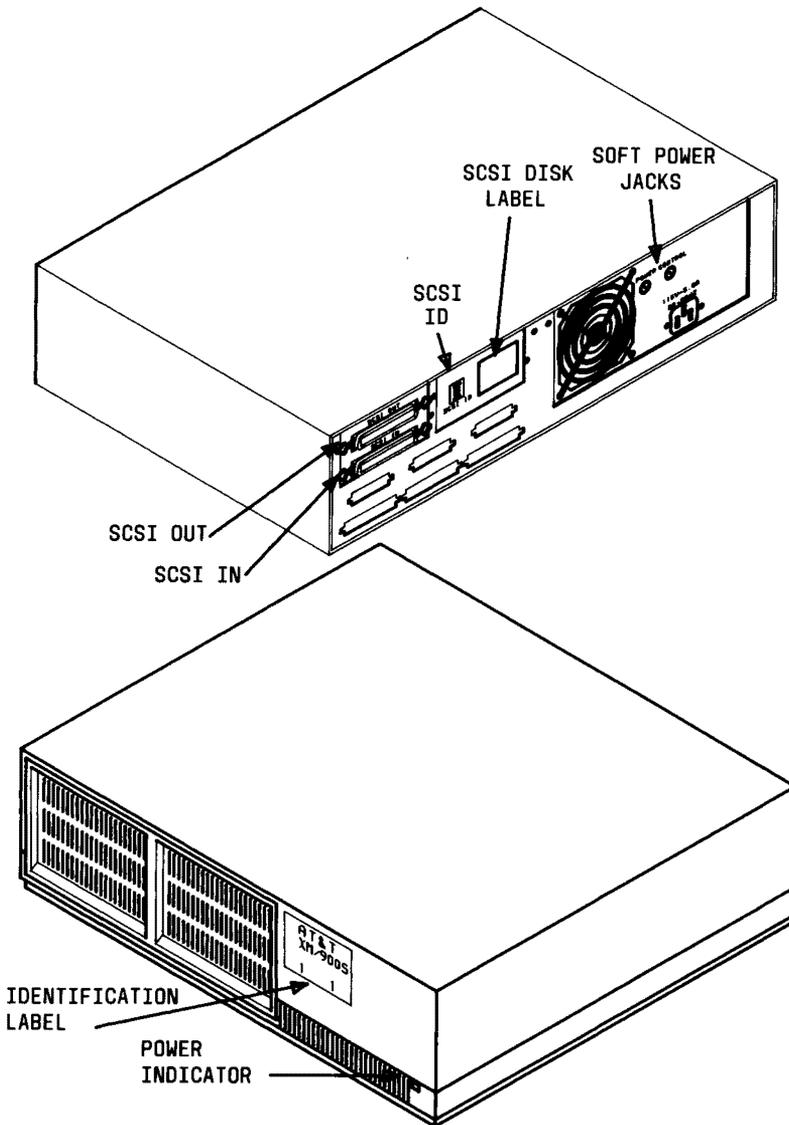


Figure 2-4: SCSI Expansion Module (XM/900S)

SCSI XM Cabling

Cabling to the SCSI XM (Figure 2-1) involves the following connectors:

- Two 50-pin connectors (SCSI IN and OUT)
- Two soft-power jacks
- AC power receptacle.

The SCSI bus cable originating at the 3B2 computer (Host Adapter) connects to the 50-pin SCSI IN connector on the SCSI XM. The SCSI OUT connector on the SCSI XM contains a SCSI bus terminator or a cable to another device on the SCSI bus.

The soft-power jacks provide power control for the SCSI XM from the 3B2 computer.

Expansion Module SCSI Bus Address

The SCSI ID push-button switch on the rear panel of the SCSI XM should be set to an appropriate setting for a peripheral device controller (1 through 7). This setting establishes the priority of this device on the SCSI bus. It is recommended that the SCSI XM have a bus priority (SCSI ID) lower than the SCSI Cartridge Tape or SCSI 9-Track Tape Drive.

The SCSI XM cabinet provides an area on the front panel for identification stickers. It is strongly recommended that stickers giving the System Administration number for the three internal disk drives be placed on the front of the SCSI XM at the time of installation.

The summary sheet on the rear panel should be filled out to include SCSI device information. The following is an example of the type of information that is needed.

SCSI Bus = 1

Host Adapter Slot Number = 1

SCSI Target Controller ID = 3

System Administration Name for each disk =

Disk 0 - disk5

Disk 1 - disk6

Disk 2 - disk7

SCSI Expansion Module (SCSI XM/900S)

The AT&T XM/900S houses three ESDI 300-MB (formatted) disk drives and a single-bridge controller to provide a total of 900 MB of data storage capacity in one package.

The XM/900S is designed for those who wish to expand their system in large increments (900 MB) of mass storage. Since it counts as only one tap, as many as seven such units could be installed per SCSI single-ended bus (14 per 3B2 computer).

The XM/900S can be used in a combination with DCMs and Tape Modules (TMs)—as long as the total number of DCMs, XM/900Ss, and TMs does not exceed 7 per bus. The cabling and bus addressing are similar to the previously described SCSI XM.

SCSI Cartridge Tape Modules (TM/60S and TM/120S)

Note: Though physically similar, this SCSI Cartridge Tape Drive should in no way be confused with the 3B2 Cartridge Tape Controller (CTC) Drive currently available with the 3B2 computer. The tapes written on these two cartridge tape drives are not compatible and should be kept separate.

Warning: If you attempt to write a cartridge tape written on a noncompatible tape drive, you may destroy the information on the tape.

The SCSI Cartridge Tape Module is a mass storage SCSI device which provides removable media capability to the SCSI System in the form of a cartridge tape. The primary purpose of the SCSI Cartridge Tape Module is for backing up and restoring the 3B2 computer file systems.

The SCSI Cartridge Tape Module contains a tape drive, an embedded SCSI controller, and power supply. The SCSI Cartridge Tape Module is supported by the 3B2 SCSI Cartridge Tape Utilities (described in the "Software" section of this chapter).

The TM/60S and TM/120S designate the 60 MB and 120 MB removable media cartridge tape drives, respectively. The TM/120S can read tapes written on the TM/60S. Figure 2-5 shows the front and rear views of the SCSI Cartridge Tape Module (TM/60S). The front panel contains recessed label areas for device identification, tape insertion mechanism, and a power switch. The rear panel of the SCSI Cartridge Tape Module contains the SCSI bus connectors, the SCSI ID switch, an AC power receptacle, and soft-power jacks.

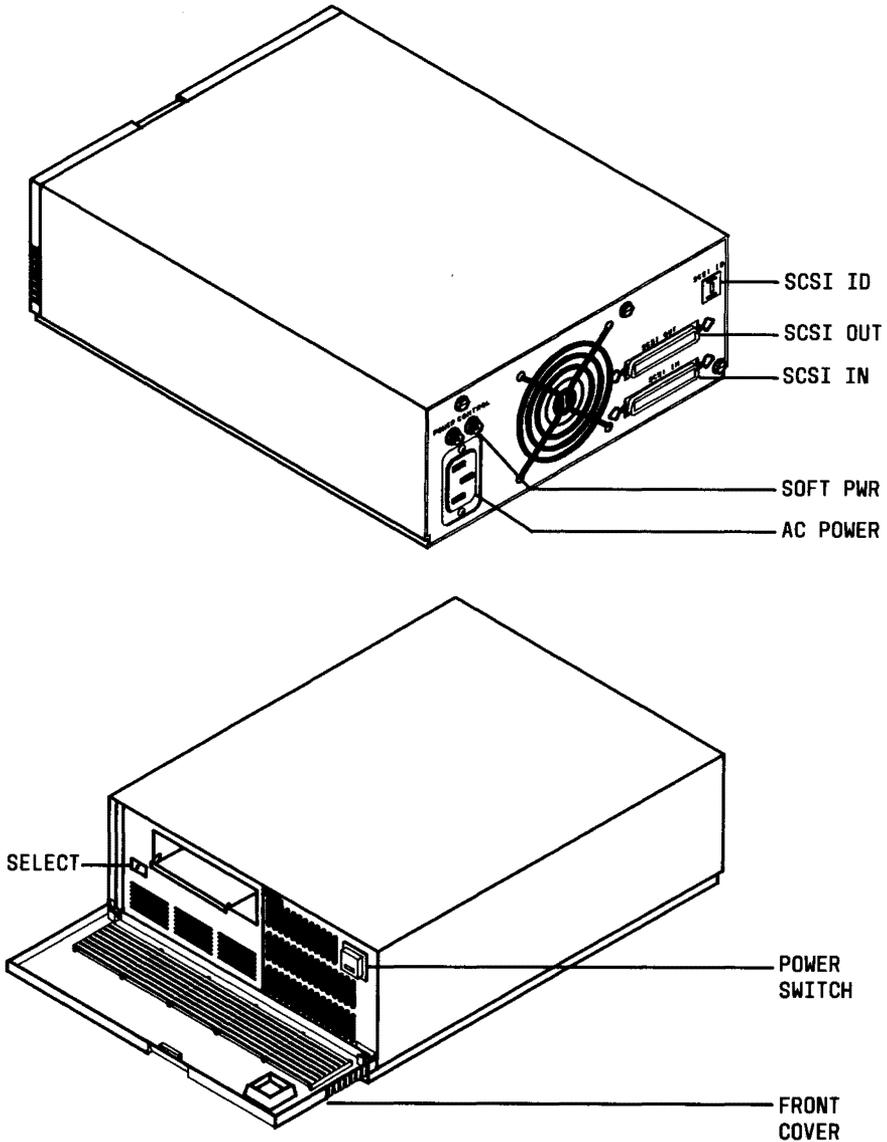


Figure 2-5: SCSI Cartridge Tape Module (TM/60S)

SCSI Cartridge Tape Cabling

Cabling to the SCSI Cartridge Tape Module (Figure 2-1) involves the following connectors:

- Two 50-pin connectors (SCSI IN and OUT)
- Two soft-power jacks
- AC power receptacle.

The SCSI bus cable originating at the 3B2 computer (Host Adapter) connects to the 50-pin SCSI IN connector on the SCSI Cartridge Tape Module. The SCSI OUT connector contains a SCSI bus terminator or a cable to another device on the SCSI bus.

The soft-power jacks provide power control to the SCSI Cartridge Tape Module from the 3B2 computer.

SCSI Cartridge Tape Module SCSI Bus Address

The SCSI ID push-button switch on the rear panel of the SCSI Cartridge Tape Module should be set to an appropriate setting for a peripheral device controller (1 through 7). This setting establishes the priority of this device on the SCSI bus. It is recommended that the SCSI Cartridge Tape Module have a bus priority (SCSI ID) higher than the SCSI DCM but lower than the SCSI 9-Track Tape Drive.

The two recessed label areas in the front panel of the SCSI Cartridge Tape Module are for device identification. The left square contains a symbol for a cartridge tape and the right square contains the unique device number given in the System Administration menus (for example: qtape1, qtape2, etc.).

The summary sheet inside the front cover should be filled out to include SCSI device information. The following is an example of the type of information that is needed.

SCSI Bus = 1

Host Adapter Slot Number = 1

SCSI Target Controller ID = 3

System Administration Name = qtape1

SCSI Manual 9-Track Tape

The SCSI 9-Track Tape is a mass storage device which provides removable media capability to the SCSI system in the form of 1/2-inch magnetic tape reels (maximum size is 2400 feet). The SCSI 9-Track Tape comes in a 5-foot, floor-standing cabinet. This peripheral device must be the last device on a SCSI bus.

The primary purpose for this device is for data transportability with other 3B computers (3B2, 3B5, 3B15, and 3B20) or other computers that support an industry standard tape media. This means data can be written on a tape from one 3B computer (for example, 3B20) and read off the tape into another 3B computer (perhaps a 3B2). (See "Using the SCSI 9-Track Tape" chapter of this manual for more information on data transfers.) A SCSI 9-Track Tape can also be used for backing up and restoring file systems.

In addition to the tape drive, the SCSI 9-Track Tape cabinet contains an embedded SCSI controller and power supply. The SCSI 9-Track Tape is supported by the 3B2 SCSI 9-Track Tape Utilities (described in the "Software" section of this chapter).

Figure 2-6 shows the front view of the SCSI 9-Track Tape with the front cover open. The front cover shields the magnetic tape and drive mechanism from dust and should be kept closed except when mounting or removing a tape. Controls for the drive can be accessed through the opening in the front cover.

Caution: Do not place any computer equipment in the SCSI 9-Track Tape cabinet. This could affect the thermal operating conditions which could result in equipment damage.

Figure 2-7 shows the rear view of the SCSI 9-Track Tape. This figure also points out the location of the SCSI IN connector and the AC power cord.

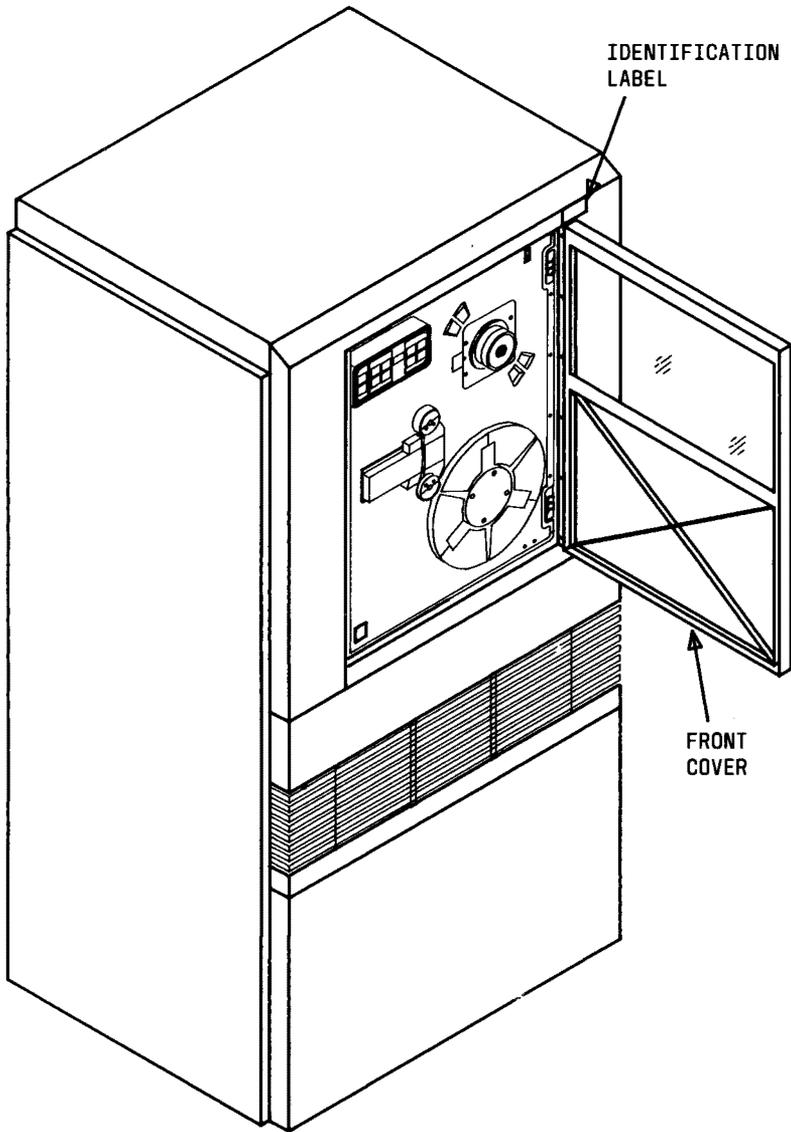


Figure 2-6: SCSI 9-Track Tape (Front View)

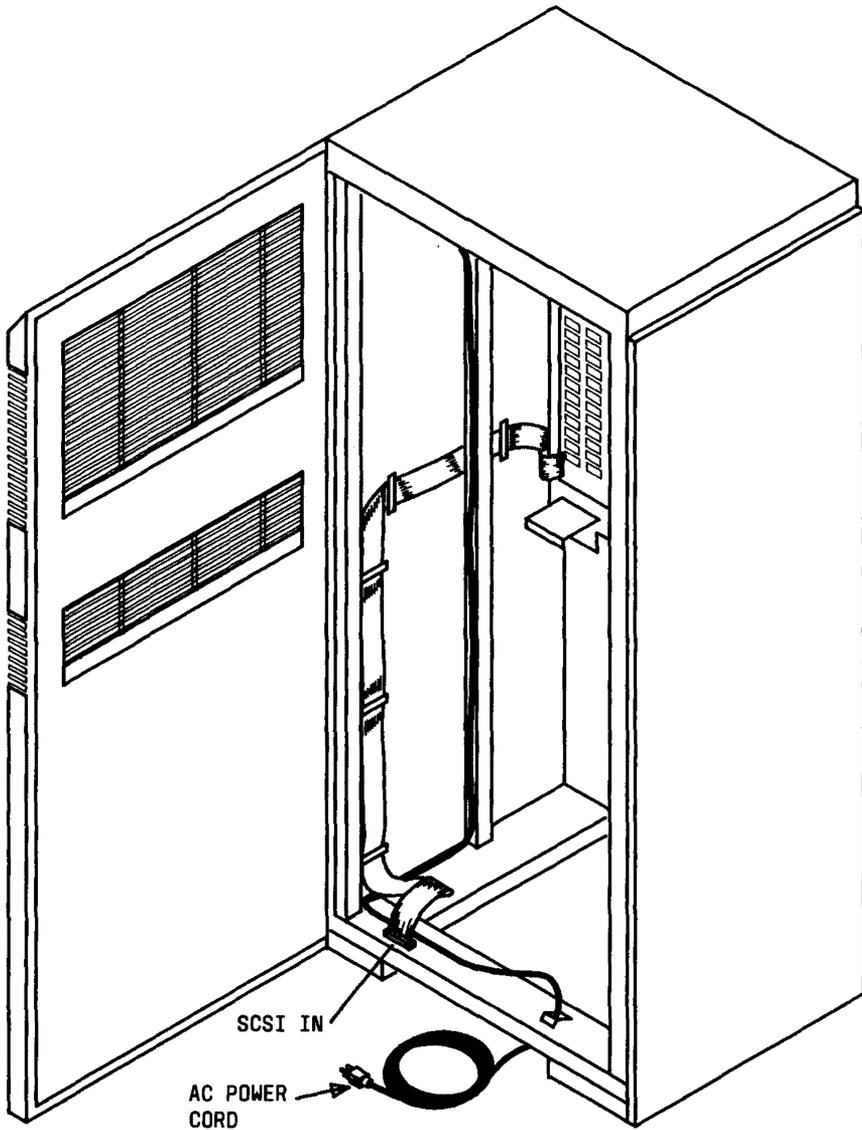


Figure 2-7: SCSI 9-Track Tape (Rear View)

9-Track Tape Cabling

Cabling to the SCSI 9-Track Tape (Figure 2-1) involves the following connectors:

- One 50-pin connector (SCSI IN)
- AC power receptacle.

The SCSI bus cable originating at the 3B2 computer (Host Adapter) connects to the 50-pin SCSI IN connector on the 9-track tape. Since the 9-track tape is the last device on a SCSI bus, a SCSI OUT connector is not required. The 9-track tape has an internal SCSI bus terminator.

Note: Installation of a 9-track tape drive at a position other than at the end of the SCSI bus should be done only by qualified personnel.

9-Track Tape SCSI Bus Address

Since the 9-track tape is at the end of the SCSI bus, it needs no SCSI ID switch. Its SCSI ID is factory preset to "7" which is the highest bus priority. Other SCSI controllers may be added between the Host Adapter (in the 3B2 computer cabinet) and the 9-track tape.

It is recommended that an identification sticker be placed on the front cover (upper right corner) of the 9-track tape cabinet at the time of installation. This sticker indicates the System Administration device name for the tape drive.

A summary sheet should be placed inside the front cover and should include SCSI device information. The following is an example of the type of information that is needed.

SCSI Bus = 1

Host Adapter Slot Number = 1

SCSI Target Controller ID = 7

System Administration = 9track1

SCSI Auto-Loading 9-Track Dual Density Tape

The auto-loading SCSI 9-Track Tape Drive provides an industry standard media and easy data interchange between systems. For SCSI Release 3.0 or later, two versions are offered; one version supports a single-ended SCSI while the other supports a differential SCSI.

When you insert a 9-track reel into the door (front-loading), the auto-loading feature threads the tape onto the take-up reel and positions the tape at the BOT (Beginning-of-Tape). Some of the advantages of the auto-loading SCSI 9-Track Tape Drive are as follows:

- smaller size and weight
- improved speed
- improved reliability
- auto-loading feature.

The following table summarizes some of the more important features.

Auto-Loading 9-Track Tape Drive	
Feature	Description
Height	8.75 inches
Weight	85 lbs
Recording Density	1600/6250 bpi
Streaming Tape Speed	125 ips
Start/Stop Tape Speed	125 ips
Time to Backup 40 MB	7 minutes in 1600-bpi mode using sysadm hsbbackup command
Time to Backup 145 MB	10 minutes in 6250-bpi mode using sysadm hsbbackup command
Auto-Load	Yes
Table Top Unit	Yes

The auto-loading SCSI 9-Track Tape connects to either the 3B2 Host Adapter or another node on the SCSI bus via the external 50-pin cable assembly. The rear of the cabinet will have two connectors marked "SCSI." Either can be used for SCSI IN or SCSI OUT. On the auto-loading 9-track tape packages, the SCSI ID is selected by front panel controls. See Chapter 7, "Using the SCSI 9-Track Tape," for additional information, operating instructions, and figures of both tape drives.

Power

Each SCSI peripheral module (DCM, DM, Cartridge Tape, SCSI XM) is equipped with a "smart" power supply which automatically switches between input voltages of 120- and 240-volts AC for both domestic and international applications. The SCSI 9-Track Tape, however, is ordered with a power supply to match the specific application (120- or 240-volts for manual). The auto-loading SCSI 9-Track Tape operates at a voltage range of 90-130 volts AC or 180-264 volts AC.

All SCSI devices should be connected to a reliable power source.

Warning: If you are not using the 3B Peripheral Power Control Unit in conjunction with the SCSI Shared Peripherals (SSP) feature to share peripherals by several computers, never remove power from any SCSI device while the system is powered up. This includes removing power by external means or by operating the front-panel power AC switch or LOGIC OFF switch. This unexpected loss of power may cause loss of data on a SCSI storage device.

Soft Power

Each of the SCSI peripheral cabinets that have soft-power jacks is under soft-power control of the 3B2 computer. This means that when the 3B2 computer is powered up or powered down, the SCSI devices will follow automatically.

Most SCSI devices get the soft-power signal through rear-panel soft-power jacks which daisy chain the signals from the 3B2 computer. The exceptions are the Disk Modules which get their soft-power signals through the 37-pin ESDI control cables from the Disk Controller Module. See Figure 2-1.

Warning: The soft-power jacks on the rear panel of ESDI Disk Modules (designated with a "/nE") are capped and should not be used. Soft power will not operate properly if these caps are removed.

Both the manual-loading and auto-loading SCSI 9-Track Tape cabinet have no soft-power jacks and, therefore, have to be manually controlled.

AT&T 3B Peripheral Power Control Unit (PPCU)

The PPCU is a small cabinet equipped to provide soft-power control for peripheral devices that are being shared on a differential SCSI bus. The PPCU outputs the power control signals necessary to power up 3B2 peripherals shared by several computers. The PPCU removes any potential difficulties arising from the need to power off one or more, but not all, of the computers using a shared set of peripherals.

The PPCU supports up to four inputs and accepts as its input three host 3B2 soft-power outputs and one remote power output. Once the PPCU is cabled and turned on, it monitors each host to determine if a "power on" condition exists. Detection of a powerup of any one or more hosts results in the output of both the 3B2 computer and the remote power control signals to the periphery. The PPCU will not monitor the remote power output unless at least one 3B2 host is cabled.

The 3B2 soft-power signal is a 5 volt DC signal that daisy chains to each 3B2 peripheral. Figure 2-8 shows the soft-power cable connections for a PPCU.

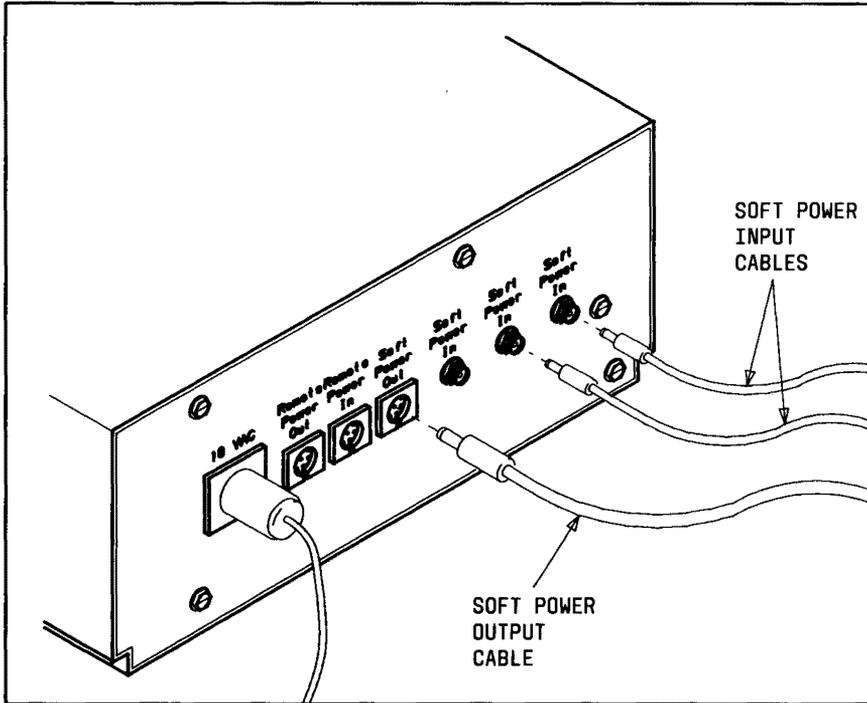


Figure 2-8: Soft-Power Connections to PPCU

SCSI Bus Terminators

Each SCSI bus requires two bus terminators; one at each end of the bus. The single-ended Host Adapter feature card normally requires an internal single-ended SCSI terminating resistor for the card and an external single-ended SCSI terminating resistor for the other end of the SCSI bus. The differential Host Adapter feature card normally requires an internal

SCSI Hardware Description

differential SCSI terminating resistor for the card and an external differential SCSI terminating resistor for the other end of the SCSI bus.

If the SCSI bus cables need to be disconnected for any reason, make certain that you reconnect all the cables and terminators properly.

Warning: If the connections to the Host Adapter are not made properly, irreparable equipment damage may occur.

Refer to the *AT&T 3B2 Computer SCSI Installation Manual* for installation instructions.

Software Description

The SCSI system comes with the appropriate software to support SCSI in both the UNIX System V and System Administration environments. New or changed UNIX System V manual pages are included in the *SCSI Release 3 Release Notes*.

UNIX System V Compatibility

The use of SCSI on the 3B2 computer requires the UNIX System V Release 2.0.5 swapping version, UNIX System V Release 3.0 paging, or later versions. Customers with operating systems preceding Release 2.0.5 will have to purchase an operating system upgrade to obtain the desired SCSI Release 3.0 features.

Utilities and Dependencies

The appropriate software utilities to support the different SCSI devices are provided as a part of each device package. The utilities for the different SCSI devices have to be installed in the proper sequence. (The *AT&T 3B2 Computer SCSI Installation Manual* gives the procedures for installing the SCSI utilities.) The following paragraphs describe the different utilities that are provided with SCSI.

Note: The SCSI Utilities are dependent on the System Administration Utilities; therefore, this package should not be removed. If, however, the System Administration Utilities are removed and reinstalled, the SCSI Utilities must also be reinstalled.

Software Packaging

SCSI Release 3.0 consists of the following five floppy disks. Some of these utilities are on the operating system cartridge tape for Version 3 3B2 computers.

- AT&T 3B2 Extended Core Upgrade Utilities (ECU)
- AT&T 3B2 SCSI Host Adapter Utilities Release 3.0 (SCSI HA)

3.1

3.0

- AT&T 3B2 SCSI Disk Controller Utilities Release 3.0 and AT&T 3B2 SCSI Disk Mirroring Utilities Release 1.0 (SD01)

Note: Both the disk mirroring and SCSI Disks Controller features reside on the same floppy disk.

- AT&T 3B2 SCSI 9-Track Tape Utilities Release 3.0 (ST00)
- AT&T 3B2 SCSI Cartridge Tape Utilities Release 3.0 (ST01).

AT&T 3B2 Extended Core Upgrade Utilities

Extended Core Upgrade (ECU) Utilities provide enhancements to both 3B2 computer operating system and System Administration functions necessary to support 3B2 computer self-configuration and peripheral utilities. Installation of the ECU Utilities requires that the System Administration Utilities be installed first.

Note: The ECU package is required for SCSI to operate on Version 2 3B2 computers but is not needed on the Version 3 3B2 computers.

Assuming you need the ECU Utilities, the order of installation follows:

- Extended Core Upgrade Utilities
- Host Adapter Utilities
- Disk Controller Utilities/Mirroring Utilities
- 9-Track Tape Utilities
- Cartridge Tape Utilities

AT&T 3B2 SCSI Host Adapter Utilities

SCSI Host Adapter Utilities provide a communication mechanism between the UNIX System V and the 3B2 SCSI Host Adapter card. Installation of the SCSI Host Adapter Utilities requires that the 3B2 Extended Core Upgrade Utilities be installed first.

AT&T 3B2 SCSI Disk Controller Utilities

Disk Controller Utilities support both the Disk Controller Modules and SCSI Expansion Modules. These utilities provide the unique functions required by the ESDI Disk Drives and SCSI target controller. These utilities provide the mechanism for communication between the 3B2 computer and the

specific Disk Controller Module or SCSI Expansion Modules connected on the SCSI bus.

Installation of the Disk Controller Utilities requires that the SCSI Host Adapter Utilities be installed first.

AT&T 3B2 SCSI Disk Mirroring Utilities

Disk Mirroring Utilities provide support for mirrored SCSI disks for 3B2 computers using UNIX System V Release 3.2 or later. The mirroring feature provides added reliability and data integrity for SCSI disks. This feature allows one driver to write to two separate disk partitions at once. See Chapter 5, "Mirroring SCSI Hard Disks," for additional information.

AT&T 3B2 SCSI 9-Track Tape Utilities

The 9-Track Tape Utilities support the SCSI 9-Track Tape. These utilities provide the unique functions required by the tape drives and the embedded SCSI controller. These utilities provide the mechanism for communication between the 3B2 computer and the specific 9-track tape connected on the SCSI bus.

Installation of the 9-Track Tape Utilities requires that the SCSI Host Adapter Utilities be installed first.

AT&T 3B2 SCSI Cartridge Tape Utilities

SCSI Cartridge Tape Utilities support the SCSI Cartridge Tape Module. These utilities provide the specific functions required by the SCSI Cartridge Tape Drive and embedded SCSI controller. SCSI Cartridge Tape Utilities provide the mechanism for communication between the 3B2 computer and the specific SCSI Cartridge Tape Module.

SCSI Cartridge Tape Utilities require that the SCSI Host Adapter Utilities be installed first.

Chapter 3: Administrative Information

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Introduction to Administrative Information

This chapter contains background information that you need to properly set up and operate your 3B2 SCSI in the UNIX System V environment. The chapters that follow go into more depth about using the SCSI peripherals.

Document Assumptions

For the purposes of this document, it is assumed that the SCSI equipment is properly installed, configured, and working according to the procedures given in the *AT&T 3B2 Computer SCSI Installation Manual*.

Likewise, problems that appear relating to UNIX System V or other 3B2 computer equipment may not be covered in this manual. If the information is not in this document, the administrator should refer to other documents, such as the 3B2 computer System Administration documentation for additional information.

System Administration

The operations explained in this manual are performed almost exclusively through the System Administration (**sysadm**) Menu commands.

System Administration is a menu-driven set of procedures which are designed to allow users to perform complicated administrative functions without having to remember all of the UNIX System V commands and arguments. The interactive **sysadm** menus allow the user to select which function to perform by typing in a number or function name. The *Owner/Operator Manual* has more general information on System Administration. However, information on System Administration commands that are unique to SCSI is given in this document.

Note: Users are strongly discouraged from embedding a call to any System Administration scripts within programs that they have written. If a user needs the function(s) that one of the System Administration scripts provides, then the user should use a copy of the desired script. That way, if that System Administration script changes in the future, the user's script will not be affected.

Execution of all System Administration commands requires that you be logged in as **root** or have **sysadm** privileges. To get to the System Administration Menu; simply type **sysadm** and press return. (Throughout the remainder of this manual, "return" will be shown as <CR>.) The following display shows the System Administration Menu.

```
# sysadm<CR>
```

```
Password: <password> <CR>
```

Note: Password may not be required but is recommended.

SYSTEM ADMINISTRATION

1	diagnostics	system diagnostics menu
2	diskmgmt	disk management menu
3	filemgmt	file management menu
4	machinmgmt	machine management menu
5	packagemgmt	package management
6	softwaremgmt	software management menu
7	syssetup	system setup menu
8	tapemgmt	tape management menu
9	ttygmt	tty management menu
10	usermgmt	user management menu

Enter a number, name, the initial part of a name, or
? or <number>? for HELP, q to QUIT:

To select one of these menus, simply type in the number of the menu or part of its name. For example, to use the Tape Management Menu, you would enter **8<CR>** after the System Administration prompt line. The following is a display of the Tape Management Menu:

```
Enter a number, name, the initial part of a name, or  
? or <number>? for HELP, ^ to GO BACK, q to QUIT:8<CR>
```

TAPE MANAGEMENT

1	compress	Compress file system
2	rmtape	Remove device nodes created for tape device(s)

Enter a number, name, the initial part of a name, or
? or <number>? for HELP, ^ to GO BACK, q to QUIT:

The command you select depends on the function you want to perform. For instance, if you want to remove a tape drive from the system configuration using the **rmtape** command in the previous display, you would enter **2<CR>** after the prompt.

Another method for performing System Administration commands is to type the desired command immediately after **sysadm** on the command line. For an example, typing **sysadm rmtape<CR>** will achieve the same result as going from the main menu to the Tape Management Menu and selecting the **rmtape** command. This method will be helpful after you have become familiar with the System Administration commands and do not need to step through the menus to find the desired command.

In this manual, the direct command procedure will be used to illustrate the sample operations.

Required Knowledge

The more knowledgeable you are about the 3B2 computer, UNIX System V, and SCSI, the easier it will be for you to properly administer the 3B2 SCSI subsystem. Some of the operations explained in this chapter will only be familiar to an experienced UNIX system user. The following paragraphs contain some of the topics with which you need to be familiar.

- You need to understand the concept of file systems and how file systems operate. A good understanding of the *root (/)* and */usr* file systems is needed.
- You need to know the names of the different devices available for use in the 3B2 computer and SCSI. An understanding of the terminology used in the System Administration menus is also necessary.
- You need to know the specifications for hard disks, 9-track tapes, and cartridge tape drives that can be used in SCSI.

The following paragraphs give basic information that you must understand in order to operate and administrate the 3B2 SCSI subsystem.

File Systems and Mounting

A file system is a section of data space that can be accessed by users who have access permission. File systems are usually divided into smaller sections called directories or files. These smaller sections make data manipulation easier.

One important term that you should know is "mount" or "mounting a file system." To mount a file system is to announce to the operating system that a file system is present on a particular storage device. Once a file system is mounted, it is treated like any other file system such as *root (/)* or */usr*. Typically, a mounted file system will reside on a hard disk.

The *root (/)* file system is the highest ranking directory in the UNIX system. The *root (/)* file system is always mounted (accessible) since you cannot operate the UNIX system without it. The *root* directory typically contains most of the administrative directories. All other file systems are mounted under the *root* directory.

Figure 3-1 shows the relationship between *root* and other file systems.

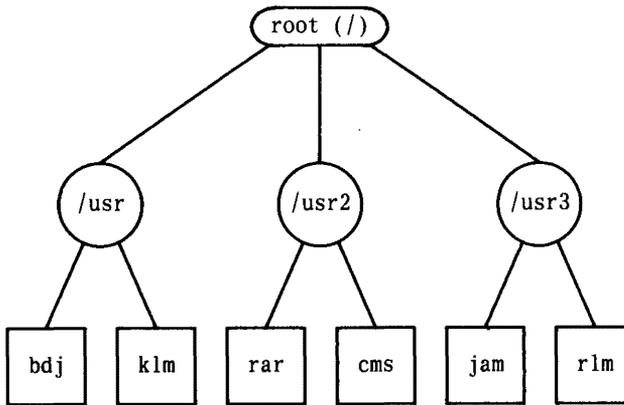


Figure 3-1: Relationship Between *root* and Other File Systems

The */usr* file system is normally an area where data is stored and manipulated by the users of the system. It is possible to have more than one file system for users. The number and organization of user file systems are discussed in detail in the chapter titled, "Using SCSI Hard Disks."

Since you can have many file systems mounted simultaneously, you must be aware of certain constraints. There is a tunable parameter in the operating system of the 3B2 computer known as **NMOUNT** that limits the number of file systems that can be mounted simultaneously. This parameter is normally set to 25 by default. This means only 25 file systems can be mounted simultaneously. With the possibility of having several file systems on multiple hard disk drives, this and other parameters may need to be increased. Your System Administration documentation contains more information on tunable parameters and how to modify tunable parameters.

System Administration Terminology

All peripheral devices associated with the 3B2 computer are assigned simplified generic names under System Administration. These device names will be listed in the appropriate System Administration menus. The following is a list of these device names:

Note: The *n* refers to the individual System Administration number of each device.

<i>9trackn</i>	Refers to the SCSI 9-Track Tape.
<i>ctapen</i>	Refers to the Cartridge Tape Controller (CTC) tape drive located in your 3B2 computer or in the 3B2 computer XM cabinet (<i>ctapen</i> is not a SCSI device).
<i>disketten</i>	Refers to the floppy disk drive.
<i>diskn</i>	Refers to all hard disk drives.
<i>qtapen</i>	Refers to the SCSI Cartridge Tape Module.

Another term that System Administration instructions refer to, but which may not be immediately clear, is "removable medium." The phrase "removable medium" refers to either a magnetic tape (cartridge or reel) or a floppy disk. Magnetic tapes and floppy disks are removable forms of data storage (as opposed to hard disks which are not removable). The phrase "removable medium" will only be used where a cartridge tape, a 9-track reel-to-reel tape, or a floppy disk is involved.

SCSI Specifications

One of the main specifications that you need to be concerned with is SCSI disk space values. Disk space refers to the amount of space available for data storage and manipulation. Disk space values are expressed as bytes or blocks of data. In this case, a "block" is equivalent to 512 bytes. A byte is equal to 8-bits of data or one character of text.

The 3B2 SCSI bus can be equipped with many hard disks (up to 28 disks are possible on one SCSI bus). These hard disks can be in Disk Modules (one per module) or in SCSI Expansion Modules (three hard disks per SCSI XM). The storage capacity of these hard disks is specified as a part of their name. For example, a DM/147E has 147 megabytes of formatted storage capacity.

An XM/900S has 900 megabytes of capacity (300 megabytes per drive). The way these hard disks are configured determines how much disk space is available for use.

To assist in partitioning the disk file area, Appendix A includes specific information on the different SCSI hard disks and blank roadmap sheets. This information should be used to keep track of the SCSI disk usage.

The SCSI Cartridge Tape Module, like the SCSI disk drives, reflects the storage capacity as a part of its name. For example, a TM/60S Cartridge Tape Module has 60 megabytes of capacity.

SCSI Device File Names

In UNIX System V, information is directed to or from a device via a special system device file. The device files are located under the */dev* directory. The following is an example of a device file for a SCSI hard disk:

`/dev/dsk/c1t1d0s6`

where: **dsk** refers to the type of device
c1 refers to the slot location of the Host Adapter
t1 refers to the target controller SCSI ID setting
d0 refers to the device logical unit number (LU ID)
s6 refers to the partition on the device.

Although most of the operations in this manual refer to the System Administration device name rather than a device file, it is a good idea to be familiar with the format of these files. Many messages to the system console refer to the device file when reporting on a peripheral device.

Refer to Appendix A for more information on the individual file names for each SCSI device.

Chapter 4: Using SCSI Hard Disks

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Introduction to Using SCSI Hard Disks

This chapter contains information on the administration and operations of the 3B2 SCSI hard disk drives in both the SCSI Disk Modules and the SCSI Expansion Modules. Moreover, this chapter includes background information, procedures on preparing the disks for use (formatting, partitioning, and repartitioning), and precautions associated with using hard disks.

As described in Chapter 2, the SCSI hard disks come in two module arrangements which are the Disk Module (single hard disk) and the SCSI Expansion Module (three hard disks). Most of the information in this chapter is, however, applicable to the hard disk in either arrangement. Therefore, all references in this chapter will be to "hard disk" and not to a specific module. Anything that is applicable to a particular module arrangement will be noted accordingly.

The SCSI bus provides the 3B2 computer with increased storage capability because of the large number of hard disk drives that can be added to the system. For example, assume you have a 3B2 computer with a SCSI bus and seven Disk Controller Modules connected to the bus. If each Disk Controller Module is supporting four Disk Modules and each Disk Module is a DM/300E (300 megabytes of storage), the total available file space is 8.4 gigabytes. With two SCSI buses, the total available file space is 16.8 gigabytes.

The primary application for SCSI hard disks is for user file space in the form of mounted file systems. Access to the SCSI hard disk will be completely transparent to the user. It is just like accessing file space on any disk drive.

Users and system administrators often have differing views concerning the function of hard disks. A user typically perceives the hard disk to be a place where all data is manipulated and stored for the convenience of the user. A system administrator, on the other hand, perceives a hard disk to be a constantly changing storage device that must function properly at all times.

The following paragraphs are intended to prepare the system administrator for setting up SCSI hard disks. The terminology used to describe hard disk drives is given with background information to explain how these terms relate to hard disks and to each other.

Note: You should be familiar with the naming conventions and terminology mentioned in Chapter 3, "Administrative Information."

The following software utilities have to be installed before a SCSI hard disk can be accessed by the 3B2 computer. (Refer to the *AT&T 3B2 Computer SCSI Installation Manual* for software installation information.)

- AT&T 3B2 Extended Core Upgrade Utilities
- AT&T 3B2 SCSI Host Adapter Utilities
- AT&T 3B2 SCSI Disk Controller Utilities.

Definitions and Terminology

Format

Formatting prepares the writing surface of a hard disk so that it can be partitioned. The SCSI hard disks are shipped from the factory already formatted. After the SCSI hard disks are installed, they are ready to be partitioned. If it becomes necessary to reformat a SCSI hard disk, the **sysadm format** command under the Disk Management Menu, "harddisk" submenu should be used.

Note: Formatting erases all data that may exist on a previously used disk drive.

Formatting one of the SCSI hard disks takes a few minutes to complete. For example, it takes approximately 15 minutes to format and verify a 147-megabyte hard disk (DM/147E). (See the "Formatting a SCSI Hard Disk" section of this chapter for more information.)

Partition(s)

One of the most important terms associated with the use of hard disk drives is "partitions." Basically, a partition is a portion of hard disk space. File systems are assigned to partitions to simplify and ease file management. A hard disk must be partitioned before it can be used.

Partitioning is the process of dividing hard disk space into smaller sections by assigning each section (partition) a certain number of blocks (1 block = 512 bytes of storage). Partitions do not have to be the same size. The total number of blocks assigned (all assigned partitions) must equal the number of blocks available.

Although the system allows for a total of 16 partitions per SCSI hard disk, System Administration only uses the last 8 partitions (designated 8, 9, a, b, c, d, e, and f). However, if you need more than 8 partitions, refer to the "Additional Hard Disk Partitions" in Appendix A for additional information.

Hard disks are partitioned using the **sysadm partitioning** or **sysadm mirpartition** commands under the Disk Management Menu. (See the "Partitioning a SCSI Hard Disk" section of this chapter or the "**sysadm mirpartition** Command" section of Chapter 5 for more information.)

Volume Table of Contents

The volume table of contents, more commonly known as VTOC, contains the partition description of a storage device, such as a SCSI hard disk drive. This is a physical block written on the disk drive. The **sysadm display** command displays the information contained in the VTOC.

The following is an example of the VTOC for a SCSI hard disk.

```
# sysadm display<CR>
```

```
Running subcommand 'display' from menu 'harddisk',  
HARD DISK MANAGEMENT
```

```
Select which device to use:
```

```
    1 disk1          2 disk2          3 disk3
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: 3<CR>
```

```
Displaying disk3 drive partitioning (hardware slot 2,  
target controller 1, drive 1):
```

```
* /dev/rSA/disk3 partition map
```

```
*
```

```
* Dimensions:
```

```
*   512 bytes/sector  
*   34 sectors/track  
*   10 tracks/cylinder  
*   816 cylinders  
*   814 accessible cylinders  
*
```

```
* Flags:
```

```
*   1: unmountable  
*  10: read-only  
*
```

```
*           First Sector   Last  
* Partition Tag  Flags Sector   Count  Sector  Mount Directory  
*   6       0    01      0    276760 276759  
*   7       0    01      0      340   339  
*   8       0    00     340  276420 276759  /usr3
```

```
#
```

Definitions and Terminology

As shown in the previous display, the VTOC for hard disks includes the following information:

Partition

The partition identifies the disk partition (section) by number.

Tag

The tag is the number code which identifies how a partition is used. The tag shows whether a partition is used as root, user, or as some other type of disk space. The table that follows gives the uses and codes that are reserved as tag identifiers.

NUMBER	NAME
0	UNASSIGNED
1	BOOT
2	ROOT
3	SWAP
4	USR
5	BACKUP

Flags

The flag is a number code identifying the mounting access mode. The following table gives the access modes and permissions they identify.

NUMBER	NAME
00	MOUNTABLE, read, and write
01	NOT MOUNTABLE
10	MOUNTABLE, read only

First Sector

This field identifies the first block of the partition. For example, partition 8 has a first sector of 340, meaning that block 340 is the first block of partition 8.

Sector Count

This count identifies the number of blocks (sectors) contained in the partition. For example, the before-mentioned partition 8 has a sector count of 276420 blocks. Partition 8 would occupy blocks 340 through 276759. In this example, partition 8 contains all of the usable disk area. However, if partition 8 had fewer blocks, partition 9 would begin where partition 8 ends. This usable area on a SCSI hard disk can be divided into 8 sequential partitions (8 through 15).

Last Sector

This field identifies the last block of the partition. For example, partition 8 has a last sector of 276759, meaning that block 276759 is the last block of partition 8.

Mount Directory

This identifies the mount point directory name if the partition contains a file system. This name is usually synonymous with the file system name.

Background Information

The allocation of disk space depends entirely on the usage of a SCSI hard disk. The entire disk can be allocated to one large partition for a large data base application, or the disk can be partitioned into eight smaller sections with various block sizes for each section. A wide variety of combinations exist between these two extreme examples. You will have to decide which configuration fits your application best. Some of the major considerations include the following:

- The use of the 3B2 computer system and the hard disks.
- The number of users on the system.
- The number of file systems needed. Also, the number of these file systems that will be mounted and available for public use.
- The procedure for handling backups. (One file system per cartridge tape, entire disk contents on cartridge tapes, etc.)
- Efficient use of the hard disk space.
- Whether or not any of the partitions will be used for mirroring. (Refer to Chapter 5, "Mirroring SCSI Hard Disk.")

All of these factors should be considered before you allocate space on a SCSI hard disk. The most important factor in deciding how to allocate space will be how you intend to use the hard disk.

dsconfig Command

The UNIX System V **dsconfig** (disk configuration) command gives a listing of the System Administration name, device file name, and the configuration for each peripheral device operating on your 3B2 computer. You can get a listing for all devices by inputting the following:

```
dsconfig<CR>
```

You can get an individual listing by inputting the following:

dsconfig *device*<CR>

The following is an example display of the **dsconfig** command.

```
$ dsconfig disk2<CR>
```

```
SA: disk2
```

```
Device: /dev/rdisk/clt1d0s6
```

```
Configuration: Slot 1 Target Controller 1 Drive 0
```

In the above example: Slot 1 refers to the location of Host Adapter card, Target Controller 1 refers to the SCSI ID setting (1) on the device controller, and drive 0 refers to the device's logical unit number (LU ID).

```
$
```

Preparing a New Hard Disk Drive

Prerequisites

There are several conditions that must be true before you can prepare a SCSI hard disk drive for use. Satisfying these conditions will help you prepare your hard disk without delays or interruptions.

1. The SCSI hard disk must be properly installed and cabled according to the *3B2 SCSI Installation Manual*.
2. All appropriate utilities, including the following, must be installed in your 3B2 computer:
 - Extended Core Upgrade Utilities
 - SCSI Host Adapter Utilities
 - Disk Controller Utilities.
3. You should have read and become familiar with Chapters 2 and 3 as well as the previous sections, "Definitions and Terminology" and "Background Information" in this chapter.
4. You should have a partitioning plan, complete with the number of partitions you want, and the approximate number of blocks of data per each partition.

Powering SCSI Hard Disks

The SCSI Disk Module has a front-panel power switch for controlling power to the internal hard disk drive. Likewise, the Disk Controller Module has a front-panel power switch that controls power to the DCM and to each associated Disk Module. In normal operation, these power switches should be in the ON position (switch pushed in). This way the DCM and DM will always be under "soft-power" control of the 3B2 computer.

Warning: **DO NOT remove power from the Disk Controller Module or the Disk Modules while the system is up. Irreparable damage to the drive or to the files may occur. Refer to your 3B2 computer documentation for the proper procedure for powering down the system.**

Before you power up the 3B2 computer, make certain that these power switches are pushed in.

Note: The SCSI Expansion Modules have no power switches and are controlled only by soft-power signals from the 3B2 Computer.

Formatting a SCSI Hard Disk

The SCSI hard disks come already formatted and normally will not need to be reformatted unless a catastrophic failure wipes out a disk or "bad blocks" occur that cannot be mapped to another area on the disk.

The **format** command only applies to the SCSI hard disks which are unmounted and unmirrored. Hard disks not on the SCSI bus cannot be reformatted using this command. System Administration allows you to select only a SCSI hard disk.

The command to format a hard disk is located in the "harddisk" submenu of the Disk Management Menu. However, if you type in **sysadm format**, you will be prompted to select one of two **format** commands. The following is an example of selecting the "harddisk" **format** command.

Caution: **Formatting erases all current information on a hard disk. Make certain you format the correct disk drive. If you ignore the system queries, you can accidentally "overwrite" a disk that has unmounted file systems.**

Note: Format should be performed while in the single-user mode.

Preparing a New Hard Disk Drive

```
# sysadm format<CR>
```

```
More than one subcommand or submenu name matches 'format'.
```

- 1 diskmgmt/format
- 2 diskmgmt/harddisk/format

```
Select one: [?, q]2<CR>
```

```
Running subcommand 'format' from menu 'harddisk',  
HARD DISK MANAGEMENT
```

```
Select which drive to use:
```

- 1 disk2
- 2 disk3
- 3 disk4

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT:disk2<CR>
```

```
By continuing with this command, the following file system(s)  
will be destroyed:
```

```
usr2 usr3 usr4.
```

```
Be sure this is what you want to do!
```

```
Do you want to continue with the format command? [y, n, q]y<CR>
```

```
Physical format of disk2 drive (hardware slot 2 tc'id 1  
drive 0) in progress.
```

```
Format /dev/rdisk/c2t1d0s6:
```

```
(Del if wrong)
```

```
Begin Format (No more than 7 minutes)
```

```
Begin Verify (No more than 10 minutes)
```

*Note: The above times will vary depending on the type disk
being formatted.*

```
The disk is now formatted and should be partitioned by  
invoking 'sysadm partitioning'.
```

```
Do you want to format another disk? [y, n, q]n<CR>
```

```
#
```

Partitioning a SCSI Hard Disk

The procedure for partitioning a SCSI hard disk drive is basically the same procedure as for all hard disk drives. The commands used for partitioning a hard disk are located in the "harddisk" submenu of the Disk Management Menu.

You need to have a complete plan for partitioning a SCSI hard disk before you start the actual partitioning procedure. Your plan should include the following:

- Number of partitions on disk (up to a maximum of eight)
- Size of each partition (in blocks)
- Name of each partition or file system (if other than default)
- Whether the partition will be mirrored (see Chapter 5, "Mirroring SCSI Hard Disks")
- Method of backup (size of each file system should be matched to the capacity of backup media).

The method of backing up a file system is important when you are determining the size of your disk partitions. For example, if you are going to use a TM/120S SCSI Cartridge Tape Module as the backup media, then partitions up to 245,000 blocks can be backed up on a single cartridge tape, since the capacity for a TM/120S cartridge tape is 245,000 blocks. Small file systems can be backed up on floppy disks that have smaller storage capacities. (Refer to Chapter 8, "Backup and Restore [Standard and Multiple Save Sets (MSS)]" for more information on backing up file systems.)

The procedure for partitioning a hard disk is as follows:

1. Before you partition a disk for the first time, you may find it useful to look at the "VTOC" of a currently partitioned hard disk drive. Invoke the **sysadm display** command on the disk drive that contains the *root* (/) and */usr* file systems (normally disk 1).

2. The next step is to partition the newly installed hard disk drive by using the **sysadm partitioning** command.

Note: As file systems are named, make sure you write these names on the summary sheet inside the front cover (Disk Module) or on the rear panel (Expansion Module).

By now, you should know the size and the mount directory name for each desired partition.

The following shows the command line entries and system responses for the **sysadm partitioning** command. In this example, two partitions of 100,000 blocks are formed. By default, the remaining blocks are placed into a third partition. The entire partitioning process will take several minutes.

```
# sysadm partitioning<CR>
```

```
Running subcommand 'partitioning' from menu 'harddisk',  
HARD DISK MANAGEMENT
```

```
Select which device to use:
```

```
1 disk1          2 disk2          3 disk3
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: 2<CR>
```

```
There are 276420 blocks remaining on disk 2.
```

```
How many blocks for disk 2 partition 8?  
[ (0 - 276420) again quit help ] (default 276420) 100000<CR>
```

```
Upon what directory should the file system within disk 2 partition 8  
be mounted? [ (pathname) again quit help ] (default /usr2) <CR>
```

```
How many blocks for disk 2 partition 9?  
[ (0 - 176120) again quit help ] (default 176120) 100000<CR>
```

*Note: The system rounds block numbers UP to the nearest disk
cylinder boundary to improve file system performance.
Therefore, the numbers do not add up correctly.*

```
Upon what directory should the file system within disk 2 partition 9  
be mounted? [ (pathname) again quit help ] (default /usr3) <CR>
```

```
How many blocks for disk 2 partition 10?  
[ (0 - 75820) again quit help ] (default 75820) <CR>
```

```
Upon what directory should the file system within disk 2 partition 10  
be mounted? [ (pathname) again quit help ] (default /usr4) <CR>
```

```
The disk2 drive is now partitioned.
```

```
#
```

3. To look at the VTOC of the newly partitioned hard disk, invoke **sysadm display** on that drive.

Preparing a New Hard Disk Drive

The following is a sample VTOC for a SCSI hard disk.

```
# sysadm display<CR>
```

```
Running subcommand 'display' from menu 'harddisk',  
HARD DISK MANAGEMENT
```

```
Select which device to use:
```

```
1 disk1          2 disk2          3 disk3
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: 2<CR>
```

```
Displaying disk2 drive partitioning (hardware slot 0  
target controller 1 drive 0):
```

```
* /dev/rSA/disk2 partition map
```

```
*
```

```
* Dimensions:
```

```
* 512 bytes/sector  
* 34 sectors/track  
* 10 tracks/cylinders  
* 816 cylinders  
* 814 accessible cylinders  
*
```

```
* Flags:
```

```
* 1: unmountable  
* 10: read-only  
*
```

```
*
```

			First	Sector	Last		
*	Partition	Tag	Flags	Sector	Count	Sector	Mount Directory
	6	0	01	0	276760	276759	
	7	0	01	0	340	339	
	8	0	00	340	100300	100639	/usr2
	9	0	00	100640	100300	200939	/usr3
	10	0	00	200940	75820	276759	/usr4

```
#
```

Repartitioning a SCSI Hard Disk

Repartitioning a SCSI hard disk that has already been partitioned may be necessary for a number of reasons. A particular partition may need more disk space (blocks) added to it, the application or use of the hard disk may have changed, you may have just added a new disk, or someone may have figured out a more efficient partitioning setup.

Warning: Repartitioning a hard disk erases all data currently stored on that disk. Make certain you repartition the correct disk and that you make a backup copy of all data beforehand.

rmdisk and /etc/scsi/mkdev Command

Repartitioning a hard disk involves using the **sysadm rmdisk** command and the **/etc/scsi/mkdev** command.

The **rmdisk** command removes all appearances of a device in the system. This is necessary in order to make new partitions on the disk.

Note: The **rmdisk** command will not remove the disk that contains the *root (/)* and */usr* file systems.

The **/etc/scsi/mkdev** executable file searches the SCSI equipped device table for any new device (a previously removed device would be new) and builds device files for them in the device (*/dev*) directory.

Examples of the **rmdisk** and **/etc/scsi/mkdev** displays are given in the following procedure.

Repartitioning Procedure

You need to have a complete plan for partitioning a SCSI hard disk before you start the actual procedure. Your plan should include the following:

- Number of partitions on disk (up to a maximum of eight)
- Size of each partition (in blocks)
- Name of each partition or file system (if other than default)

- Whether the partition will be mirrored (see Chapter 5, "Mirroring SCSI Hard Disks")
- Method of backup (size of each file system should be matched to the capacity of backup media).

The method of backing up a file system is important when determining the size of your disk partitions. For example, if you use a TM/120S SCSI Cartridge Tape Module as the backup media, partitions up to 245,000 blocks can be backed up on a single cartridge tape, since the capacity of a TM/120S cartridge tape is 245,000 blocks. Small file systems can be backed up on floppy disks that have smaller storage capacities. (Refer to Chapter 8, "Backup and Restore [Standard and Multiple Save Sets (MSS)]" for more information on backing up file systems.)

The procedure for repartitioning a SCSI hard disk is as follows:

Note: Read the entire repartitioning procedure before attempting to repartition a hard disk. The repartitioning of a hard disk requires a considerable amount of time due to the number of extended procedures. Be sure to consider the downtime of the computer.

1. Take the system to single-user mode by using the following:

shutdown -y -is

2. Mount all file systems using the following **mountall** command.

Note: The */etc/fstab* file contains the list of file systems to be mounted.

mountall /etc/fstab

3. If the data on the disk to be repartitioned is to be preserved, perform a backup of the file systems using the **sysadm backup** command. This backup can be used to restore the data to the hard disk after it is repartitioned. (Refer to Chapter 8, "Backup and Restore [Standard and Multiple Save Sets (MSS)]" for more information on **sysadm backup**.)

4. Remove the current partitions from the hard disk by using the **rm disk** command of the "hard disk" submenu (Disk Management Menu).

Caution: The "sysadm rmdisk" command will remove the specified hard disk from the system configuration. Be SURE you want to remove all access to the hard disk before executing this command.

The following shows the command lines and system responses for removing the SCSI hard disk (disk 2). In this example, the SCSI hard disk contains the */usr2*, */usr3*, and */usr4* file systems.

Repartitioning a SCSI Hard Disk

```
# sysadm rmdisk<CR>
```

```
Running subcommand 'rmdisk' from menu 'harddisk',  
HARD DISK MANAGEMENT
```

```
Select which device to use:
```

```
1 disk1          2 disk2          3 disk3
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: disk2<CR>
```

```
Removing disk2 from configuration (hardware slot 2  
target controller 1, drive 0).
```

```
This will DESTROY the contents of the following file systems:
```

```
  /usr2 (/dev/dsk/c2t1d0s8)  
  /usr3 (/dev/dsk/c2t1d0s9)  
  /usr4 (/dev/dsk/c2t1d0sa)
```

*Note: Make certain these are the file systems to be removed
and that they are not mirrored.*

```
Continue? [y, n, help] y<CR>
```

```
The disk2 drive (hardware slot 2, drive 0) has been  
removed from the configuration.
```

```
Select which drive to use:
```

```
1 disk1          2 disk3
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: q<CR>
```

```
#
```

5. Execute `/etc/scsi/mkdev` to update the device files so the system will recognize the existence of the disk to be repartitioned.

The following shows the command line and system responses associated with the `/etc/scsi/mkdev` command.

```
# /etc/scsi/mkdev<CR>
```

A new device has been labeled as follows:

```
System Administration Name      = disk2
Host Adapter Slot Number       = 2
SCSI Target Controller (TC) ID = 1
Logical Unit (LU) ID           = 0
Use "sysadm partitioning" to prepare it, if necessary.
#
```

6. Partition the hard disk as desired by using the **sysadm partitioning** command. (See the "Partitioning a SCSI Hard Disk" section earlier in this chapter.)

Note: As file systems are named, make sure you write these names on the summary sheet inside the front cover (Disk Module) or on the rear panel (Expansion Module).

7. Restore the data to the hard disk, if desired. This only applies to previously partitioned disks. (Refer to Chapter 8 for more information on restoring data to the hard disk.)
8. Return the system to the normal operating condition (multiuser mode) by using the following commands:

```
umountall
init 2
```

Note: The system may require a file system check at this time. If so, this may take a considerable amount of time depending on the size of the file systems to be checked.

Hard Disk—Precautions and Maintenance

The SCSI hard disks are basically maintenance-free devices. However, like any electro-mechanical device, they can be damaged through neglect. The following are a set of guidelines to use to ensure maximum life for your hard disks:

Warning: Drives sitting on the floor are susceptible to damage because of their location. Dirt and paper can block air-flow passages, and spilled liquids can cause several problems.

- Keep area around the disks clean and dry.
- Provide adequate space around the disk modules for proper ventilation. Make sure air vents are unobstructed.
- Do not move a disk drive while the front panel "power" indicator is on.
- Be cautious about bumping or kicking floor-mounted devices.
- Do not add nonstandard cables to the SCSI system.
- Follow all standard growth patterns.

Note: Always mount the Disk Modules on top of the Disk Controller Modules.

- Never unplug a disk drive without removing system power first.
- Never unplug a soft-power cable without shutting down the computer first.
- Never turn off the power to any SCSI controller without shutting down the computer first.

Chapter 5: Mirroring SCSI Hard Disks

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General

The AT&T 3B2 SCSI Release 3.0 provides an added high reliability and data integrity feature for SCSI disks called mirroring. Since hard disks are the most vulnerable part of a system, mirroring helps solve any reliability problems by allowing one driver to write to two separate disk sections at once. This is done by having the operating system provide a single virtual mirror partition to the user, while internally maintaining two physical disk partitions. If an error occurs while accessing either one of these disk partitions, the operating system can remove the offending disk from service and continue to operate using the other partition. The disk partitions bound to a mirrored partition can be in either the **ACTIVE** or **OUT-OF-DATE** state. If a disk partition is **ACTIVE**, this means that reads and writes to the mirrored partition are also being made to the disk partition. If the disk partition is **OUT-OF-DATE**, this means that the accesses are not being made to the disk partition.

The mirroring feature provides the 3B2 computer with data storage that has a greater reliability than a single disk, and with a greater overall fault tolerance if the **boot** device containing the */filesystem* is mirrored. When any disk is taken out of service, you can have an exact duplicate of a specific partition, or of the entire disk, already on line and immediately accessible. When the damaged disk is brought back on-line, you can use the **sysadm mirrestore** command to update the **OUT-OF-DATE** disk. The state of the mirrored partitions are maintained even when the system is rebooted.

This section provides the instructions on the following areas:

- Mirroring SCSI disk partitions through **sysadm** commands
- Mirroring SCSI disk partitions through UNIX system level commands
- Mirroring the *root*, *usr*, and *swap* partitions on a SCSI boot device.

The following commands are discussed in this chapter:

Procedure	Command
Display System Administration Mirror Management Menu	sysadm mirrorgmt
Partition a SCSI hard disk for mirroring	sysadm mirpartition
Configure a processor to support mirrored disk partitions	sysadm mirsetup
Verify that two mirrored disk partitions are identical	sysadm mirverify
Mirror two disk partitions on a processor	sysadm mirror or mirror(1M)
Copy the contents of a disk partition to another or the mirrored pair	sysadm mirrestore or mirrestore(1M)
Unmirror partitions of a SCSI disk	sysadm unmirror or umirror(1M)
Remove mirroring	sysadm mirremove
Display the current mirrored partitions for a SCSI disk	sysadm mirdisp or mirror(1M)
Unmirror the <i>root</i> , <i>/usr</i> , and/or <i>swap</i> partitions on a SCSI boot device	sysadm rootremove
Mirror the <i>root</i> , <i>/usr</i> , and/or <i>swap</i> partitions on a SCSI boot device	sysadm rootsetup

Mirroring Components

Actual mirroring is performed by a mirror driver residing in the */boot* directory. The mirror driver interfaces at one end with the user via the normal UNIX operating system calls (**open**, **close**, **read**, **write**, and **ioctl**) and on the other end, with the SCSI Release 3.0 disk driver. The mirror driver is a software module that is responsible for maintaining information about all mirrored partitions and for accessing the disk partitions that are mirrored. It also provides the **ioctl** function to do such things as restore, verify, mirror, and unmirror disk partitions.

This feature allows the user to bind two normal disk partitions, of equal size, to a mirror special device file name. Thus, each pair of mirrored partitions has one mirror special file. Once the two disk partitions are bound to the mirror special file, their separate disk special files are ignored. So, direct access to the partitions are no longer allowed.

Note: Some commands will not work on mirrored partitions because they require direct access to the device file (**hsbackup**, for instance). In this case, the partition should be unmirrored, backed up, and then remirrored. Other commands can be performed using similar work-arounds.

All writes are performed to both partitions through their mirror special file. Reads are alternated between the two partitions. Read performance of mirrored disks will be equivalent to that for nonmirrored disks. For small configurations, the write performance for a mirrored disk configuration is equivalent to that of a nonmirrored configuration.

Mirroring is supported for two partitions on the same disk (however; if you lose that disk, you have lost both partitions), the same bus, or two different buses on the same machine. If, for instance, you want to create and mount a file system on a currently mirrored disk partition, you would use the mirror special file name for the two partitions. The file system would then be created on both partitions at the same time.

If one of the disks should then fail, the disk could be removed, repaired, and brought back on-line without interrupting access to the currently mounted file system. The following restrictions apply when mirroring disk partitions:

- The disk partitions must be the same size.
- The disk partitions cannot contain mounted file systems.
- The disk partitions cannot contain the Volume Table of Contents (VTOC).

The number of possible mirrored partitions in your system is determined by a tunable parameter called **MPARTS** located in the */etc/master.d/mirror* file. This parameter determines the maximum amount of mirrored partitions.

There are three UNIX system level commands used to setup and maintain mirrored devices: **mirror**, **umirror**, and **mirrestore**. Each of these commands have a System Administration interface under the Mirror Management Menu. Before any of these commands can be used, however, you must make sure that the **MIRROR** driver is included in the */boot* directory. The */etc/system* file should contain the following line:

INCLUDE:MIRROR

The **mirror** command substitutes one mirror device file for two separate device files on separate disks. These mirror device files are contained in the */dev/dsk* and */dev/rdsk* directories. If you do not use the **sysadm mirsetup** command to create these files, you must create a device file for each mirrored pair. A file named */etc/scsi/mirrortab* contains a table of each currently mirrored device file.

Mirror device files are named consecutively using a *mirXXX* format. The XXX values indicate the sequence in which the mirror device file was created, beginning with *mir000*. For example, *mir000* is the name of the first mirror device file created; *mir001* is the name of the second, *mir002* is the name of the third, and so on. You can use the **sysadm mirror** command to display a current list of all mirror device files for each processor.

Note: For SCSI boot devices, *mir000*, *mir001*, and *mir002* are reserved for the *root*, */usr*, and *swap* partitions, respectively.

The **umirror** command unbinds one or both special disk files from the mirror special file. Once unbound, the two disk partitions can again be accessed through their special disk file names.

The **mirrestore** command is used to update an **OUT-OF-DATE** partition with the data from an up-to-date partition. Whenever you are setting up two partitions to be mirrored for the first time, you must use the **mirrestore** command to make sure both partitions are in the same state. You must also use the **mirrestore** command to update a disk that has been taken out of service and is brought back on-line.

The following sections discuss the format for each separate command, and their System Administration interfaces.

Using System Administration to Mirror SCSI Disks

The System Administration Mirror Management commands provide a facility for enabling and disabling the mirroring feature.

To reach the Mirror Management Menu, enter the **sysadm mirrormgmt** command or enter **mirrormgmt** from the Disk Management Menu.

The following menu is displayed:

MIRROR DISK PARTITION MANAGEMENT

1	mirdisp	display all mirrored partitions
2	mirpartition	partition a hard disk for mirroring
3	mirremove	remove the mirroring capability
4	mirrestore	copy a disk partition to its mirrored pair
5	mirror	mirror two disk partitions
6	mirsetup	configure the system to support mirroring
7	mirverify	verify two mirrored partitions are identical
8	rootremove	unmirror root, /usr, and swap partitions
9	rootsetup	mirror root, /usr, and swap partitions
10	unmirror	unmirror one or two disk partitions

Enter a number, a name, the initial part of a name, or
? or <number>? for HELP, q to QUIT:

Use the Mirror Management commands in the following order when setting up your mirrored devices for the first time:

mirsetup The **sysadm mirsetup** command includes the mirror driver line in the */etc/system*, creates a specified number of mirror device files or a default of 16 in the */dev/dsk* and */dev/rdisk* directories, and specifies the value for the **MPARTS** parameter in the */etc/master.d* mirror file.

mirpartition The **sysadm mirpartition** command interactively configures a SCSI hard disk for mirroring. Once partitioned, the drive can be mirrored by using the **sysadm rootsetup** command or the **sysadm mirror** command. This command does not configure the drive into the system automatically.

- mirror** The **sysadm mirror** command binds one or two disk special files to one mirror device file. The mirror device file is then added to the */etc/scsi/mirrortab* file. Currently, mounted file systems must be unmounted before the disk partitions can be bound to the mirror special file.
- mirrestore** The **sysadm mirrestore** command copies the contents of an **ACTIVE** partition to an **OUT-OF-DATE** partition, bringing both partitions into the **ACTIVE** state.

Once you have set up your mirrored devices, the following commands can be used to maintain mirroring:

- mirdisp** The **sysadm mirdisp** command lists all currently mirrored partitions.
- mirremove** The **sysadm mirremove** command undoes the setup done by **sysadm mirsetup**, removing the mirroring capability from the system.
- mirverify** The **sysadm mirverify** command verifies that two disk partitions that are mirrored together are identical.
- rootremove** The **sysadm rootremove** command performs the steps necessary to remove mirroring of *root*, *usr*, and *swap*. It edits the necessary files (*/etc/system*, */etc/scsi/mirlist*, etc.) to remove the mirror information associated with *root*, *swap*, or *usr*.
- rootsetup** The **sysadm rootsetup** command performs the steps necessary to support mirroring for *root*, */usr*, and *swap*. It does things like edit the */etc/system* file, edit the */etc/scsi/mirlist* file, etc. The */etc/scsi/mirlist* file lists all disk partitions which should automatically be mirrored when the system comes up. A "sysinit" entry in */etc/inittab* executes the shell script */etc/init.d/mirdisk*. When invoked, the **mirdisk** shell script executes **setmirror** and then mirrors all partitions listed in the */etc/scsi/mirlist* file. When the system goes to multiuser state, the */etc/rc2.d/S80restore* shell script examines all mirrored partitions and starts restores for any mirrored partitions with one disk **ACTIVE** and the other **OUT-OF-DATE**.

unmirror The **sysadm unmirror** command is used to unbind a mirrored partition from a mirror device file. The **sysadm mirdisp** command can be used to access the */etc/scsi/mirrortab* file and display all currently **ACTIVE** mirror device files and the states of their partitions.

The following sections cover each of these commands in more detail.

sysadm mirsetup Command

The **sysadm mirsetup** command is used to initially configure or reconfigure the number of mirror device files for a specific processor. The **sysadm mirsetup** command performs the following functions:

- includes the following mirror driver line in the */etc/system* file:

INCLUDE:MIRROR

- updates the */dev/dsk* and */dev/rdsk* directories to include the new device files. It prompts you for a specific number of mirror device files. If you do not choose a specific number, a default value of 16 mirror device files is used.
- updates the **MPARTS** parameter residing in the */etc/master.d/mirror* file. The **MPARTS** parameter determines the total number of mirrored device files supported by a processor at one time. This number can be anywhere from 1 to 255.

To set up mirroring, follow these steps:

1. Install the 3B2 SCSI Disk Mirroring Utilities Release 1.0 (see instructions for installing packages). The installation process will invoke the **sysadm mirsetup** command.
2. Enter the number of mirror devices to make. This step creates a specified or default number of mirror device files in the */dev/dsk* and */dev/rdsk* directories and updates the **MPARTS** parameter. Up to 255 mirror device files can be created. Pressing **RETURN** creates a default 16 mirror device files. On a SCSI boot device, the first three mirror device files (*mir000*, *mir001*, and *mir002*) are automatically reserved for the *root*, */usr*, and *swap* partitions. (See this chapter for information on mirroring a SCSI boot device.)

Note: Executing **sysadm mirsetup** later on can be used to change the number of mirror device files.

When your selections have been made, **sysadm mirsetup** displays a message indicating that the setup is complete. The following is a sample mirror setup procedure:

```
# sysadm mirsetup<CR>
```

```
Running subcommand 'mirsetup' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

```
The System has already been setup for mirroring and has 20  
mirror device files.
```

```
Do you want to re-configure the mirror device files? [y, n, ?] y<CR>
```

```
The first three mirror device files (mir000, mir001, and mir002)  
will be reserved for the sysadm rootsetup command to mirror root (/),  
usr (/usr), and the swap (/dev/swap) device.
```

```
Enter the number of mirror devices you want to make (default=16) [q, ?]: <CR>
```

```
Mirror setup on the System is complete. The System must  
be rebooted in order to mirror disk partitions on all of  
the 16 mirror devices.
```

```
Execute "shutdown -i6 -g0 -y" and  
wait for the "Console Login:" prompt.  
#
```

sysadm mirpartition Command

The **sysadm mirpartition** command is used to partition a SCSI hard disk to be used for mirroring. The procedure for partitioning a SCSI hard disk drive for mirroring is basically the same procedure as for all hard disk drives. Refer to Chapter 4, "Using SCSI Hard Disks" for partitioning definitions and terminology.

You need to have a complete plan for partitioning a SCSI hard disk for mirroring before you start the actual partitioning procedure. Your plan should include the following:

- Type of partitioning (bootable or nonbootable)
- Number of partitions to be mirrored (up to a maximum of 9 if nonbootable or 14 if bootable)
- Size of each partition to be mirrored (in blocks).

The type of partitioning is important when you are determining which file systems will be mirrored. For example, if you are going to mirror the *root* file system, it is suggested that the *root* file system be mirrored to a bootable device; then, the system can be booted from the mirrored device. User file systems and other system partitions can be allocated on either a bootable or nonbootable device.

The procedure for partitioning a hard disk for mirroring is as follows:

1. Before you partition a disk for mirroring, you will need to look at the VTOC of the partitioned hard disk drive you want to mirror. Invoke the **sysadm display** command on the disk drive that contains the *root* (*/*), *swap*, and */usr* partitions (normally disk 1).
2. The next step is to partition the hard disk drive by using the **sysadm mirpartition** command.

Note: As mirror partitions are allocated, make sure you write these names on the summary sheet inside the front cover (Disk Module) or on the rear panel (Expansion Module).

By now, you should know the size of each partition you are mirroring.

The following display shows the command line entries and system responses for the **sysadm mirpartition** command. In this example, three partitions of different block sizes are formed to mirror the *root*, *swap*, and */usr* partitions. The remaining unallocated blocks, if any, will be displayed after all partitions have been selected.

```
# sysadm mirpartition<CR>
```

```
Running subcommand 'mirpartition' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

```
Select which drive to use:
```

```
1 disk1          3 disk3          4 disk4          5 disk5  
2 disk2
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: 3<CR>
```

```
Do you want a bootable partition to mirror root?
```

```
[ yes no quit help ] help<CR>
```

Enter "yes" to allocate partitions 0 - 5 and 8 - 15 on disk 3. The TAG and FLAG fields in the VTOC will be assigned for partitions 0, 1 and 2.

Enter "no" to allocate partitions 2 and 8 - 15 on disk 3.

You may also enter "quit" to quit.

See the "SCSI Operations Manual" for more information on setting up mirrored partitions.

```
Press RETURN to continue <CR>
```

```
Do you want a bootable partition to mirror root?
```

```
[ yes no quit help ] yes<CR>
```

```
There are 276660 blocks remaining on disk 3.
```

```
How many blocks for disk 3 partition 1 (swap)?
```

```
[ (0 - 276660) again quit help ] (default 276660) 10440<CR>
```

Note: This command starts all partitions (except 1) on a cylinder boundary to improve file system performance. Therefore, you may have some unallocated blocks between partitions.

```
How many blocks for disk 3 partition 0 (root)?
```

```
[ (0 - 266220) again quit help ] (default 266220) 18360<CR>
```

```
How many blocks for disk 3 partition 2 (/usr)?
```

```
[ (0 - 247860) again quit help ] (default 247860) <CR>
```

```
The disk3 drive is now partitioned.
```

```
#
```

sysadm mirror Command

The **sysadm mirror** command binds a single disk partition or a pair of disk partitions to a single mirror device file. No more than two device files can be bound to a mirror device file at once. Once the partition or partitions have been bound to the mirror device file, all reads and writes to those partitions must go through the mirror special file.

Note: Some commands will not work on mirrored partitions because they require direct access to the device file (**hsbackup**, for instance). In this case, the partition should be unmirrored, backed up, and then remirrored. Other commands can be performed using similar work-arounds.

The mirror file can then be treated just like a regular disk partition. One of two **ACTIVE** disk partitions can also be unbound from the mirror device file for repair and then rebound without affecting a mounted file system on the mirror device file, as long as the remaining partition is in an **ACTIVE** state.

If you are setting up mirrored devices for the first time, make sure you run the **sysadm mirrorsetup** command BEFORE running **sysadm mirror**. Also, if you currently have file systems mounted on the partitions you want to mirror, you must unmount them before the partitions can be bound to the mirror special file.

To bind a single partition or a pair of partitions to a single mirror device file, follow these steps:

1. Enter the **sysadm mirror** command or enter **mirror** from the Mirror Management Menu.
2. Decide whether to bind one or two partitions to a mirror device file.
3. Select the disk that has the first partition to mirror.
4. Select the partition on the disk to mirror.
5. Enter the disk that has the second partition to mirror.
6. Enter the second partition to bind to the mirror device file.

The two partitions selected must be the same size. If they are not, an error message is displayed informing you of both partition sizes and indicating that they do not match.

Using System Administration to Mirror SCSI Disks

A warning message is also displayed if the mirrored partitions are on the same disk. Mirroring partitions on the same disk reduces both the high reliability and data integrity capabilities of the system. If the disk fails, both partitions become unavailable.

7. Enter the partition that is to be in the up-to-date or **ACTIVE** state, or let the system attempt to determine the **ACTIVE** partition.

The following example shows the procedure:

```
# sysadm mirror<CR>
```

```
Running subcommand 'mirror' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

```
Only two partitions can be mirrored to a mirror device file at once.  
The mirror device file is then used for all reads and writes to those  
partitions; that is, the mirror device file acts like the disk special  
device files. It can be mounted and treated like a regular disk file  
system. A disk partition can be unmirrored (unbound) from the mirror  
device file (as long as its not the only ACTIVE partition), for repair  
and then re-mirrored without affecting the users interface to a mounted  
file system on the mirror device file.
```

```
Enter which function you want to perform.
```

1. mirror two disk partitions to an available mirror device
2. mirror a single disk partition to an already mirrored disk partition

```
[1,2,?,q]: 1<CR>
```

```
Select which disk on the System has the first partition to mirror.
```

```
1 disk1          3 disk3          4 disk4          5 disk5  
2 disk2
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: 2<CR>
```

```
(Display continued on next page.)
```

("sysadm mirror" display continued from previous page.)

Select which partition on the disk2 drive to mirror.
Possibilities are: 0 1 2 6 7 8 9 a b c [?.q]: c<CR>

Select which disk on the System has the second partition to mirror.
1 disk1 3 disk3 4 disk4 5 disk5
2 disk2

Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 5<CR>

Select the second partition on the disk5 drive to mirror.
Possibilities are: 0 1 2 6 7 8 9 a b c [?.q]: c<CR>

Select which partition to initially be up-to-date (labeled ACTIVE). By default, the other partition will be initialized as out-of-date (labeled OUT_OF_DATE). The partition labeled ACTIVE contains the data that will initially be seen through the mirror device.

The third choice will allow the system to determine if a partition is up-to-date, and will then label the partitions accordingly. If the system cannot find an up-to-date partition then you MUST choose one.

Enter which function you want to perform.

1. initialize partition c of disk disk2 to be up-to-date
 2. initialize partition c of disk disk5 to be up-to-date
 3. let the system try to determine the up-to-date partition
- [1,2,3,?.q]: 3<CR>

Note: The system determines which partition is **ACTIVE** by checking the time stamps that were created by a previous mirror. If no activity has occurred on either partition and the system cannot determine which is the most up-to-date, an error message is displayed along with a prompt asking you to choose a partition.

ERROR: The system cannot determine which partition is up-to-date.

Enter which partition to initialize as up-to-date.

```
1 partition c of disk disk2
2 partition c of disk disk5
[1,2,?,q]: 1<CR>
```

The mir003 device has been used to mirror these disk partitions.

Would you like this entry to be mirrored automatically when the system comes up.

Enter [yes, no, ?]: yes<CR>

This entry has been added to the system mirror list.

Do you want to mirror another disk? [y, n, q] n<CR>

#

When the **sysadm mirror** command is complete, it is a good idea to use the **sysadm mirdisp** command to display the current table of mirrored partitions contained in the */etc/scsi/mirrortab* file. The table shows the mirror device name and both disk partitions, including their states. At the end of the **sysadm mirdisp** command, one of the disk partitions should be listed as the **ACTIVE** partition, and the other as the **OUT-OF-DATE** partition.

sysadm mirrestore Command

The **sysadm mirrestore** command brings an **OUT-OF-DATE** partition to the **ACTIVE** state by copying the contents of the **ACTIVE** partition to the **OUT-OF-DATE** partition. The **sysadm mirrestore** command is an uncomplicated command, but it must be performed in order to bring both partitions to the **ACTIVE** state.

To bring an **OUT-OF-DATE** partition to the **ACTIVE** state, follow these steps:

1. Enter the **sysadm mirrestore** command or enter **mirrestore** from the Mirror Management Menu.
2. Select the mirror device file to restore.

The **mirrestore** command then determines which partition is **ACTIVE** and copies its contents to the **OUT-OF-DATE** partition. The following example shows the procedure:

```
# sysadm mirrestore<CR>
Running subcommand 'mirrestore' from menu 'mirrormgmt',
MIRROR DISK PARTITION MANAGEMENT

Select the mirror device file to restore.
  1 mir001          2 mir003
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 2<CR>

Restoring the mir003 device file is in progress.
mir003 has been restored.

Do you want to restore another device file? [y, n, q] n<CR>
#
```

The **mirdisp** command should now list both partitions as **ACTIVE**.

sysadm mirverify Command

The **sysadm mirverify** command is used to compare the data on two mirrored disk partitions and verify that they are identical.

To verify that disk partitions are identical, follow these steps:

1. Enter the **sysadm mirverify** command or select option **6** from the Mirror Management Menu.
2. Select the mirror device file to verify.

The **mirverify** command then verifies that both mirrored disk partitions are identical. If they are not, the command will list the disk blocks that are different. The following example shows the procedure:

```
# sysadm mirverify<CR>

Running subcommand 'mirverify' from menu 'mirrormgmt',
MIRROR DISK PARTITION MANAGEMENT

Select the mirror device file to verify.
    1 mir003          2 mir004
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 2<CR>

Verification of the mir003 device file is in progress.

The verification of mir003 is complete.

Do you want to verify another device file? [y, n, q] n<CR>
#
```

sysadm mirdisp Command

The **sysadm mirdisp** command displays the contents of the */etc/scsi/mirrortab* file, including all currently **ACTIVE** and **OUT-OF-DATE** partitions for each mirror device file. Note that you may have created many mirror device files, but have only initialized a few through the **sysadm mirror** command. Only those mirror device files that have disk partitions bound to them are in the */etc/scsi/mirrortab* file.

To display the contents of the */etc/scsi/mirrortab* file, do the following:

- Enter the **sysadm mirdisp** command or enter **mirdisp** on the Mirror Management Menu.

The following example shows the procedure and table:

```
# sysadm mirdisp<CR>
```

```
Running subcommand 'mirdisp' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

MIRROR DEVICE	DISK PART #1 (STATE)	DISK PART #2 (STATE)
mir002	c1t4d0s1 (ACTIVE)	c2t3d1s1 (ACTIVE)
mir000	c1t4d0s0 (ACTIVE)	c2t3d1s0 (ACTIVE)
mir001	c1t4d0s2 (ACTIVE)	c2t3d1s2 (ACTIVE)
mir003	c2t3d0sc (ACTIVE)	none (-)

```
#
```

sysadm unmirror Command

The **sysadm unmirror** command unbinds a specified partition from its mirror special file, and removes its entry from the */etc/scsi/mirrortab* file. Once the partition has been unbound, it can only be accessed through its disk special file.

Note: It is suggested to only access an unmirrored partition if that partition will not be remirrored in the future. If the disk partition is unmirrored, then any accesses to it are not known by the mirror driver. If the partition is remirrored, the mirror driver will consider it to be in the same state as when it was unmirrored.

To unmirror a partition, follow these steps:

1. Enter the **sysadm unmirror** command or enter **umirror** from the Mirror Management Menu.
2. Select the mirror device file binding the disk partition(s).
3. Select the partition you would like unbound.

The **sysadm unmirror** command then unbinds the partition from the mirror special file. If no disk partitions are left bound to the mirror special file, **sysadm unmirror** then removes its entry from the */etc/scsi/mirrortab* file. When these functions have been completed, a message is displayed.

This command can be used to unbind one or both disk partitions from all mirrored partitions, except *root*, */usr*, and *swap* (*mir000*, *mir001*, and *mir002*). This command can be used on *root*, */usr*, or *swap*, only to remove one of the two disk partitions if the other disk partition is **ACTIVE**. To totally unmirror *root*, */usr*, and *swap*, use **sysadm rootremove**.

The following example shows the command line entries and system responses for the **sysadm unmirror** procedure:

```
# sysadm unmirror<CR>

Running subcommand 'unmirror' from menu 'mirrormgmt',
MIRROR DISK PARTITION MANAGEMENT

Select the mirror device which binds the disk partitions to unmirror.
  1 mir000          2 mir002          3 mir001          4 mir003
Enter a number, ? for HELP, or q to QUIT: 4<CR>

The mir003 device file is currently binding two disk partitions.

Enter which partition to unmirror:

  1. partition a of the disk5 drive
  2. partition a of the disk3 drive
  3. both partitions
[1,2,3,?,q]: 3<CR>

The unmirroring of mir003 completed successfully.

Enter which entry to substitute for the mirror entry in
/etc/fstab:

  1. partition a of the disk5 drive
  2. partition a of the disk3 drive
[1,2,?,q]: 1<CR>

Would you like to remove this entry from the system mirror list.
Enter [yes, no, ?]: y<CR>

The mir003 entry has been removed from the system mirror list.

Do you want to unmirror another disk? [y, n, q] n<CR>
#
```

To verify that the mirror partition was removed, the **sysadm mirdisp** command can be used. A **sysadm mirdisp** table for the previous example would not have a *mir003* entry listed in the output, but would still have *mir000*, *mir001*, and *mir002*.

sysadm mirremove Command

The `sysadm mirremove` command disables mirroring by removing the **MIRROR** driver and setting the **MPART** tunable parameter. Before you can use `sysadm mirremove`, you must first unmirror any mirrored partitions.

To remove mirroring, follow these steps:

- Enter the `sysadm mirremove` command or enter `mirremove` from the Mirror Management Menu.

The following example shows the procedure:

```
# sysadm mirremove
```

```
Running subcommand 'mirremove' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

```
The root, usr and/or swap partitions are mirrored on the system.  
Do you want to continue with this request? [y, n, q] y<CR>
```

```
The system must now be rebooted to remove  
the mirror capability from the system.
```

```
Execute shutdown -i6 -g0 -y and  
wait for the Console Login: prompt.  
#
```

Mirroring the SCSI Root Device— **sysadm rootsetup** Command

Mirroring the system boot device significantly increases the reliability of your system. If one disk containing the *root*, */usr*, and *swap* partitions becomes disabled, the system can be supported from the second device without interruption.

Mirroring the root device can either be performed manually, or through the **sysadm rootsetup** command under the Mirror Management Menu. Because mirroring the root device is a complicated procedure, it is highly recommended that you use the **sysadm rootsetup** command. It is also recommended that you mirror *root*, */usr*, and *swap* since this command automatically reserves mirror partitions *mir000*, *mir001*, and *mir002* for the *root*, */usr*, and *swap* partitions.

The **sysadm rootsetup** command provides an easy method of performing the complicated steps involved in mirroring the root device. To mirror a root device using System Administration, perform the following steps:

- If not previously installed, install the mirroring package to automatically invoke **sysadm mirsetup** or enter the **sysadm mirsetup** command.

This command creates the necessary mirror device files in the */dev/dsk* and */dev/rdisk* directories, and includes the **MIRROR** driver in the */etc/system* file (**mirsetup** coverage can be found earlier in this chapter).

- Enter the **sysadm rootsetup** command.
- Press **RETURN** for the default of mirroring *root*, */usr*, and *swap*.
- Select the disk that has the second partition to mirror.
- Select the second partition to mirror.

The same series of prompts is provided for each of the partitions.

- When you have completed **sysadm rootsetup**, reboot the 3B2 computer from the */etc/system* file.

Using System Administration to Mirror SCSI Disks

This rebuilds the */unix* file from the modified */etc/system* file, and mounts the *root* and */usr* file systems by their mirror device file specifications.

The following example shows the command line entries and system responses for mirroring a root device:

```
# sysadm rootsetup<CR>
```

```
Running subcommand 'rootsetup' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

```
Enter the file systems that are to be mirrored.
```

```
Possibilities are: root, usr, swap, all [(default all) ?, q]: all<CR>
```

```
Interrupt signals will be ignored.
```

```
The setup for mirroring root is in progress.
```

```
It is strongly recommended that the mirrored root partition  
be on a bootable drive (partition 0). Then in the event the  
primary root partition fails, the system can be rebooted from  
the mirrored backup drive. A bootable drive must be disk 0 on  
a target controller. Use the sysadm mirpartition command to  
create the bootable drive.
```

```
The root partition is on the disk3 drive partition 0.
```

```
Select the second disk on which you want to mirror root:
```

```
1 disk3          2 disk4          3 disk5          4 disk6
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: 3<CR>
```

```
Select the second partition on the disk5 drive to mirror root.
```

```
Possibilities are: 0 1 2 8 9 a b c [?, q]: 0<CR>
```

```
(Display continued on next page.)
```

("sysadm rootsetup" display continued from previous page.)

The setup for mirroring usr is in progress.

The usr partition is on the disk3 drive partition 2.

Select the second disk on which you want to mirror usr:

1 disk3 2 disk4 3 disk5 4 disk6

Enter a number, a name, the initial part of a name, or

? for HELP, q to QUIT: 3<CR>

Select the second partition on the disk5 drive to mirror usr.

Possibilities are: 0 1 2 8 9 a b c [?, q]: 2<CR>

The setup for mirroring swap is in progress.

The swap device(s) is/are:

disk3 drive partition 1

Select the first disk you want to contain the swap partition:

1 disk3 2 disk4 3 disk5 4 disk6

Enter a number, a name, the initial part of a name, or

? for HELP, q to QUIT: 1<CR>

Select the partition on the disk3 drive used for swap.

Possibilities are: 0 1 2 8 9 a b c [?, q]: 1<CR>

Select the second disk on which you want to mirror swap:

1 disk3 2 disk4 3 disk5 4 disk6

Enter a number, a name, the initial part of a name, or

? for HELP, q to QUIT: 3<CR>

Select the second partition on the disk5 drive to mirror swap.

Possibilities are: 0 1 2 8 9 a b c [?, q]: 1<CR>

/etc/system has been modified and should be used during a
reboot of the system.

The setup for mirroring root, usr, and swap partitions is
now complete. In order for the mirroring to become effective,
you must reboot the system now.

Execute shutdown -i6 -g0 -y and
wait for the Console Login: prompt.

#

sysadm rootremove Command

The **sysadm rootremove** command is used to unmirror the *root*, */usr*, and/or *swap* partitions. Mirroring the root device is a complicated procedure, but can be done easily through the **sysadm rootsetup** command. The **rootremove** command works backwards through the complicated procedure to "undo" the **rootsetup** command.

If it is desired to remove mirroring from the system, this command does not need to be executed. The **sysadm mirremove** command can be executed without unmirroring the *root*, */usr*, and/or *swap* partitions.

After the **rootremove** process is complete, you should reboot the system. This will complete the unmirroring of the root device.

The following shows the command line entries and system responses associated with the **sysadm rootremove** command.

```
# sysadm rootremove<CR>
```

```
Running subcommand 'rootremove' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

```
Enter the file systems that are to be unmirrored.
```

```
Possibilities are: root, usr, swap, all [(default all) ?,q]: all<CR>
```

```
Interrupt signals will be ignored.
```

```
Unmirroring of the root partition is in progress.
```

```
Unmirroring of the usr partition is in progress.
```

```
Unmirroring of the swap partition is in progress.
```

```
The unmirroring of root, usr, and swap partitions is  
now complete. In order for the unmirroring to become  
effective, you must reboot the system now.
```

```
Execute shutdown -i6 -g0 -y and  
wait for the Console Login: prompt.
```

```
#
```

Using UNIX System Commands to Mirror SCSI Disks

The following sections describe the UNIX system commands used to mirror SCSI disks. These commands are located in the `/etc/scsi` directory. In order to execute these commands, you must either place `/etc/scsi` into your search path (PATH variable in the `.profile`) or enter the full path name for each command. The examples in this manual assume that `/etc/scsi` has been added to the login search path.

mirror Command

The UNIX system `mirror(1M)` command substitutes two separate disk device files for one mirror device file, and inserts an entry in the `/etc/scsi/mirrortab` file for the mirror device. The `mirror` command only links the two special device files to a mirror special file. In order to make both partitions **ACTIVE**, you must use either the `mirrestore` or the `sysadm mirrestore` command to copy the contents of the **ACTIVE** partition to the **OUT-OF-DATE** partition.

The `mirror` command is entered in the following format:

```
mirror special1 special2 special3
```

Where:

- special1* The mirror special file. This is the special file used to identify the two mirrored partitions.
- special2* The disk special device file for the first partition to be mirrored. When used with the `-f` option, this partition will be made the up-to-date or **ACTIVE** partition.
- special3* The disk special device file for the second partition to be mirrored. When used with the `-f` option, this partition will be made the **OUT-OF-DATE** partition.

For example, the following command line binds partitions `c0t6d0s1` and `c0t7d0s8` to the `mir005` mirror device file:

```
$ mirror /dev/rdisk/mir005 /dev/rdisk/c0t6d0s1 /dev/rdisk/c0t7d0s8
```

This next example binds partitions **c0t7d0sa** and **c0t6d0s8** to the *mir010* mirror device file. The **-f** is included to force the command to use the first partition special device file as the **ACTIVE** partition, and the second partition special device file as the **OUT-OF-DATE** partition:

```
$ mirror -f /dev/rdisk/mir010 /dev/rdisk/c0t7d0sa /dev/rdisk/c0t6d0s8
```

The **mirror** command determines which partition is up-to-date by checking the time stamps on both partitions and determining which partition was most recently accessed. Time stamps are updated each time a special file is closed. In the event of a system crash, the time stamps for currently open files will not be updated. In this case, the mirror command will not be able to find an up-to-date partition and will fail. You must then force *special2* into the **UP-TO-DATE** condition by using the **-f** option. If you use the **-f** option, the position of the special files on the command line becomes important. The **-f** option forces *special2* into the **ACTIVE** state and *special3* into the **OUT-OF-DATE** state.

You can use the **mirror(1M)** command to bind just one disk special device file to a mirror special file. If a mirror special file is bound to just one disk special device file and you want to bind it to the second disk special device file, you must use both disk special device files as arguments in the command.

Entering the **mirror** command without specifying any special file names displays a list of all the mirrored disk partitions contained in the */etc/scsi/mirrortab* file. The */etc/scsi/mirrortab* file consists of a table of all currently mirrored partitions and their states. Entering the **mirror** command with one currently active mirror device file displays the partitions associated with that mirror file.

The following is an example of the **mirror(1M)** without arguments:

```
# mirror<CR>
Entry Date:  Mon Nov 16 15:51:52 1987
Mirror partition : /dev/rdisk/mir005
Partition Size  : 90396 blocks
Disk Partition 1 : /dev/rdisk/c0t6d0s1  ACTIVE
Disk Partition 2 : /dev/rdisk/c0t7d0s8  OUT_OF_DATE
*****
Entry Date:  Mon Nov 16 15:51:55 1987
Mirror partition : /dev/rdisk/mir010
Partition Size  : 90396 blocks
Disk Partition 1 : /dev/rdisk/c0t7d0sa  ACTIVE
Disk Partition 2 : /dev/rdisk/c0t6d0s8  OUT_OF_DATE
#
```

The **mirror** command binds two special disk files to one mirror special file, but it may only make one active. To make them both active you use the **mirrestore** command, which is discussed in the next section.

mirrestore Command

The **mirrestore(1M)** command copies the contents of the **ACTIVE** partition to the **OUT-OF-DATE** partition and sets both flags in the mirror driver to an **ACTIVE** state. This command must be used whenever partitions are mirrored for the first time through the **mirror(1M)** command to make the mirrored partitions active. This needs to be done whether the up-to-date partition has any data or not, as it sets the state of the mirror driver flags.

The **mirrestore** command is entered in the following format:

```
mirrestore special1
```

Where: *special1* is the mirror special file.

The **mirrestore** command checks the mirror driver to determine which of the mirrored pair is **OUT-OF-DATE**. When it has determined the **OUT-OF-DATE** partition, **mirrestore** sends a command to the mirror driver to copy the contents of the **ACTIVE** partition to the **OUT-OF-DATE** partition.

The following is a typical example of a **mirrestore** command line. A mirror special file (*mir004*) is first bound to two disk partitions through the **mirror** command. The two disk partitions are then brought to the **ACTIVE** state through the **mirrestore** command.

```
$ mirror /dev/rdisk/mir004 /dev/rdisk/c0t7d0s8 /dev/rdisk/c0t6d0s8
$ mirrestore /dev/rdisk/mir004
```

umirror Command

The **umirror(1M)** command unbinds the mirrored partitions from the mirror special file. You can unbind both partitions, or you can unbind just one, provided the other partition is **ACTIVE**. The **umirror** command is entered in the following format:

```
umirror special1 special2
```

Where:

- special1* The mirror special file. If only the mirror special file name is specified, the disk special files bound to that mirror special file are unmirrored and the mirror special file entry in the */etc/scsi/mirrortab* file is removed. After the command completes, the disk partitions can only be accessed through the disk special file name and not the mirror special file name.
- special2* A disk special file for a specific partition. If a specific disk special file name is given, only that partition will be unmirrored. The second partition is still bound to the mirror special file and the mirror special file remains in the */etc/scsi/mirrortab* file. However, the **umirror** command will not unbind the last **ACTIVE** partition of a mirrored pair.

There may be times when you would like to unmirror one disk partition from a mirror special file in order to service the disk, then rebind that partition

to the same mirror special file when the disk is back in service. As long as the remaining partition is in the **ACTIVE** state, this can be done simply by specifying the disk special file as the argument for the **umirror** command:

```
$ umirror /dev/rdisk/mir004 /dev/rdisk/c0t6d0s8
```

Note: It is suggested to only access an unmirrored partition if that partition will not be remirrored in the future. If the disk partition is unmirrored, then any accesses to it are not known by the mirror driver. If the partition is remirrored, the mirror driver will consider it to be in the same state as when it was unmirrored.

If the partition you want to mirror is the only **ACTIVE** partition, you must first make the other partition **ACTIVE**. For example, the following portion of a **sysadm mirdisp** command output shows partition **c0t6d0s8** to be an **OUT-OF-DATE** partition and **c0t7d0s8** to be an **ACTIVE** partition:

MIRROR DEVICE	DISK PART#1 (STATE)	DISK PART #2 (STATE)
mir003	c0t1d0sa (ACTIVE)	c0t1d1s8 (ACTIVE)
mir004	c0t1d0s8 (ACTIVE)	none (-)
mir005	c0t7d0s8 (ACTIVE)	c0t6d0s8 (OUT-OF-DATE)

In order to unbind **c0t7d0s8** from the mirror special file, you must first run the **mirrestore** command to bring both partitions up-to-date so as to leave one **ACTIVE** partition bound to the mirror device file when the **umirror** command is executed:

```
$ mirrestore /dev/rdisk/mir005
$ umirror /dev/rdisk/mir005 /dev/rdisk/c0t7d0s8
```

Similarly, if the mirror special file has only one partition currently mirrored to it, you must first use the **mirror** command to bind another partition to the mirror special file, then use the **mirrestore** command to bring the new mirrored partition to the **ACTIVE** state.

Other UNIX System Mirroring Commands

If the mirror table (*/etc/scsi/mirrortab*) becomes out of sync with the mirror driver (loses an entry for a currently mirrored partition), you can use the **setmirror(1M)** command to insert an entry into the mirror table.

The **mverify(1M)** command can then be used to verify that the data on two mirrored partitions is identical.

Mirroring the SCSI Boot Device Manually

Mirroring the system boot device significantly increases the reliability of your system. If one disk containing the *root*, */usr*, and *swap* partitions becomes disabled, the system can be supported from the second device without interruption.

Mirroring the root device can either be performed manually, or through the **sysadm rootsetup** command under the Mirror Management Menu. Because mirroring the root device is a complicated procedure, it is highly recommended that you use the **sysadm rootsetup** command. It is also recommended that you mirror *root*, */usr*, and *swap* since this command automatically reserves mirror partitions *mir000*, *mir001*, and *mir002* for the *root*, */usr*, and *swap* partitions. However, the manual procedure is as follows.

Steps for Mirroring *root*

Mirroring the *root* disk partition requires that the */etc/system* file be edited to include a new device specification called **MIRRORDEV**, and to change the existing **ROOTDEV** and **PIPEDEV** entries (the */etc/system* file includes **ROOTDEV** and **PIPEDEV** entries, but comments them out). Normally, the location of the *root* file system is determined from the VTOC on the SCSI boot disk, and not from the */etc/system* file. Adding new **MIRRORDEV** and **ROOTDEV** entries to the */etc/system* file overrides the original *root* partition specification in the VTOC and specifies the mirror device file on which the *root* file system is mounted. You do not need to change the boot disk VTOC.

Mirroring the *root* partition involves the following steps. The **sysadm rootsetup** command performs these steps automatically. If you are mirroring the *root* partition manually, complete the following steps using disk partitions appropriate for your system:

1. Edit the */etc/system* file to include the **MIRRORDEV** device specification.

This device specification includes only the two partition device files in the following format:

```
MIRRORDEV:/dev/rdisk/c1t4d0s0 /dev/rdisk/c2t3d1s0
```

2. Modify the **ROOTDEV** and **PIPEDEV** entries in the */etc/system* file to reflect the mirror device file.

This step redirects the root and pipe devices to the mirror device file instead of a specific disk device file. For example, after the above two steps, the */etc/system* file should be modified to include entries like the following:

```
MIRRORDEV:/dev/rdisk/c1t4d0s0 /dev/rdisk/c2t3d1s0
ROOTDEV:/dev/dsk/mir000
PIPEDEV:/dev/dsk/mir000
```

3. Ensure the first partition used to mirror *root* is in the **ACTIVE** state, and that the second partition is in the **OUT-OF-DATE** state.

The mirror device driver determines which partition is in the **ACTIVE** state by reading the time stamp on the partition's device file. The one that has received the most current activity is the one determined to be **ACTIVE**.

You can manually ensure that the second partition is determined to be **OUT-OF-DATE** by performing the following set of commands:

```
# prtvtoc /dev/rdisk/c2t3d1s0 > vtoc
# fmthard -s vtoc /dev/rdisk/c2t3d1s0
# rm vtoc
```

The above commands first redirect the contents of the second disk VTOC into a file called **vtoc**. The VTOC is then re-created using the same information. Rewriting the VTOC clears the time stamps on all partitions. With the second partition time stamp set to 0, the mirror driver will automatically determine it to be **OUT-OF-DATE**.

The `/etc/fmthard` command is used to zero out the time stamp on disk partitions. The mirror feature uses the time stamp information to determine which disk partition in a mirrored pair should be made **ACTIVE**. If one time stamp is zero and the other is nonzero, the nonzero one will be made **ACTIVE** (unless the force option is used).

Steps for Mirroring `/usr`

The next step is to mirror the `/usr` disk partition.

To mirror the `/usr` disk partition, perform the following steps:

1. Manually edit the `/etc/scsi/mirlist` file to include the `/usr` mirror device file and its corresponding partition device files.

This will ensure that the `/usr` disk partition will be mirrored whenever the system is rebooted.

2. Change **fstab** so it mounts `/dev/dsk/mir001` as `/usr`.
3. Ensure the first partition used to mirror `/usr` is in the **ACTIVE** state, and that the second partition is in the **OUT-OF-DATE** state.

You can use the same procedure to force the second partition into the **OUT-OF-DATE** state that you used with the `root` mirror device:

```
# prtvtoc /dev/rdisk/c1t4d0s2 > vtoc
# fmthard -s vtoc /dev/rdisk/c2t3d1s2
# rm vtoc
```

As with the `root` procedure, rewriting the VTOC on the second partition clears the partition time stamp. With the time stamp set to 0, the mirror driver will automatically establish the second partition as **OUT-OF-DATE**.

Steps for Mirroring `swap`

The final step in mirroring the entire boot device is to establish a mirror device file as the boot disk `swap` device. The original location of the `swap` device is determined by the VTOC on the boot disk. The default VTOC for a SCSI boot device reserves partition 1 as the `swap` device.

The following procedure will create a mirror device file for *swap* and set up your system to insert the mirror device file as the *swap* device specification each time you boot.

1. Choose the two disk partitions you want to bind to the mirrored *swap* partition.
2. Add to the file */etc/scsi/mirlist* the following:

```
/dev/rdisk/mir002 disk part #1 disk part #2
```

3. Add to the file */etc/system* the following directive:

```
SWAPDEV:/dev/dsk/mir002 0 size_of_swap_device
```

The Reboot Step of Mirroring a SCSI Boot Device

When the setup has been completed to mirror any combination of *root*, */usr*, and *swap*, the system needs to be rebooted. When the system comes up, these partitions will automatically be mirrored. The system will also make sure they are automatically put in the **ACTIVE-ACTIVE** state.

For example, if all three partitions (*root*, */usr*, and *swap*) were set up for mirroring, after the system is rebooted, the **sysadm mirdisp** command would display the following:

```
# sysadm mirdisp<CR>
```

```
Running subcommand 'mirdisp' from menu 'mirrormgmt',  
MIRROR DISK PARTITION MANAGEMENT
```

MIRROR DEVICE	DISK PARTITION #1 (STATE)	DISK PARTITION #2 (STATE)
mir000	c1t4d0s0 (ACTIVE)	c2t3d1s0 (ACTIVE)
mir001	c1t4d0s2 (ACTIVE)	c2t3d1s2 (ACTIVE)
mir002	c1t4d0s1 (ACTIVE)	c2t3d1s1 (ACTIVE)

Maintenance for Mirrored Disks

When you want to perform service or maintenance on disks that are mirrored, you can work only on one disk at a time. There must be a disk in the **ACTIVE** state at all times. For example, the following shows the sequence of procedures that would have to occur for performing maintenance on two disks that have been mirrored and are currently **ACTIVE**.

Disk 1 Procedure	Disk 1 Partition	Disk 2 Partition
Beginning state	ACTIVE	ACTIVE
Unmirror Disk 1 Partition	UNMIRRORED	ACTIVE
Perform maintenance on Disk 1	DISABLED	ACTIVE
Mirror Disk 1 Partition to Disk 2 Partition	OUT-OF-DATE	ACTIVE
Restore the Partitions	ACTIVE	ACTIVE

Disk 2 Procedure	Disk 1 Partition	Disk 2 Partition
Beginning state	ACTIVE	ACTIVE
Unmirror Disk 2 Partition	ACTIVE	UNMIRRORED
Perform maintenance on Disk 2	ACTIVE	DISABLED
Mirror Disk 2 Partition to Disk 1 Partition	ACTIVE	OUT-OF-DATE
Restore the Partitions	ACTIVE	ACTIVE

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Introduction to Using the SCSI Cartridge Tape

This chapter gives information that is needed for the administration and operation of the 3B2 SCSI Cartridge Tape. This chapter includes background information, instructions on inserting and removing tapes, commands for using the SCSI Cartridge Tape Module, and maintenance procedures.

SCSI Cartridge Tape Module

Note: Though physically similar, this SCSI device should in no way be confused with the CTC cartridge tape that is available with the 3B2 computer. The tapes written on these two cartridge tape drives are not compatible and should be kept separate.

Warning: If you attempt to read or write a cartridge tape written on a noncompatible tape drive, you may destroy the information on the tape.

The SCSI Cartridge Tape Module is a mass storage SCSI device which provides removable media capability to the SCSI System in the form of a cartridge tape. The primary purpose of the SCSI Cartridge Tape Module is for backing up and restoring the 3B2 computer file systems.

The SCSI Cartridge Tape Module has an embedded SCSI controller which connects directly to the SCSI bus. The SCSI bus address for the SCSI Cartridge Tape Module is set by the SCSI ID switch on the rear panel of the tape module. This setting establishes the priority of this device on the SCSI bus. It is recommended that the SCSI Cartridge Tape have a bus priority (SCSI ID) higher than the SCSI DCM but lower than the SCSI 9-Track Tape.

The following software utilities have to be installed before the SCSI Cartridge Tape can be configured into the 3B2 computer. (Refer to the *3B2 SCSI Installation Manual* for software installation information.)

- AT&T 3B2 Extended Core Upgrade Utilities
- AT&T 3B2 SCSI Host Adapter Utilities
- AT&T 3B2 SCSI Cartridge Tape Utilities.

Definitions and Terminology

Cartridge Tape

The cartridge tape used in SCSI Cartridge Tape Modules is an ANSI standard quarter-inch tape such as the 3M DC600A, or equivalent.

Transportability

The SCSI Cartridge Tape Module provides the ability to transfer data between the 3B2 computer and other computers that have a 1/4-inch cartridge tape drive that uses the QIC-24 or QIC-120 data format. The 60-megabyte SCSI Cartridge Tape Module writes and reads data in QIC-24 format; the 120-megabyte SCSI Cartridge Tape Module writes and reads data in QIC-120 format but can also read tapes written in QIC-24 format.

Write Protect Feature

Figure 6-1 shows the write protection tab on the cartridge tape. This tab is the key for protecting data written on the cartridge tape. If the arrow on the write protect tab is turned to the SAFE position, then the cartridge tape is write protected. If the arrow on the tab is pointing away from the SAFE position, then data can be written on the tape.

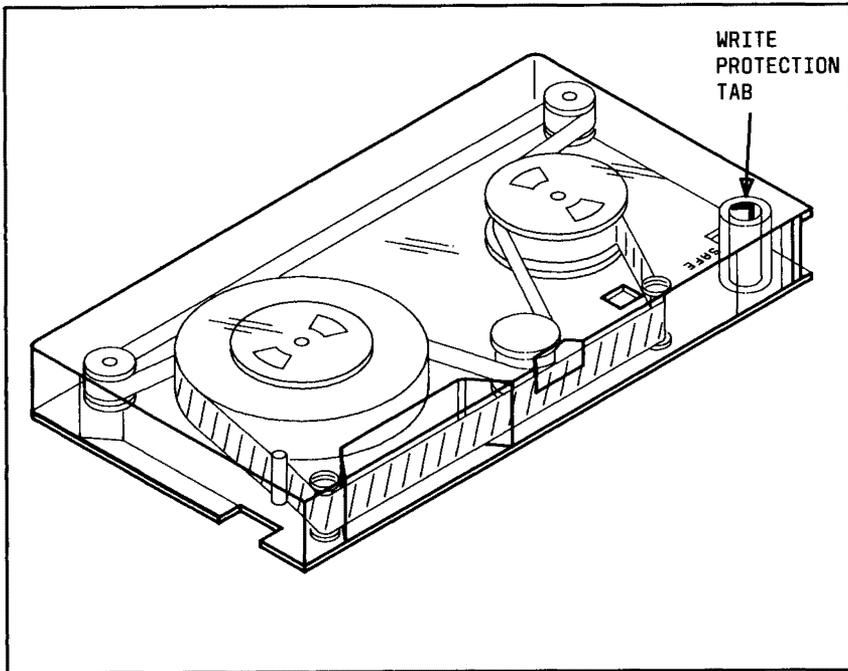


Figure 6-1: Cartridge Tape and Write Protection Tab

System Administration Commands

There are several System Administration commands that are associated with the operation of the SCSI Cartridge Tape Module. These commands fall

Definitions and Terminology

under the Tape Management Menu and File Management Menu. The following is a listing of the associated commands from each menu.

File Management Menu (filemgmt)	backup hsbackup hsrestore restore store
------------------------------------	--

Tape Management Menu (tapemgmt)	rmtape compress
------------------------------------	----------------------------------

The commands in the File Management Menu are associated with file system backups and restorals. Detailed information on these commands is given in Chapter 8, "Backup and Restore [Standard and Multiple Save Sets (MSS)]."

The Tape Management Menu commands are covered in this chapter.

Controls and Indicators

Figure 6-2 shows the front and rear panels of the SCSI Cartridge Tape Module. The front panel of the Tape Module contains the front cover, the tape insertion slot, the Power switch, and the Select indicator (behind the front cover). A product ID label on the inside of the front cover identifies the type of Tape Module that you have, such as, a 60 megabyte (TM/60S) or a 120 megabyte (TM/120S). The Power switch controls power to the Tape Module. The Power indicator lights when the Tape Module power is on. The Select indicator will light only when the Tape Module is performing a read or write operation.

The rear panel of the Tape Module contains the SCSI bus interface connectors, soft-power jacks, and the SCSI ID switch. (See the "System Description" chapter for more information.)

Powering the SCSI Cartridge Tape Module

The SCSI Cartridge Tape Module has a front-panel power switch which controls power to the internal tape drive. In normal operation, this switch should always be in the ON position (switch pushed in). This way the SCSI Cartridge Tape Module will be under soft-power control from the 3B2 computer.

Warning: DO NOT remove power from the SCSI Cartridge Tape Module while the system is powered up. Doing this may cause irreparable damage to the drive or to the files. Refer to your 3B2 computer documentation for the proper procedure for powering down the system.

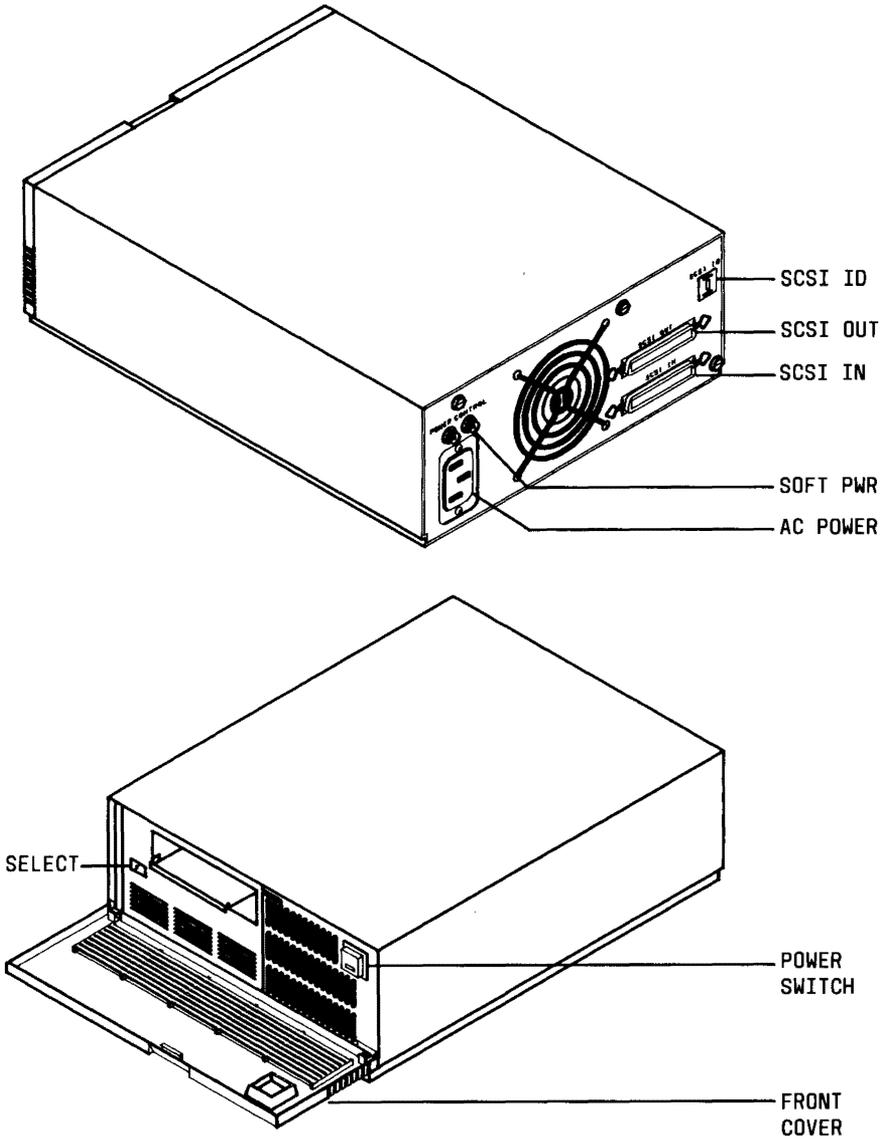


Figure 6-2: SCSI Cartridge Tape Module

Tape Operations

Precautions

Note: Observe the manufacturer's recommendations for proper care and usage of the cartridge tapes.

When handling cartridge tapes, observe the following precautions:

1. Never touch the tape surface or drive rollers.
2. Keep cartridge tapes away from X-rays and magnetic field devices, direct sunlight, excessive moisture, or extreme temperature changes.
3. Always acclimate a cartridge tape to the operating environment before inserting it into the tape module. Allow one hour of acclimation time for each hour outside the operating environment, up to a maximum of eight hours.
4. Never attempt to use a damaged cartridge tape; this may result in damage to the tape drive.
5. Store the cartridge tapes in their protective cases, preferably at room temperature.
6. Make certain the tapes used in the SCSI Cartridge Tape Module are properly marked so that they can be easily distinguished from the 3B2 computer CTC Cartridge Tape Drives.

Inserting Cartridge Tapes

The following procedure describes how to insert a cartridge tape into a typical SCSI Cartridge Tape Module.

Warning: To avoid equipment damage due to static electricity, be sure to touch the cabinet enclosure before inserting the cartridge tape into the tape drive.

Note: This procedure may differ slightly, depending on the type of tape drive that is supplied in the SCSI Cartridge Tape Module.

Tape Operations

1. Hold the cartridge tape so the tape door opening is facing to the left. (See Figure 6-3.)
2. Place the cartridge tape into the front loading slot.
3. Push the cartridge tape firmly into the drive until the locking mechanism operates (Figure 6-4).
4. Release the cartridge and it will spring forward slightly and stop just outside the front of the drive.

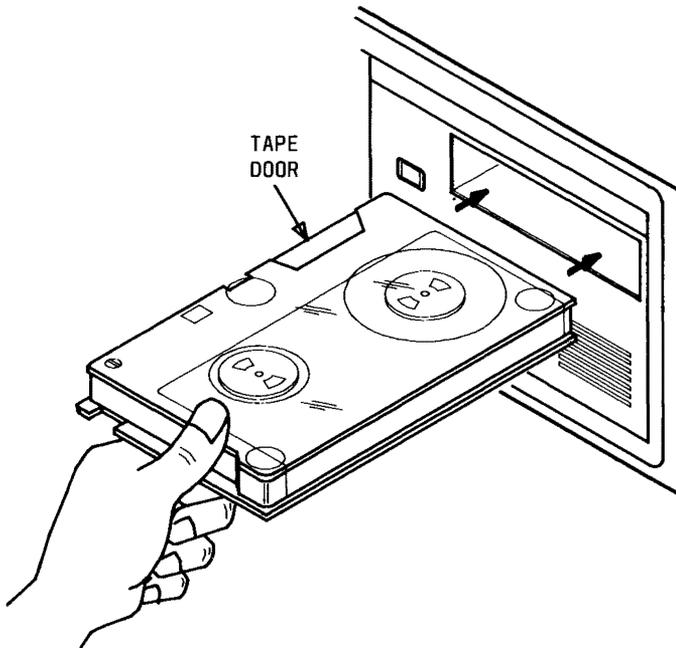


Figure 6-3: Positioning Cartridge Tape

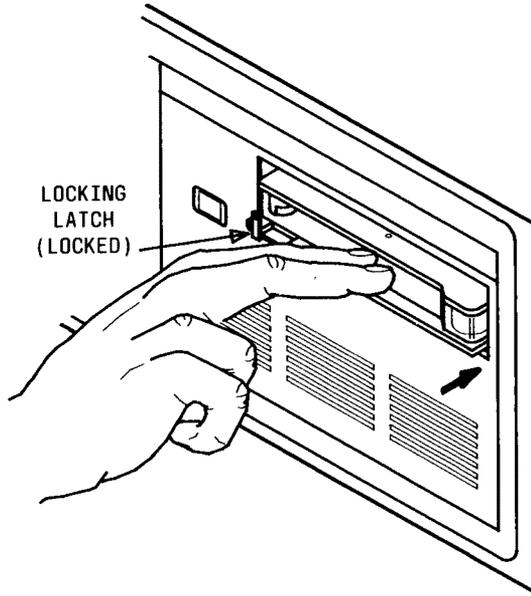


Figure 6-4: Inserting Cartridge Tape

The cartridge tape is now locked into place. Some tape movement will occur once the tape is inserted. After this movement stops, the tape is at the beginning and is ready to be used.

Removing Cartridge Tapes

The following steps describe how to remove a cartridge tape from a typical SCSI Cartridge Tape Module.

Note: This procedure may differ slightly depending on the type of tape drive that is supplied in the SCSI Cartridge Tape Module.

1. Make sure the "Select" indicator on the SCSI Cartridge Tape Drive is off before you remove a cartridge tape.

Tape Operations

Caution: Removing a cartridge tape while the indicator is on may result in lost data.

2. To remove the cartridge tape, push the cartridge into the tape drive to release the locking mechanism. You will hear an audible "click" when the latch releases (Figure 6-5).
3. Carefully pull out the cartridge tape until it clears the tape assembly.
4. Remove the cartridge tape and return it to its plastic case.

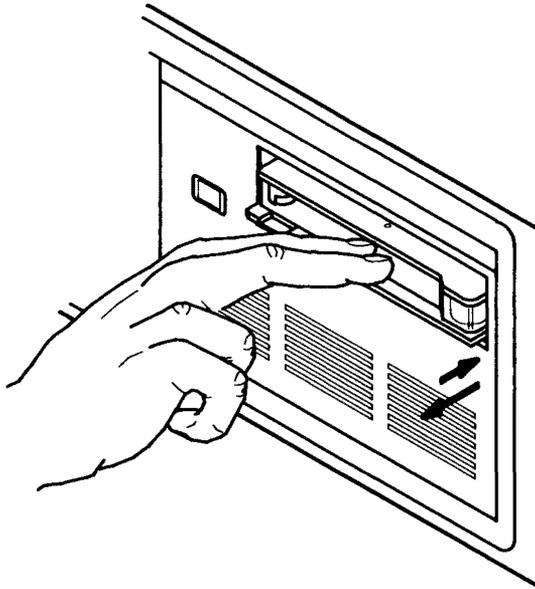


Figure 6-5: Removing Cartridge Tape

Caution: Make sure the cartridge tape drive remains in the unloaded position, that is, carriage plate in and locking latch not visible when no cartridge tape is installed. If the cartridge tape drive is in the loaded position when you turn on the computer, the cartridge tape drive is not added to the system configuration and you cannot access it.

Retensioning Cartridge Tapes

Most tape operation commands, such as **sysadm hsbbackup**, **hsrestore**, **backup**, **restore**, **store**, **compress**, etc., cause an automatic retensioning of the cartridge tape before the operation. This retensioning process ensures the integrity of the tape for use. The **sysadm compress** and **/etc/scsi/compress** commands cause the tape to be retensioned twice: once before the data is written to the tape and again before the data is read back from the tape.

If a tape operation requires more than one cartridge tape, the **hsbackup** and **hsrestore** commands will automatically retension each additional tape. The **backup**, **restore**, **store**, and **compress** commands, however, require you to manually retension each additional cartridge tape before you start the tape operation. Manual retensioning can be done using the **tapecntl(1)** command [see the **tapecntl(1)** manual page for more information].

Data Transfer Using SCSI Cartridge Tape

Data Transfer Between AT&T 3B2 Computers

The 3B2 computers with SCSI bus interfaces can transport files via the SCSI Cartridge Tape Module, using the **cpio** command. (Refer to the appropriate *3B2 Computer User's Reference Manual*.) The **cpio** utility preserves pertinent file information such as owner, permissions, and last time modified. The **cpio -oc** command writes files to tape, while the **cpio -ic** command retrieves files from tape. All data transfers should use the character device (raw mode).

Data Transfer Between AT&T 3B2 Computers and AT&T 6300 PLUS Personal Computers

The 3B2 computers with SCSI bus interfaces can also transport data files and directory structures to and from 6300 PLUS UNIX System Personal Computers equipped with 6300/PLUS Tape Expansion Units via the SCSI Cartridge Tape Module using the **cpio** command. (Refer to the appropriate user's reference manuals.) The **cpio** utility preserves pertinent file information such as owner, permissions, and last time modified. The **cpio -oc** command writes files to tape from the source computer, while the **cpio -ic** command retrieves files from tape to the destination computer. All data transfers should use the character device mode. Transfers between these computer systems that require more than one tape cartridge are not supported at this time.

Using the **sysadm compress** Command

Caution: One of the intermediate steps of this command erases the file system. Always make sure a backup of the file system is available.

The **sysadm compress** command internally rearranges the free disk space to improve access time. The **sysadm compress** command works by first writing the named file system onto a tape. Then, the original copy of the file system is removed from the hard disk, and the free block list is sorted into sequential order. Finally, the file system is copied from the tape back onto the hard disk in such a way that previously scattered file system blocks are collected together.

Note: The **sysadm compress** command will not compress the *root(/)* or */usr* file systems. See "Compressing the */usr* File System" section of this chapter to compress */usr*.

The execution time of the **sysadm compress** command will depend on the size of the file system being compressed. Improvement of system performance is directly related to the number of scattered free blocks that were present before compression. The greater the number of scattered free blocks (before compression); the greater the improvement of system performance.

The **sysadm compress** Procedure

The procedure for compressing a file system using **sysadm compress** is as follows:

1. Go to single-user mode. (See your System Administration documentation for more information.)
2. Mount the */usr* file system and the file system that is to be compressed by using the **mount** command:

Note: The */usr* file system must be mounted in order for you to use the **sysadm** commands.

3. Execute the **sysadm compress** command and follow the interactive instructions.

Using the sysadm compress Command

4. Unmount the `/usr` file system and any other file systems (other than `root`) and return the computer system to the normal operating condition (multiuser mode) by executing the following commands:

```
umountall  
init 2
```

The following shows the command line entries and system responses associated with the **sysadm compress** command. The system is in the single-user mode with the `/usr` and `/usr2` file systems mounted at the start of the sample.

```
# sysadm compress<CR>  
Running subcommand 'compress' from menu 'tapemgmt',  
TAPE MANAGEMENT  
Does an up-to-date backup copy of the file system  
you are about to compress exist? [y, n, ?] y<CR>  
If you had answered "no" to this question, the system would  
respond with a question asking if this process should be halted  
for you to perform a backup. A "no" to that question will  
continue the compress process.  
Select which drive to use:  
    1 qtapel          2 9track1  
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: qtapel<CR>  
Mounted file systems available for compression:  
/usr                /usr2  
Enter the file system you want to compress [q]: /usr2<CR>  
mount -f S51K /dev/dsk/clt1d0s8 /usr2  
Insert the first tape into qtapel drive.  
Press <RETURN> when ready. [q]:<CR>  
Retensioning tape.
```

(Display continued on next page.)

Using the sysadm compress Command

("sysadm compress" display continued from previous page.)

Copying file system to qtapel drive.
Copy to qtapel drive completed.

Removing file system; please wait.
Consolidating the freelist to reorganize the space.

/dev/dsk/c1t1d0s8

File System: usr2 Volume: 3.2.1

** Phase 1 - Check Blocks and Sizes
** Phase 2 - Check Pathnames
** Phase 3 - Check Connectivity
** Phase 4 - Check Reference Counts
** Phase 5 - Check Free List (Ignored)
** Phase 6 - Salvage Free List

2 files 2 blocks 978 free

*** FILE SYSTEM WAS MODIFIED ***

mount -f S51K /dev/dsk/c1t1d0s8 /usr2

Insert the first tape into qtapel drive.

Press <RETURN> when ready. [q]:<CR>

Retensioning tape.

Copying file system back in from qtapel drive.
2000 blocks

File system copy from qtapel drive completed.

Compress of /usr2 finished

You may now remove the tape.

#

Compressing the */usr* File System

Caution: One of the intermediate steps of this command erases the file system. Always make sure a backup of the file system is available.

The */usr* file system cannot be compressed using the **sysadm compress** command. The **/etc/scsi/compress** command has to be used instead. This is because System Administration is located in */usr*. The **/etc/scsi/compress** command internally rearranges the free disk space to improve access time. The **/etc/scsi/compress** command works by first writing the named file system onto a tape. Then, the original copy of the file system is removed from the hard disk, and the free block list is sorted into sequential order. Finally, the file system is copied from the tape back onto the hard disk in such a way that previously scattered free space is collected together.

The execution time of the **/etc/scsi/compress** command will depend on the size of the */usr* file system being compressed. The amount of system performance improvement will depend on the number of scattered free blocks that were present before compression.

The **/etc/scsi/compress** Procedure

The procedure for compressing a */usr* file system using **/etc/scsi/compress** is as follows:

1. Go to single-user mode. (See your System Administration documentation for more information.)
2. Mount the */usr* file system.

mount /usr

3. Execute the ***/etc/scsi/compress*** command and follow the interactive instructions.
4. Unmount the */usr* file system and any other file systems (other than *root*) and return the computer system to the normal operating condition (multiuser mode) by executing the following commands:

```
umountall  
init 2
```

The following display shows the command line entries and system responses associated with the ***/etc/scsi/compress*** command. The system is in the single-user mode with the */usr* file systems mounted at the start of the sample.

Compressing the /usr File System

```
# /etc/scsi/compress<CR>
```

Does an up-to-date backup copy of the file system
you are about to compress exist? [y, n, ?] y<CR>

*If you had answered "no" to this question, the system would respond with a
question asking if this process should be halted for you to perform a backup.*

*A "no" to that question will continue the **compress** process.*

Mounted file systems available for compression:

```
/usr
```

Enter the file system you want to compress [q]: /usr<CR>

```
mount -f S51K /dev/dsk/c1d0s2 /usr
```

Insert the first tape into qtapel drive.

Press <RETURN> when ready. [q]: <CR>

Retensioning tape.

Copying file system to qtapel drive.

Copy to qtapel drive completed.

Removing file system; please wait.

Consolidating the freelist to reorganize the space.

```
/dev/dsk/c1d0s2
```

```
File System: usr Volume: 3.2.1
```

```
** Phase 1 - Check Blocks and Sizes  
** Phase 2 - Check Pathnames  
** Phase 3 - Check Connectivity  
** Phase 4 - Check Reference Counts  
** Phase 5 - Check Free List (Ignored)  
** Phase 6 - Salvage Free List  
2 files 2 blocks 33306 free  
*** FILE SYSTEM WAS MODIFIED ***
```

```
mount -f S51K /dev/dsk/c1d0s2 /usr
```

(Display continued on next page.)

("sysadm compress" display continued from previous page.)

Insert the first tape into qtapel drive.

Press <RETURN> when ready. [q]: <CR>

Retensioning tape.

Copying file system back in from qtapel drive.

29650 blocks

File system copy from qtapel drive completed.

Compress of /usr finished.

You may now remove the tape.

#

Removing a SCSI Tape Device Using rmtape Command

This section gives the procedure for removing a SCSI Cartridge Tape device from the system configuration. This will be necessary for repair of the tape drive. The **sysadm rmtape** command removes the device files under */dev/rmt* and */dev/rSA* for a specified SCSI tape device.

Note: Once removed, the SCSI 9-Track Tape Drive can be reconfigured back into the system by executing the **/etc/scsi/mkdev** command.

The following is an example of the **sysadm rmtape** display:

```
# sysadm rmtape<CR>

Running subcommand 'rmtape' from menu 'tapemgmt',
TAPE MANAGEMENT

Select which drive to use:
    1 9track1      2 qtape1
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: qtape1<CR>

    Selected device: qtape1 drive is in hardware slot 1 tc'id 5 drive 0.
    Do you wish to continue? [y, n, ?, q] y<CR>
    Device nodes for qtape1 have been removed.

Do you want to remove device nodes of another tape drive? [y, n, q] n<CR>
#
```

SCSI Cartridge Tape Maintenance

The following is a list of suggested preventive maintenance activities that apply to the SCSI Cartridge Tape Module and associated tapes.

Tape Drive

- Keep the front cover closed at all times except when inserting or removing tapes.
- Clean the outside of the unit with mild soap and water.
- Since the Tape Module depends on an internal fan for cooling, make certain the inlet (front panel) and exhaust (rear panel) are unobstructed.
- Clean the tape head and tape cleaner blades once every 20 hours of use or after a reported tape error. Use the "Cleaning Procedure" in this section.

Note: Tape head may need cleaning more frequently if new tapes are being used.

- Inspect tape head for any build up or wear that could cause tape damage.

Note: Demagnetizing tape head and associated tape path is not required on this unit.

Cartridge Tape Care

- Store in tape container when not being used.
- Keep tapes in clean environment.
- Keep written tapes away from strong magnetic fields, such as large motors or microwave ovens.

Cleaning the Tape Head

Periodic cleaning of the head assembly is the only preventive maintenance required on the SCSI Cartridge Tape Module. The head needs to be cleaned after every 20 hours of actual tape operation. You may need to clean the head more often, however, if read/write errors occur. When a new tape is used, the head should be cleaned after the first two hours of use.

Establishing a Cleaning Schedule

Since the SCSI Cartridge Tape Module will be used primarily as a backup device, the cleaning schedule should be based on the time the Tape Module is used during backup and how often backup is performed.

For example, assume you have a 3B2 computer which has six file systems. Each file system takes approximately 15 minutes to back up each time, and backup is performed twice a week. This means the SCSI Tape Module would be used 3 hours each week and the head should be cleaned every six to seven weeks.

If a new tape is used in the above example for each file system, then the head should be cleaned in the first week and every 20 hours thereafter.

Cleaning Procedure

The following materials are required to clean the head assembly:

- Lintless cotton swab
- FREON* TF cleaner.

Warning: Clean only the tape head and tape cleaner blades with the FREON cleaner. Never clean the capstan with the head cleaning solution, as severe damage may result.

* Registered trademark of E. I. Dupont de Nemours & Co., Inc.

To clean the tape drive, do the following:

1. If a cartridge tape is in the tape drive, remove the cartridge tape.
2. Turn off the 3B2 computer.
3. Push the carriage plate forward until the tape load latch triggers.
4. Locate the head assembly (Figure 6-6).
5. Slightly moisten a swab with the cleaning solution and rub the swab up and down across the surface of the head.
6. Next, rub the swab along the white nylon tape blade on either side of the head.
7. If the capstan roller needs cleaning, use a clean cotton swab moistened with water only.
8. Wait approximately 10 seconds for the wet surfaces to dry.
9. Push the carriage plate in until it stops and the latch is released.
10. Turn the 3B2 computer back on.

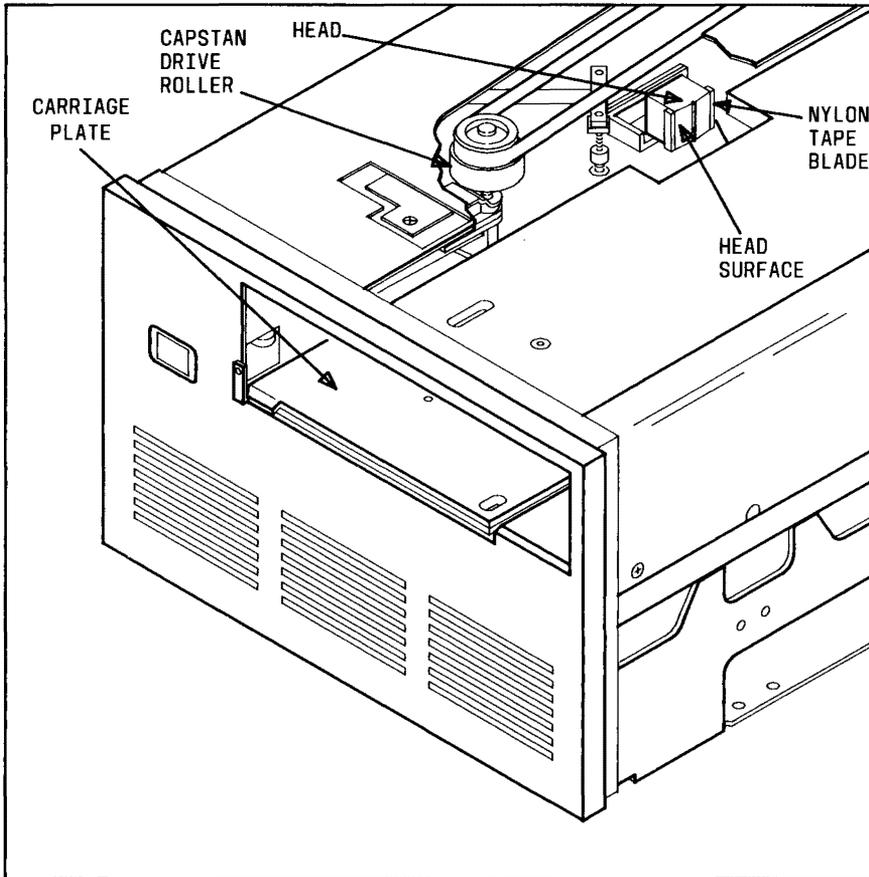


Figure 6-6: Cleaning SCSI Cartridge Tape Drive

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Introduction

This chapter contains information that is needed for the administration and operation of the 3B2 SCSI 9-Track Tape Drives. This chapter includes background information, instructions on loading and unloading tapes, commands for using the SCSI 9-Track Tape Drives, and maintenance procedures.

There are three 3B2 SCSI 9-Track Tape Drives:

- Manual-loading, single-density [1600 bpi (bits-per-inch)]
- Manual-loading, dual-density (1600/6250 bpi)
- Desk-top, auto-loading, dual-density (1600/6250 bpi).

The SCSI 9-Track Tape Drives are common mass storage media for the 3B computer product line. These tape drives are standard, 9-track, reel-to-reel devices which permit transfer of data between 3B2, 3B5, 3B15, 3B20, and 3B4000 computers. These drives are also media compatible with other vendors' computers. Although a SCSI 9-Track Tape Drive is intended primarily as a data transfer mechanism, it can also be used as a mass storage backup device.

All SCSI 9-Track Tape Drives have an embedded SCSI controller which connects directly to the SCSI bus. The SCSI ID number for manual-loading SCSI 9-Track Tape Drives is factory preset to "7" and must be the last device on a SCSI bus. The SCSI ID number for an auto-loading SCSI 9-Track Tape Drive is set by the customer. This tape drive can be located anywhere on a SCSI bus, however, "7" is recommended.

The following software utilities have to be installed before a SCSI 9-Track Tape Drive can be configured into the 3B2 computer. (Refer to the *AT&T 3B2 Computer SCSI Installation Manual* for software installation information.)

- AT&T 3B2 Extended Core Upgrade Utilities
- AT&T 3B2 SCSI Host Adapter Utilities
- AT&T 3B2 SCSI 9-Track Tape Utilities.

Definitions and Terminology

Transportability

The SCSI 9-Track Tape Drives provide the ability to transfer data between a 3B2 computer and other computer systems. A 9-track tape written on a SCSI 9-Track Tape Drive is compatible with 9-track tape drives on all AT&T 3B computers and computers manufactured by other companies.

The single-density SCSI 9-Track Tape Drive writes data at 1600 bpi (low-density); the two dual-density SCSI 9-Track Tape Drives allow you to write data at either 1600 bpi (low-density) or 6250 bpi (high-density). Low-density data is written in the ANSI standard x3.39-1973 Phase Encoded (PE) format. High-density data is written in the ANSI standard x3.54-1976 Group Coded Recording (GCR) format.

Reel Size

The SCSI 9-Track Tape Drives use 1/2-inch magnetic tape reels that are 7.0, 8.5, and 10.5 inches in diameter. Figure 7-1 lists the data storage capacity of 1/2-inch magnetic tape reels.

REEL SIZE (INCHES)	LOW DENSITY (MEGABYTES)	HIGH DENSITY (MEGABYTES)
7.0	10.5	38.5
8.5	21.0	77.0
10.5	42.0	154.0

Figure 7-1: Tape Storage Capacity

Write Enable Ring

The 9-track tape reels are designed to use write enable rings. Write enable rings are located on the back of a reel. A write enable ring is illustrated in Figure 7-2. The SCSI 9-Track Tape Drives provide a sensor to detect the presence of this ring when the reel is mounted. If a user wants to prevent someone from accidentally overwriting data that is on a reel, the ring should be removed. If the ring is present, the SCSI 9-Track Tape can perform normal write operations to the tape.

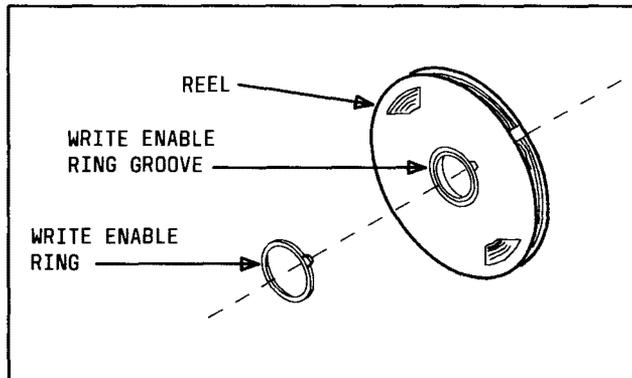


Figure 7-2: Write Enable Ring

System Administration Menus

There are two System Administration (**sysadm**) menus that are associated with operation of SCSI 9-Track Tape Drives. These are the Tape Management Menu and File Management Menu. The following is a listing of the associated commands from each menu.

File Management Menu (filemgmt)	backup hsbackup hsrestore restore store
Tape Management Menu (tapemgmt)	rmtape compress

The commands in the File Management Menu are associated with file system backups and restorals. Detailed information on these commands is given in Chapter 8, "Backup and Restore [Standard and Multiple Save Sets (MSS)]."

Only the **rmtape** command from the Tape Management Menu is covered in this chapter. Since use of the **compress** command is similar whether it is used with a 9-track tape or a cartridge tape, information on the **compress** command is not repeated in this chapter. Refer to Chapter 6, "Using the SCSI Cartridge Tape," for detailed information on using the **compress** command.

Note: There will be some minor differences in the system responses when using the **compress** command with a 9-track tape.

Controls and Indicators

This section illustrates and describes the controls and indicators of both the auto-loading and manual-loading SCSI 9-Track Tape Drives.

Manual-Loading Tape Drives

Figure 7-3 illustrates the front-panel controls and indicators of the manual-loading SCSI 9-Track Tape Drive. Figure 7-4 describes the function of each control and indicator.

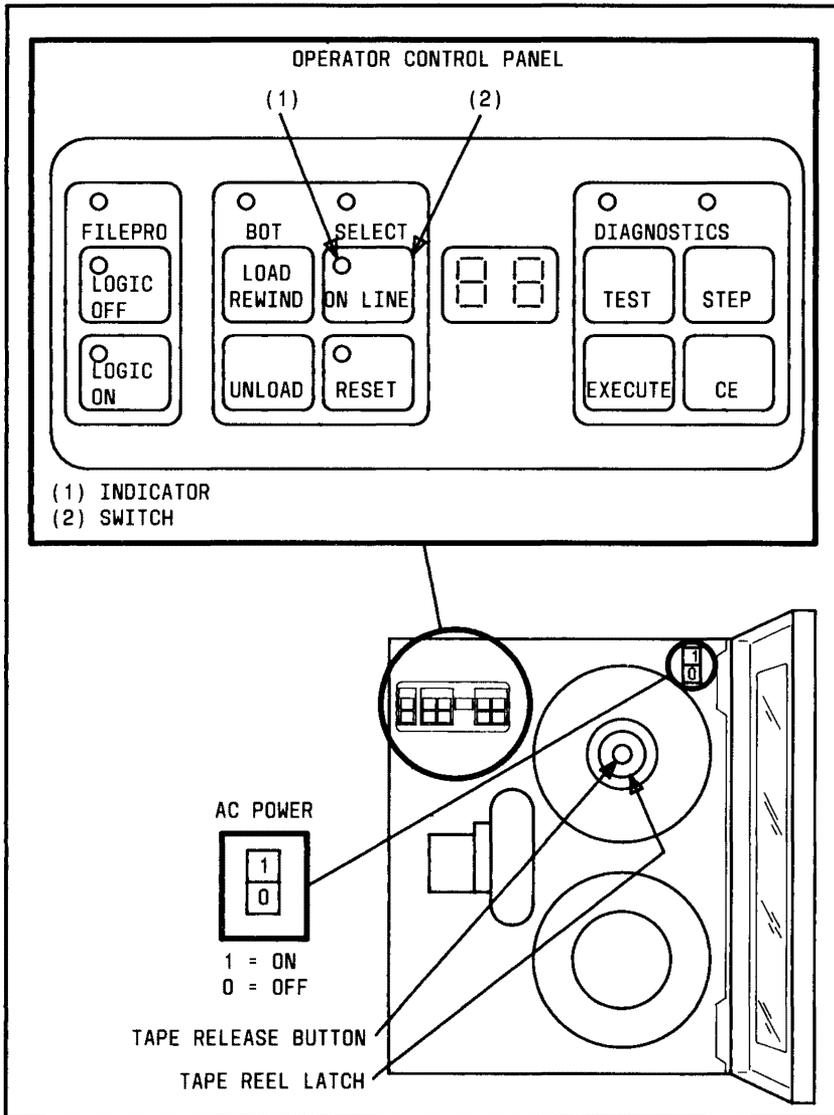


Figure 7-3: Manual-Loading Tape Drives—Control Panel

Control/Indicator	Description
AC POWER	Controls AC power input to the tape drive.
BOT	Lights when tape is positioned at the beginning-of-tape mark on the tape.
DIAGNOSTICS and two-digit display	Fault conditions are indicated by codes on the two-digit display. These conditions can be investigated by use of the DIAGNOSTIC switches. Information of the fault codes and switch operation is given in the vendor's manual supplied with the tape drive.
FILEPRO	Lights when write protected (ring off).
LOAD/REWIND	Causes tape to be positioned at the beginning-of-tape mark.
LOGIC OFF/LOGIC ON	Controls power to the tape drive electronics. Caution: The LOGIC ON indicator must always be on while the 3B2 computer is on. Operating the LOGIC OFF switch while the 3B2 computer is on can cause an error condition and reset the entire SCSI bus.
ONLINE	Makes the tape drive accessible by its controller.
RESET	Resets the tape drive.
SELECT	Indicates tape drive is being accessed.
UNLOAD	Moves tape off the "take-up" reel so that tape can be removed from the drive.

Figure 7-4: Manual-Loading Tape Drives — Controls and Indicators

Auto-Loading Tape Drive

Figure 7-5 illustrates the front-panel controls and indicators of the auto-loading SCSI 9-Track Tape Drive. Figure 7-6 illustrates the AC power switch located on the rear panel of the tape drive.

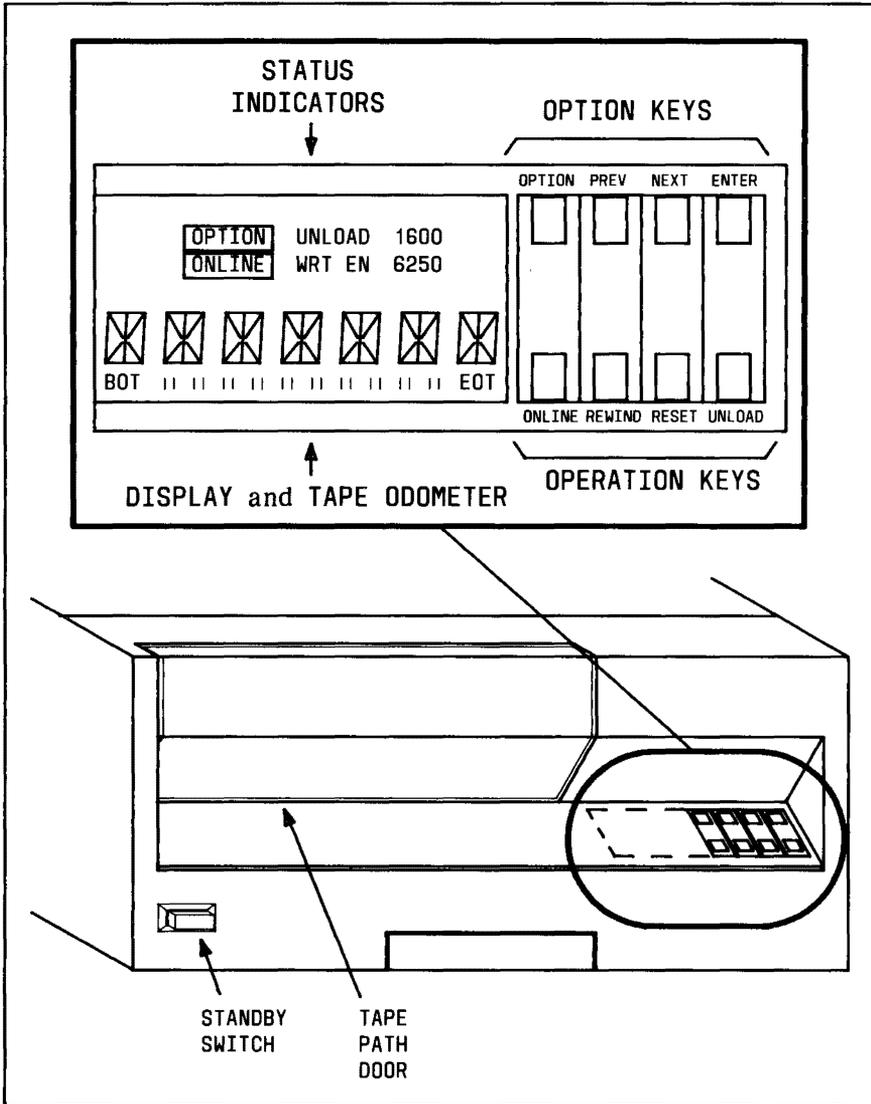


Figure 7-5: Auto-Loading Tape Drive—Control Panel

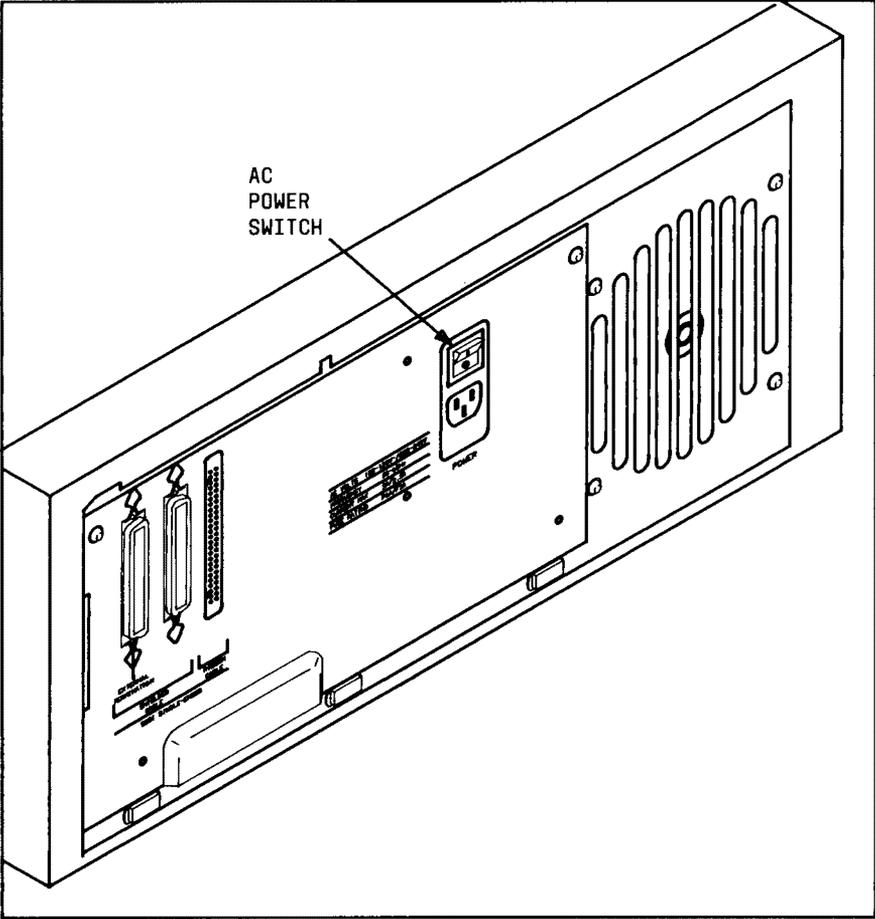


Figure 7-6: Auto-Loading Tape Drive—Rear Panel

Controls and Indicators

Figure 7-7 describes the function of each control and indicator. Figure 7-8 describes the normal display messages that can be illustrated on the display. Figure 7-9 describes the error messages that can be illustrated on the display, and the action to be taken for each error.

Operation Keys	
Control/ Indicator	Description
ONLINE	Selects online or offline. May press ONLINE when drive finds BOT after tape load or queue, after closing door (drive will go online after finding BOT). Pressing ONLINE again takes drive offline.
RESET	Stops or suspends operations. If BUSY appears in the display, pressing RESET suspends operations. Operation is resumed only by placing drive online. Additional actions, such as an additional reset, will cause data in buffer to be lost. Inoperative while drive is online (except when BUSY is displayed), loading or unloading tape, or tape door is open.
REWIND	Operative while drive is offline. REWIND positions tape at BOT, and BOT appears in display. Inoperative while drive is online or tape door is open.
UNLOAD	Unloads tape and opens tape door. Tape must be at BOT marker and drive must be offline. Opens door if no tape is present. May be queued after initiating rewind.

Figure 7-7: Auto-Loading Tape Drive—Controls and Indicators
(Sheet 1 of 3)

Status Indicators	
Control/ Indicator	Description
ONLINE	Remains on when drive is online. Flashes when ONLINE is queued after load is initiated.
OPTION	Lit when OPTION mode is activated.
UNLOAD	Remains on while tape is unloading. Flashes when UNLOAD command is queued after starting rewind. Turns off after drive unloads the tape and opens the door. UNLOAD appears on displays.
WRT EN	Lit when a tape equipped with a write enable ring is loaded in drive.
1600	Lit when 1600 density-phase encoded (PE) tape is detected upon completion of load. Remains on until recording density changes or tape is unloaded. Stays off when a blank tape is loaded. The 1600 and 6250 will light if a tape of unrecognized density is loaded.
6250	Lit when 6250 density group-coded recording (GCR) tape is detected upon completion of load. Remains on until recording density changes or tape is unloaded. Stays off when a blank tape is loaded. The 1600 and 6250 will light if a tape of unrecognized density is loaded.

Figure 7-7: Auto-Loading Tape Drive—Controls and Indicators
(Sheet 2 of 3)

Option Keys	
Control/ Indicator	Description
ENTER	Selects desired option and subsequent choices within those options.
NEXT	Advances to next option or increments number in display.
OPTION	Activates option mode. Lights OPTION INDICATOR and disables Operation Keys. TEST ? appears in display. <i>OPTIONS available: TEST, CONFIguration, INfOrmation, ADDRess, and UNIT.</i>
PREV	Returns to previous option or decrements number in <i>display</i> .
Display and Tape Odometer	
Display	Displays messages associated with tape operations.
Tape Odometer	Illustrates relative position of the tape during operation. Consists of a BOT indicator, a row of fluorescent segments, and an EOT (end-of-tape) indicator.

Figure 7-7: Auto-Loading Tape Drive—Controls and Indicators
(Sheet 3 of 3)

Message	Description
BOT	Tape is positioned at beginning-of-tape.
BUSY	Central processing unit is busy; drive cannot execute control panel command.
CHECK	Excessive soft error rate (anything that causes drive to retry reading or writing a record).
EOT	Tape is positioned at end-of-tape.
FAIL ##	Test ## has failed.
IDLE	Five-second timeout; drive is waiting for central processing unit or control panel command.
INVALID	Key press is invalid.
LOADING	Tape is loading.
MISLOAD	Drive cannot load tape.
NO BOT	No beginning-of-tape marker found.
PASS ##	Test ## has passed.
POWER	Drive is powering up.

Figure 7-8: Auto-Loading Tape Drive — Normal Display Messages
(Sheet 1 of 2)

Message	Description
READING	Central processing unit is reading data from tape.
READY	Drive is ready to receive commands or load tape.
REWIND	Drive is rewinding tape.
RUN ##	Test ## is running.
TESTING	Drive is running power-on self tests.
UNLOAD	Drive is unloading tape.
WRITING	Central processing unit is writing data to tape.

Figure 7-8: Auto-Loading Tape Drive — Normal Display Messages
(Sheet 2 of 2)

Test	
Message	Action
E 001	Must have tape to execute test.
E 004	Tape is write protected. Attach write enable ring or use a new or scratch tape.
E 006	Close top cover.
E 020	Select valid test number.
E 031	Wait until system is available.
E ###	Call the Service Center if you see a code not listed here.
FAIL ##	Test ## has failed. Press ENTER to display error code.
PASS ##	Test ## has passed. No action necessary.
RUN ##	Test ## is running. No action necessary.
Operation	
BUSY	Drive completing online functions. No action necessary. May press RESET to suspend operations and then place drive online to resume. Any other action will purge data in the buffer.
CHECK	Excessive soft error rate. Check tape or tape path.
INVALID	Select valid key.
MISLOAD	Retry loading procedure.
NO BOT	Unload tape and check for BOT marker within 30 feet of the BOT. If BOT marker is absent, place marker 16 feet from the BOT.

Figure 7-9: Auto-Loading Tape Drive — Error Messages and Actions

Tape Operations

Powering the Tape Drive

Manual-Loading Tape Drives

Caution: The LOGIC ON indicator must always be ON while the 3B2 computer is turned on. Operating the LOGIC OFF or AC POWER "0" switch while the 3B2 computer is turned on can cause an error condition.

Unlike other SCSI devices, a SCSI 9-Track Tape Drive is not under power control from the 3B2 computer (no soft-power). For this reason, the tape drive has to be powered manually from its front control panel. Refer to Figure 7-3 for tape drive controls and use the following procedures:

Power On Procedure

1. Ensure power to the associated 3B2 computer is off.
2. On the front panel of the tape drive:
 - a. Press the "1" portion of the AC POWER switch
 - b. Press the LOGIC ON switch.
3. Power up the associated 3B2 computer.

Power Off Procedure

Caution: Never operate the LOGIC OFF or AC POWER "0" switch while the 3B2 computer is turned on. Operating these switches while the 3B2 computer is turned on can cause an error condition.

1. Shut down the 3B2 computer, using the **shutdown** command, as shown in the following example:

```
shutdown -y -g0 -i0
```

2. On the front panel of the tape drive.
 - a. Press the LOGIC OFF switch
 - b. Press the "0" portion of the AC POWER switch.

Auto-Loading Tape Drive

Caution: The tape drive must be on while the 3B2 computer is on. Operating the STANDBY or AC POWER "0" switch while the 3B2 computer is on can cause an error condition.

Unlike other SCSI devices, a SCSI 9-Track Tape Drive is not under power control from the 3B2 computer (no soft-power). For this reason, the tape drive has to be powered manually from the front and rear control panels, using the following procedures.

Power On Procedure

The following procedure describes how to power on the tape drive.

1. Ensure power to the 3B2 computer is off.
2. Ensure that the tape path door is closed.
3. On the rear panel (Figure 7-5) of the tape drive, press the "1" portion of the AC POWER switch.
4. On the front panel (Figure 7-6) of the tape drive, press the STANDBY switch.

Tape Operations

5. Wait for READY to appear on the display.

Note 1: TESTING will appear on the control panel display before READY is displayed. Also, other indicators will be turned ON, then OFF, before READY is displayed.

Note 2: When testing is displayed on the control panel display, automatic tape drive diagnostics are running.

6. Tape drive will automatically attempt to load tape.

Note 1: If a tape is in the tape drive during the power-up sequence, the drive will automatically load the tape and go ONLINE.

Note 2: If the tape drive does not contain a tape, the drive will return to the READY state.

7. Wait for READY or ONLINE to appear on the control panel display.

Power Off Procedure

Caution: Never operate the STANDBY or AC POWER "0" switch while the 3B2 computer is on. Operating the STANDBY or AC POWER "0" switch while the computer is on can cause an error condition.

Refer to Figures 7-5 and 7-6 for tape drive controls.

1. Shut down the 3B2 computer using the **shutdown** command as shown in the following example:

```
shutdown -y -g0 -i0
```

2. On the front panel of the tape drive, press the STANDBY switch.

Note: It is not necessary to perform the following step unless the tape drive is being removed from service.

3. On the rear panel of the tape drive, press the "0" portion of the AC POWER switch.

Loading Tape

Manual-Loading Tape Drives

Figure 7-10 shows the tape path to be followed when loading a tape. Before loading the tape drive, check the write enable ring (Figure 7-2) on the tape to ensure you have the desired protection of, or access to, data on the tape.

Caution: Care should be used when threading the tape to prevent scratching or otherwise damaging any of the components in the tape head area. Foreign objects, such as screwdrivers, pliers, etc., should never be used in the tape head area.

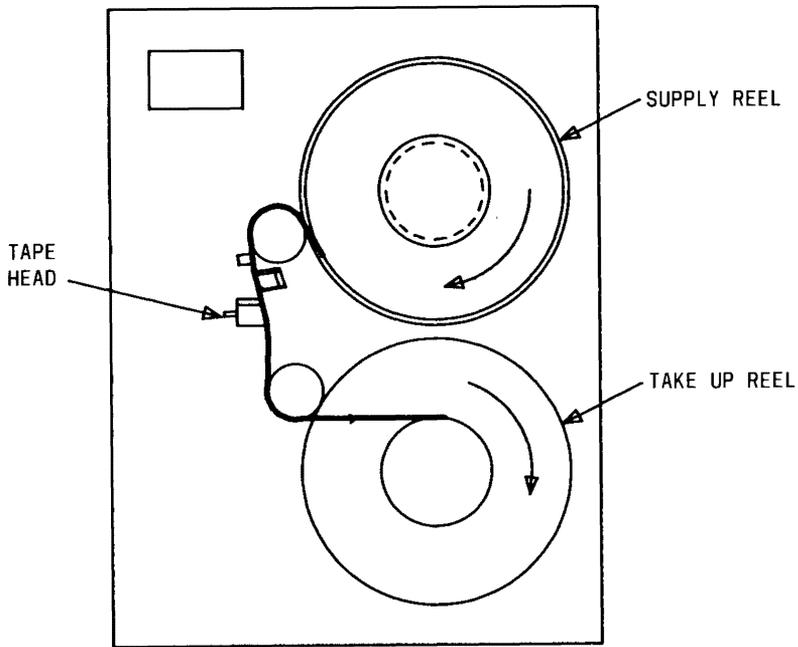


Figure 7-10: Manual-Loading Tape Drives—Tape Path

Figure 7-11 details the procedure for loading a magnetic tape reel (any size) on a manual-loading SCSI 9-Track Tape Drive.

CONDITION	PROCEDURE STEP	COMMENT
LOGIC ON light on	1. Open front door and mount tape on supply (top) hub. 2. Thread tape on take-up reel and wind 2 to 3 turns. After reel is threaded, be sure to close door. 3. Press LOAD/REWIND.	Press tape release button to mount, then press reel to secure tape. See Figure 7-3. See Figure 7-10. Tape moves to the BOT marker and BOT indicator lights.
BOT indicator lights	4. Press ONLINE.	ONLINE and SELECT indicators light up.

Figure 7-11: Manual-Loading Tape Drives — Loading Tape Procedure

Auto-Loading Tape Drive

Before loading the tape drive, check the write enable ring (Figure 7-2) on the tape to ensure you have the desired protection of, or access to, data on the tape. Figure 7-12 gives the procedure for loading a magnetic tape reel (any size) on an auto-loading SCSI 9-Track Tape Drive.

Tape Operations

CONDITION	PROCEDURE STEP	COMMENT
READY is illuminated on display, no tape in drive	1. Press UNLOAD.	Tape path door opens. Always press unload to open door or stop a load operation. Also, do not lift the top cover unless the drive is turned off.
	2. Slide a tape, write enable ring side down, into the center of the tape path door opening.	Ensure that the tape leader is free and on the right side of the reel.
READY is illuminated on display, tape in drive	3. Manually close tape path door.	Closing the door initiates the loading sequence and queues the drive to go ONLINE. The drive tensions the tape and advances the tape to the BOT marker. After the tape is loaded, the drive will automatically be placed ONLINE.

Figure 7-12: Auto-Loading Tape Drive—Loading Tape Procedure

Unloading Tape

Manual-Loading Tape Drives

Figure 7-13 details the procedure for unloading a magnetic tape reel from a manual-loading SCSI 9-Track Tape Drive.

Caution: Make certain the tape is completely off the "take up" reel before you attempt to remove the reel from the "supply" hub.

CONDITION	PROCEDURE STEP	COMMENT
Tape drive online, door closed	1. Press ONLINE.	Takes drive offline.
	2. Press UNLOAD.	Winds all tape onto the supply reel.
Tape unloaded	3. To release tape, open door and press release.	

Figure 7-13: Manual-Loading Tape Drive—Unload Tape Procedure

Auto-Loading Tape Drive

Figure 7-14 details the procedure for unloading a magnetic tape reel from an auto-loading SCSI 9-Track Tape Drive.

CONDITION	PROCEDURE STEP	COMMENT
Tape drive online, door closed	1. Press ONLINE.	Takes drive offline.
ONLINE indicator off	2. Press REWIND.	Tape is positioned at BOT marker.
BOT indicator illuminated	3. Press UNLOAD.	Drive unloads tape and opens door. Can press UNLOAD any time after rewind starts.
Door open, READY illuminated on display	4. Remove/replace tape.	
	5. Manually close door.	Closing the door initiates the loading sequence and queues the drive to go ONLINE. If the drive is empty, it will return to the ready state. If a tape was inserted in the drive, the drive will load the tape and go ONLINE.

Figure 7-14: Auto-Loading Tape Drive—Unload/Replace Tape Procedure

Data Transfer Using SCSI 9-Track Tape Drive

Transferring data between the SCSI host 3B2 computer and another computer using a SCSI 9-Track Tape Drive involves writing the data on the tape on one system and reading it on the other. To ensure the compatibility of this tape, you must know what the other computer is and what operating system it is using.

Data Transfers Between AT&T 3B Computers

All 3B computers can transfer files via a SCSI 9-Track Tape Drive, using the **cpio** command. (Refer to the appropriate 3B computer User's Reference Manual.) The **cpio** utility preserves pertinent file information such as owner, permissions, and last time modified. It is recommended that the **cpio -oc** command be used to write files to tape while the **cpio -ic** command retrieves files from tape. Also, all data transfers should use the character device (raw) mode.

You can write data to 9-track tape drives at different densities. Information in the "Introduction" to this chapter describes the data density capabilities of the various SCSI 9-Track Tape drives. In order to read a tape, you need to know the density that was used to write it. Therefore, whenever you write a tape, be sure to place a label on the tape that identifies the density that was used.

Transfer Data Between Other Types of Computers

Character data written on a SCSI 9-Track Tape Drive can be transferred to other computers with ANSI standard 1600 bpi or 6250 bpi 9-track tape devices. The details of doing the transfer are beyond the scope of this document.

Removing a SCSI 9-Track Tape Drive Using rmtape Command

This section gives the procedure for removing a SCSI 9-Track Tape Drive from the system configuration. The **sysadm rmtape** command removes the device files under */dev* for a specified SCSI tape drive.

Note: Once removed, the SCSI 9-Track Tape Drive can be reconfigured back into the system by executing the */etc/scsi/mkdev* command.

The following display illustrates how the **rmtape** command is used:

```
# sysadm rmtape<CR>

Running subcommand 'rmtape' from menu 'tapemgmt',
TAPE MANAGEMENT

Select which drive to use:
    1 9track1      2 qtapel
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 9track1<CR>

    Selected device: 9track1 drive is in hardware slot 1 tc' id 7 drive 0.
    Do you wish to continue? [y, n, ?, q] y<CR>
    Device nodes for 9track have been removed.

Do you want to remove device nodes of another tape drive? [y, n, q] n<CR>
#
```

Using the `sysadm compress` Command

Caution: One of the intermediate steps of this command erases the file system. Always make sure a backup of the file system is available.

The `compress` command operates the same for a 9-track tape as it does for a cartridge tape. Refer to the "Using the `sysadm compress` Command" section of Chapter 6 for the procedure to use the `sysadm compress` command.

Caution: Care should be used when compressing to a 9-track tape due to a time when the tape is vulnerable to access from a shared bus.

SCSI 9-Track Tape Drive Maintenance

The following information describes suggested preventive maintenance activities that apply to SCSI 9-Track Tape Drives and associated tapes.

Manual-Loading Tape Drives

The following information describes the preventive maintenance activities for the manual-loading tape drives:

- Keep all panels and doors closed at all times.
- Clean outside of the unit with mild soap and water.
- Clean the tape head, guide, and tape cleaner once every 8 hours of use or after a reported tape error.

Note: Refer to the vendor-supplied tape manual for procedure.

- Clean the tape path, hub, take-up reel, and tape bearing every 90 days. (See above note.) Also, check tape head for any buildup or wear that could cause tape damage.
- Demagnetizing tape head and associated tape path is not required.
- Check filter inside tape cabinet every 3 weeks and clean as required. See the vendor-supplied manual on the tape unit for more information.

Auto-Loading Tape Drive

The following information describes the preventive maintenance activities for the auto-loading tape drive:

1. Keep all panels and doors closed at all times.
2. Clean outside of unit with mild soap and water.
3. Clean tape path once every 8 hours of use or after reported tape error:
 - a. Acquire liquid FREON TF cleaning solvent, nonabrasive lint-free cloths and/or swabs, and a clean unwaxed container.

- Caution 1:** Do not use cleaning solutions that contain lubricants. Lubricants deposited on the tape head will impair performance.
 - Caution 2:** Do not use standard hub cleaners or strong alcohol solutions (greater than 20%). These solutions will damage the guides and rollers in the tape path.
 - Caution 3:** Do not use aerosol cleaners, even if they are FREON TF. The spray is difficult to control and often contains metallic particles that can damage the tape head.
 - Caution 4:** Do not use soap and water on the tape path. Soap leaves a thick film, and water may damage electronic parts.
 - Caution 5:** Do not retain cloths and swabs after use. Even if they appear clean, they are contaminated.
 - Caution 6:** Do not use facial tissues. Although they may seem effective, they leave highly abrasive lint in the tape path.
 - Caution 7:** Do not use waxed paper cups. FREON TF dissolves wax. If a waxed cup is used, wax will be deposited on the tape path.
 - Caution 8:** Do not dip cloths or swabs into solvent container. This will contaminate the solvent.
- b. Open tape drive cabinet door (top of cabinet).
 - c. Raise plastic cover that is located under tape drive cabinet door.

- d. Pour a small amount of solvent into container.
- e. Dab cloth or swab into container as needed.
- f. Applying gentle pressure in one direction, use a lint-free swab or cloth to clean the following surfaces (see diagram located under tape drive cabinet door):
 - Tension arm roller
 - Fixed guide
 - Tape cleaner (clean scraping surfaces and inside debris traps)
 - Arm of tape displacement unit
 - Read/write erase heads
 - Speed sensor roller and washer
 - Rubber gripping surfaces on the supply hub assembly
 - Surfaces of the casting.
- g. Lower plastic cover and close tape drive cabinet door.

Magnetic Tape Care

The following information describes the preventive maintenance activities for magnetic tapes:

- Store in tape container when not being used.
- Keep tapes in clean environment.
- Keep written tapes away from strong magnetic fields, such as large motors or microwave ovens.

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Introduction to Backup and Restore Using SCSI Devices

This chapter gives background information that is needed to properly back up and restore complete file systems or individual directories and files.

The procedures in this chapter involve operations with all SCSI storage devices including:

- SCSI Hard Disk Drives
- SCSI 9-Track Tape Drive
- SCSI Cartridge Tape Drive.

The procedures in this chapter are supported almost totally by System Administration commands from the File Management Menu.

Creating a backup (making a copy) of information stored in your computer system provides the security of knowing you will not have to start all over again from the beginning. You will only lose the data that has been input since the last backup. The importance of establishing and following a file system backup plan is too often not appreciated until data is lost and cannot be recovered. Backing up a file system takes time. Trying to recover lost or damaged data from paper records and best-guess-work takes significantly more time.

Performing backup and restore operations involves handling data in the following forms:

- Entire file systems
- Partial or incremental backup of file systems
- Individual directories and files.

A complete backup copies an entire file system. An incremental backup only copies files that were "changed" since the last backup.

System Administration provides the following commands for backing up and restoring files:

- **hsbackup**—High-speed backup of an entire file system
- **hsrestore**—High-speed restoral of an entire file system

- **backup**—Complete or partial backup of a file system
- **restore**—Restores individual files or a complete file system
- **store**—Backs up individual files or directories.

Special Precautions

Remember this important fact about the backup and restore commands: when you perform backup with a particular method, you are restricted to use a corresponding method to restore that data. For example, if you back up a user file system with **sysadm backup**, then you can only restore that file system using **sysadm restore**.

Many of the procedures in this section require you to shut down the 3B2 computer to the "single-user" mode. To do this means that you have to be logged in as *root*. If you attempt to do one of these procedures and the system will not let you, it may mean that you are not logged in properly. Also, shutting down to single-user disrupts all user processes and, therefore, should be done with discretion.

The next section discusses the backup and corresponding restore commands that are applicable to the SCSI devices.

Backup and Restore Commands

The System Administration File Management Menu provides the simplest methods to perform the many backup and restore procedures. The following is an example of the File Management Menu.

FILE MANAGEMENT

1 backup	backup files from built-in disk to removable media
2 bupsched	backup reminder scheduling menu
3 diskuse	display how much of the hard disk is being used
4 fileage	list files older than a particular date
5 filesize	list the largest files in a particular directory
6 hsbackup	high-speed backup of a file system
7 hsrestore	high-speed restore of a file system
8 restore	restore files from "backup" & "store" media to built-in disk
9 store	store files and directories of files onto removable media

Enter number, a name, the initial part of a name, or
? or <number>? for HELP, ^ to GO BACK, q to QUIT:

Complete Backup and Restore

To back up complete file systems, it is recommended that you use the **hsbackup** command. The **hsbackup** command is much faster than the **backup** command when doing a complete file system backup.

The **hsbackup** command uses the UNIX System V **volcopy** command as its copy vehicle.

Use the **sysadm hsrestore** command to restore file systems that were backed up using the **hsbackup** command.

Refer to the "Performing Backups" and "Performing Restores" sections for example displays of these commands.

Incremental Backup and Restore

The **sysadm backup** command from the File Management Menu performs complete or incremental backup operation of file systems. The **backup** operation is slower than **hsbackup** and is not preferred when doing a complete file system backup. The **backup** command is primarily intended for doing incremental backup of file systems that have been recently backed up and only have a few files that have been modified and need backup.

A complete backup (using **sysadm backup**) can be done at any time and must be done at least once before an incremental backup can be done on the file system.

The **sysadm store** command copies selected files or directories of files from a specified file system.

Use the **sysadm restore** command to restore files or file systems that have been copied using the **backup** or **store** commands.

The **backup**, **restore**, and **store** commands use a version of the UNIX System V **cpio** command as their copying vehicle.

Refer to the "Performing Backups," "Performing Stores," and "Performing Restores" sections for example displays of these commands.

Multiple Save Sets (MSS)

The MSS feature allows you to create and store multiple **cpio(1)** type backups on the following types of media:

- cartridge tape, or
- 9-track tape.

The capability to keep multiple backups on tapes (cartridge or 9-track) allows you to utilize the tapes entire capacity for more effective and efficient backups. This means, for example, that you can store incremental backups from Monday and Tuesday and Wednesday, etc. on the same tape.

The MSS feature is provided for both the cartridge tape and 9-track tape drives via the System Administration backup facility. All new features of MSS are implemented as options of the existing System Administrations backup commands **backup**, **store**, and **restore**.

Note: The MSS feature is supported with the SCSI Release 3.0 or later software. The System Administration backup facility will continue to support older backup facilities for compatibility.

This section covers the following topics:

- The two types of multiple backups provided by the MSS feature
- Enhancements to the System Administration facility (e.g., **backup**, **store**, and **restore**)
- Differences in compatibility between MSS backup and a standard backup
- Manual method for reading MSS backup tapes.

Backups

The **sysadm backup** command can be used to perform a complete or incremental MSS backup of a file system. Once a complete backup of a file system is made on the medium, any additional incremental backups can be appended to the end of the previous backup of that same file system. This simplifies incremental backups and provides a more efficient use of the entire tape medium.

Backups can consist of multiple unrelated save sets (e.g., copies of independent files, directories, and file systems such as `/`, `/usr`, and `/usr1`) on a tape medium by using **sysadm store**. Also, backups can consist of a single complete backup of a file system such as `/`, `/usr`, or `/usr1`, followed by any number of incremental backups of that initial complete backup on the same medium, or subsequent media, by using **sysadm backup**.

The Restore Feature for MSS Backups

This feature allows you to restore any number of (or all) backups residing on cartridge or 9-track media. The **restore** command reads the label information and prints it on the screen, in a convenient format, for each backup you may want to restore. Using this information, you have the capability to do the following:

- Position the medium at a specific save set
- List the contents of a particular save set
- Restore any files, directories, or the entire save set
- Restore the latest version of specific files, directories, or the entire media.

When you position the medium to a specific save set, the label information is printed. This allows you to search for a particular save set that you need to restore.

Note: Although the MSS feature provides a mechanism to locate specific save sets, it is recommended that you maintain a log of save sets written to the tape. This log should include the save set name, the save set position on the tape, the date that the save set was made, and the save set size. A log is very useful if a portion of a tape becomes corrupted, and you have to manually read the tape.

Also, you should include the list of save sets and their sequence on the tape as part of the external tape labeling information.

Compatibility Between MSS Backup and Standard Backup

The MSS feature has been implemented while still maintaining compatibility with older backup facilities. This has been done by having the system prompt you to select MSS or standard backup. A <CR> response to the prompt puts you in the older backup facility. This prompt is provided in the **sysadm backup** and **sysadm store** commands. Determination of MSS or standard backup is done transparently in the **sysadm restore** command.

Automatic Density Selection

Once a density has been selected for a tape, that tape can only be used at that density. During subsequent backups, the software reads information from the tape and automatically selects the appropriate density to be written. Therefore, the density prompts are not displayed for additional backups on the same medium.

Scheduling and Planning Backups

There is no standard method for planning and performing backups. Each application and system configuration has different aspects that must be considered. Personal preference also plays a part in establishing backup procedures. The main issue is that you must evaluate your particular system needs for backup and form a backup plan accordingly. The backup plan should be reevaluated as the use and configuration of the machine changes.

To assist in getting started with a schedule, a basic schedule is provided under **sysadm bupsched**. Modification can be made according to your system requirements.

There are many things to consider when formulating a backup schedule. Some of the main considerations include the following:

- The method in which the lost or damaged data will be restored (recovered).
- The importance of the data.
- The downtime of the machine needed to perform backup.
- The use of the system; that is, how the 3B2 computer is being used.
- The size of the file system to be saved.
- The type(s) of backup to perform.
- The device(s) used to store the backup data; the storage device could be floppy disk(s), 9-track tape(s), hard disk(s), or cartridge tape(s).

Restoral/Recovery

The main consideration in formulating a backup plan is the method of recovery for lost or damaged data. The recovery process should be as quick and easy as possible. The speed of recovery depends on many things. The device used to store the data is very important. For example, an individual file can be restored faster from a floppy disk than from a cartridge tape. However, if a complete file system needs to be restored, the tape will be faster than inserting and removing several floppy disks.

Backing up to a SCSI hard disk may be the easiest method of all the backup alternatives as far as recovery of data. These devices have fast access times and require no media storage. However, it may not be cost effective for you to use one of these devices as a backup media.

Organization of Data

The ease of recovery depends greatly on how the data is organized and how the file systems are set up on the machine. It is better if all files and file systems are structured logically and efficiently.

Organization also refers to how the backup media are physically stored. Rummaging through a drawer of floppy disks for the one disk labeled "john's files" would be ridiculous. Each time a backup of a file or file system is performed, the storage medium (cartridge tape, 9-track tape, or floppy disk) should be labeled with the following information and then properly stored.

1. Identify the type of backup performed (complete, incremental, etc.).
2. Record the complete name of the file or file system.
3. Record the date and time.
4. Specify the order or sequence number for the storage medium (for example: 1 of 5, 2 of 5). If more than one medium is required, you will need to know which medium to load first.
5. Provide some instructional information for someone else who may have to restore the data from the storage medium.
6. Specify the device used as the backup media. Use the System Administration device name such as qtape1 (SCSI Cartridge Tape), 9track1 (SCSI 9-Track Tape), etc.

The following is an example of what a storage media label might look like:

```
Complete Backup of all files in: /usr
Fri. 02/22/85  5:38:04 pm
PART 1 of 2
TO LOAD: sysadm restore
Backed up on: qtape1
```

This information should be used to organize the storage media into a library of stored data. In this way, obsolete data can be removed or written over instead of building a historical library of numerous floppy disks and tapes. Also, you do not want to create a great deal of work for yourself by having to look through all the saved data to find the one file that was lost or damaged.

Importance of Data

Very important data should be saved more often than data of average importance. For something very critical, the data should be saved every time there is an update. This will ensure that the data is safe if an unexpected system crash occurs before the planned backup can be performed. For example, if your building has an unreliable power source, you should naturally perform backups more often than you would in most other environments.

Downtime of System

The 3B2 computer should be in the single-user mode when a backup is being performed or when a complete restore is taking place. Therefore, the amount of backup downtime (time that the machine is unavailable for use) should be considered. For this reason, you may want to schedule backups during "nonworking" hours.

The time in which a file may need to be recovered is not predictable. Recovery downtime is another reason why you should organize the stored data appropriately with the configuration of the system. If you know where a stored file is located, the file will be easier to find and can be more quickly

replaced. Also, if there are just a few files, you can restore them in multiuser mode and notify the user that needs them without disturbing other users.

System Application

The way the 3B2 computer is being used influences the planning of backup schedules. A system with several users needs to be backed up more often than a system with one or two users. The more users that are on a system automatically increases the chances of files being lost or damaged. Thus, the need for more frequent backups.

Another example of a system that needs to be backed up frequently would be a data base which is accessed by many customers. This data base must be kept as current as possible so customers will not be conducting business using data from last week. If there is a system failure, you will want the restored data to match the latest accessed data as accurately as possible.

File Size

The sizes of files and file systems of data you wish to save are important considerations when formulating a backup schedule. You will probably want to store large file systems on a cartridge tape, 9-track tape, or hard disk drive so you do not have to load several floppy disks just to restore one file system. A complete backup of a typical file system could be done on one or two cartridge tapes as opposed to 30 or more floppy disks.

On the other hand, frequent storing of small files could be done rapidly on floppy disks. If you have a small file system which contains critical data, this data can be backed up on floppy disks at the end of each day.

Type of Backup

In developing a file system backup plan, you have to decide what type of backup procedure is best for your situation. You can do frequent backups using the "high-speed" **hsbackup** command to a SCSI device. Or, you can do less frequent complete backups using **backup** and do routine incremental backups. Or, you may want to do a combination of "high-speed" and regular backups with incrementals, depending on the size and frequency of change of

individual file systems. The ultimate decision is yours. However, the following list gives some things to consider about the different backup procedures that may help you in making your decision:

- You cannot mix backup and restore procedures. File systems backed up using **hsbackup** must be restored using **hsrestore**. You cannot use **restore** in this case.
- **hsbackup/hsrestore**
 - Complete backups and restorals using these commands are very fast, usually taking only a matter of minutes.
 - The SCSI devices (cartridge tape, 9-track tape, and hard disks) are the primary backup media.
 - The **hsbackup** backs up one entire file system per operation. This means only one file system per backup media. However, if your file systems have partitions to match available backup media, you will get the maximum benefits from both **hsbackup** and your backup media. Also, it makes keeping track of what is on each backup media much easier.
 - The **hsbackup** does not provide for incremental backups. However, because complete backups using **hsbackup** do not take very long to do, they can be done more often than complete backups using **backup**. This would require fewer incremental backups between complete backups.
 - The **hsrestore** restorals are normally much easier to do than incremental restorals. Because you are restoring from a complete backup, you only have to reload from one previous backup. Incremental restorals require you to reload, in sequence, all backups from the desired backup to the most recent.
 - The **hsbackup** does not provide for backups to floppy disk. However, complete backups to floppy disk are generally time consuming and not very cost effective.
 - Restorals using **hsrestore** means the entire file system will be rewritten. This may retrieve the desired data, but if the file system is restored to the original file system, it may cause other users to lose recently entered data. This can be resolved by restoring the file system to an unused file system on hard disk.

Then, you can mount that file system, retrieve the data, and mail it to the appropriate user.

- Cannot backup the *root (/)* or */usr* file systems.

■ **backup/restore**

- Complete or incremental backups of selected file systems can be done in one operation to the same device. This includes the *root (/)* and */usr* file systems.
- Single files, directories, or entire file systems can be restored.
- Complete or incremental backups to floppy disks are possible.
- The **backup** copies only the data that is written in a file system. It does not duplicate the entire file system like **hsbackup**. In cases where there is a small amount of data written in a large file system, a complete backup may be done quicker using **backup**. In most cases, however, **backup** takes much longer than **hsbackup**.
- The **backup** only provides for backing up to removable media devices, such as cartridge tape. You cannot back up to a hard disk using **backup**.

Storage Device

The device chosen to store the backup data falls in the personal preference category. The storage device can be floppy disk(s), cartridge tape(s), 9-track tape reels, hard disk drives, or combinations of the above. Each device has advantages and disadvantages. Some of the advantages and disadvantages are pointed out in the following discussion:

- In general, the SCSI Cartridge Tape Module seems to be the best choice for backup devices. For example, the TM/60S provides 60 megabytes of storage area and removable media that are relatively inexpensive and a convenient size for storage.

- A SCSI Disk Module makes an excellent backup device as far as recovery performance. For example, the DM/147E has fast data-access time, 147 megabytes of storage area, and can accommodate more than one file system. However, it has fixed media which makes it expensive when compared to the other backup devices.
- The SCSI 9-Track Tape, like the SCSI Cartridge Tape Module, has large storage capacity and removable media.
- The integral floppy disk has good access time and inexpensive, removable media; however, the floppy disk is capacity limited and should only be considered in small storage operations.

Backup Schedule Reminder

System Administration provides an automatic backup schedule reminder service (**bupsched** in the File Management Menu). Once you have formulated your backup schedule, you can enter the information into the backup schedule reminder files. At the appropriate time, the system will remind you which file systems should be backed up.

The **sysadm bupsched** command displays the following submenu:

```
                                BACKUP REMINDER SCHEDULING

1 schedcheck      schedule backup reminder checks
2 schedmsg       schedule backup reminder message

Enter a number, a name, the initial part of a name, or
? or <number>? for HELP, q to QUIT:
```

These submenu commands can be performed directly by entering **sysadm command**. The **schedcheck** command will allow you to manipulate the data that informs the system of the times to display the reminder message. The **schedmsg** command will allow you to manipulate the data that controls what reminder message is displayed. Each command is interactive and displays instructions according to the input received from you.

The schedcheck Command

The **sysadm schedcheck** command controls when a reminder message is displayed. The time is specified by the following information:

- Time of day (Military time for hours and minutes)
- Day of week (Sun.-Sat. is 0-6, respectively)
- Day of month (1-31)
- Month (1-12).

The command allows you to print, change, and write (save) the information found in the reminder check file. Since changes to the reminder check file are not incorporated until the system is taken to multiuser mode, it is recommended that this command be executed while in the single-user mode.

The following display is a sample **schedcheck** command execution. This sample displays the current backup reminder check file and adds the information necessary to display a backup reminder at 3:00 p.m. on the second Tuesday of every other month. The output may vary slightly according to the displayed line length on your terminal.

Note: The "q" option must be selected for each question in order to move on to the next field.

```
# sysadm schedcheck<CR>
```

```
Running subcommand 'schedcheck' from menu 'bupsched',
BACKUP REMINDER SCHEDULING
```

```
Enter the command you wish to execute [p, r, a, m, w, ?, q]: ?<CR>
```

```
Commands available for editing:
```

```
p - Print lines of the file
r - Remove a line or group of lines
a - Add a line
m - Modify a line
w - Write the changes into the file
q - Quit - Leave bupsched
```

```
Enter the command you wish to execute [p, r, a, m, w, ?, q]: p<CR>
```

```
#ident @(#)usr/spool/cron/crontabs/sysadm.sl 1.1 3.0 08/14/85 33651
```

```
# This file will be scheduled via the cron command
```

```
#
```

```
# Format of lines:
```

```
#min hour daymo month daywk /etc/ckbupscd >/dev/console 2>/dev/console
```

```
#
```

```
# min - time(s) of day
```

```
# hour
```

```
# daymo - day(s) of month (1, 2, ... 31)
```

```
# month - month(s) of the year (1, 2, ... 12)
```

```
# daywk - day(s) of week (0-6, 0 = sun)
```

```
#
```

```
# Example:
```

```
#00 17 * * 1 /etc/ckbupscd >/dev/console 2>/dev/console
```

```
#
```

```
# At 5:00 pm in the evening on Mondays during any month of the year,
```

```
# check to see if there are any file systems that need
```

```
# to be backed up.
```

```
#
```

```
#-----
```

```
# Default backup schedule calls for checks Monday through Friday
```

```
# at 5:00pm.
```

```
#
```

```
1 00 17 * * 1,2,3,4,5 /etc/ckbupscd >/dev/console 2>/dev/console
```

The "1" at the beginning of the line represents the line number.

The asterisk (*) in the "day of month" and "month" fields represents all legal values (every day and every month).

(Display continued on next page.)

Backup Schedule Reminder

("sysadm schedcheck" display continued from previous page.)

Enter the command you wish to execute [p, r, a, m, w, ?, q]: a<CR>

Enter the time at which you want to check to see if any backups
are scheduled [?, q]: 18:00<CR>

Enter the day of the week [0-6, *, q, ?]: 2<CR>

Enter the day of the week [0-6, *, q, ?]: q<CR>

Enter the day of the month [1-31, *, q, ?]: 8<CR>

Enter the day of the month [1-31, *, q, ?]: 9<CR>

Enter the day of the month [1-31, *, q, ?]: 10<CR>

Enter the day of the month [1-31, *, q, ?]: 11<CR>

Enter the day of the month [1-31, *, q, ?]: 12<CR>

Enter the day of the month [1-31, *, q, ?]: 13<CR>

Enter the day of the month [1-31, *, q, ?]: 14<CR>

Enter the day of the month [1-31, *, q, ?]: q<CR>

Enter the month [1-12, *, q, ?]: 2<CR>

Enter the month [1-12, *, q, ?]: 4<CR>

Enter the month [1-12, *, q, ?]: 6<CR>

Enter the month [1-12, *, q, ?]: 8<CR>

Enter the month [1-12, *, q, ?]: 10<CR>

Enter the month [1-12, *, q, ?]: 12<CR>

Enter the month [1-12, *, q, ?]: q<CR>

Enter the command you wish to execute [p, r, a, m, w, ?, q]: w<CR>

Changes will be in effect after the next system restart.

Enter the command you wish to execute [p, r, a, m, w, ?, q]: q<CR>

#

If you had chosen to print the lines of the file again, you would have seen the following line added to the bottom of the file.

```
2 00 15 8,9,10,11,12,13,14 2,4,6,8,10,12 2 /etc/ckbupscd >/dev
/console 2>/dev/console
```

May vary according to the displayed line length of your terminal.

The new entry will be incorporated into the cron process the next time the system is put in multiuser mode. The new entry will be incorporated either during powerup or after changing from single-user to multiuser mode.

The schedmsg Command

The **sysadm schedmsg** command controls what file systems are included in the reminder message. The message received is as follows:

```
The following file systems are due for backup at this time:
string of file systems
```

The file systems included in the message are displayed according to **WHEN** the backup reminder message is displayed. A message is displayed either from the backup reminder check file or from the execution of a **shutdown** command without a **-y** option during the time range specified in the backup reminder message file.

Backup Schedule Reminder

To control which file systems are included in the message, the following information must be entered in the backup reminder message file:

- Range of time (Military time for hours and minutes)
- Day (Sun.-Sat. is 0-6, respectively; 1-31 for day of month)
- Month (1-12)
- List of file systems or command to execute.

The **sysadm schedmsg** command allows you to print, change, and write (save) the information found in the reminder message file. The following display is a sample **schedmsg** command execution. This sample displays the current backup reminder message file and adds the information necessary to display a reminder to back up the */usr2* file system whenever there is a message displayed between 3:30 p.m. and 7:00 p.m. on the fifteenth and thirtieth day of each month.

Note: The "q" option must be selected for each question in order to move on to the next field.

```
# sysadm schedmsg<CR>

Running subcommand 'schedcheck' from menu 'bupsched',
BACKUP REMINDER SCHEDULING

Enter the command you wish to execute [p, r, a, m, w, q, ?]: ?<CR>

Commands available for editing:
    p - Print lines of the file
    r - Remove a line or group of lines
    a - Add a line
    m - Modify a line
    w - Write the changes into the file
    q - Quit - Leave bupsched

Enter the command you wish to execute [p, r, a, m, w, q, ?]: p<CR>
#ident "@(#)etc/bupsched.sl 1.3 3.1 05/19/86 5093 AT&T-SF"
#
# Format of lines:
#time day month list
#
# time - time(s) of day
# day - day(s) of week (Mon, Tue, etc)
# - day(s) of month (1, 2, ... first, last)
# month - month(s) of the year (Jan, Feb, ...)
# list - list of file systems to be backed up
# or command to be executed ( !command line )
#
# Example:
#16:00-18:00 Mon * /usr
# If ckbupscd is invoked between 4:00 and 6:00 in the
# evening on Mondays during any month of the year,
# display /usr as the name of the file system that needs
# to be backed up.
#
#=====
# Default backup schedule calls for daily backups of /usr
# and monthly backups of root (/) on the 15th of each month.
#
1 00:00-08:00,16:00-23:59 mon,tue,wed,thu,fri * /usr
2 16:00-23:00 15 * /

Asterisk (*) represents all legal values for that field.

(Display continued on next page.)
```

Backup Schedule Reminder

("sysadm schedmsg" display continued from previous page.)

```
Enter the command you wish to execute [p, r, a, m, w, q, ?]: a<CR>
Enter time intervals in which backup reminder messages are to be printed
[ q, ? ] : 15:30-19:00<CR>
Enter time intervals in which backup reminder messages are to be printed
[ q, ? ] : q<CR>
Enter the day of the week [ 0-6, *, q, ? ] : *<CR>
Enter the day of the month [ 1-31, *, q, ? ] : 15<CR>
Enter the day of the month [ 1-31, *, q, ? ] : 30<CR>
Enter the day of the month [ 1-31, *, q, ? ] : q<CR>
Enter the month [ 1-12, *, q, ? ] : *<CR>
Enter the file system you wish to backup [ q, ? ] : /usr2<CR>
Enter the file system you wish to backup [ q, ? ] : q<CR>
Enter the command you wish to execute [p, r, a, m, w, q, ?]: w<CR>
Enter the command you wish to execute [p, r, a, m, w, q, ?]: q<CR>
```

#

If you had chosen to print the lines of the file again, you would have seen the following line added to the bottom of the file.

```
3 15:30-19:00    15,30  *    /usr2
```

Performing Backups

General

It is assumed that you have read the previous section on scheduling backups and have formulated a backup plan. The next step of the backup procedure is the actual execution of a backup. This section presents the procedure for doing a backup using either the **sysadm hbackup** command or the **sysadm backup** command.

Generally, the **sysadm hbackup** command will be used for doing complete "high-speed" backups of individual file systems, while **sysadm backup** will be used to do incremental backups and complete backups of the *root (/)* and */usr* file systems.

Back Up the *root (/)* and */usr* File Systems

The **sysadm backup** and **sysadm restore** commands should be used to back up and restore the *root (/)* and */usr* file systems. The **sysadm hbackup** command will not permit backing up the *root (/)* and */usr* file system because the reciprocal command, **sysadm hsrestore**, cannot copy to a mounted file system. Since *root (/)* has to always be mounted and */usr* has to be mounted to use System Administration, the "high-speed" backup commands cannot be used.

The */usr* file system can be backed up outside the System Administration environment by using the UNIX System V **volcopy** command to an appropriate backup medium. To restore */usr*, copy from the backup medium with */usr* unmounted using the **volcopy** command again. Refer to **volcopy(1M)** in the *AT&T 3B2 Computer SCSI Release Notes* for more information on using **volcopy**.

Backups Using the **hbackup** Command

The **sysadm hbackup** command is used to do a complete "high-speed" backup of a file system to a designated backup media. For better high-speed backup performance while using the 9-track tape, it is recommended that the

9-track tape drive be placed on the same SCSI bus as the hard disks which will require frequent backups.

Special Log File

The **sysadm hsbbackup** and **hsrestore** commands use the UNIX System V **volcopy** command as their copy vehicle. Records of all **volcopy** operations, including those invoked by **hsbackup** and **hsrestore**, are kept in a special file called */etc/log/filesave.log*. Although this file is created by the SCSI software, you will have to maintain it as far as deleting out-of-date entries.

hsbackup Procedure

The following procedure gives the steps for doing **hsbackup**. Read the entire procedure before starting.

Additional information and example displays follow this procedure. For each step there is a corresponding text section. For example, Step 5 of the procedure says to "Execute **hsbackup** command and follow the displayed instructions." Additional information on this step and example displays can be found in the "Execute the **sysadm hsbbackup** Command" section.

1. Depending on the backup media that you are using (cartridge tape, 9-track, or hard disk), make sure you have adequate blank tapes or file space to accommodate the backup. The **hsbackup** display will tell you how many cartridge tapes or reels of tape you will need.
2. Take the system to the single-user mode.

```
shutdown -y -is
```

3. Run a check on the file system(s) to be backed up.

4. Mount the file systems. A file system must be mounted before it can be backed up.

mountall /etc/fstab

(Mount only "/usr" and the file system to be backed up if the 9-track tape is on the same bus as the hard disk containing the file system.)

Note: The */usr* file system contains the System Administration commands and, therefore, must be mounted to execute the **sysadm** commands.

5. Execute **sysadm hsbbackup** and follow the displayed instructions.
6. Unmount the */usr* file system (and any other file systems other than *root*), and return the system to the normal operating configuration (multiuser mode).

**umountall
init 2**

Note: The *root* file system (/) should be the only file system mounted before returning the system to the normal operating configuration (multiuser mode).

7. Store the backup media in a safe place. If the backup media is another file system on a hard disk, make sure that file system is not mounted.

Performing a backup should be relatively easy if you follow these operations carefully. Remember to read through the entire procedure before actually starting any backup.

Select a Backup Media—Step 1

The **sysadm hsbbackup** display will list the backup devices that are available and will ask you to select one. The following is a list of SCSI devices that can be used as backup media and their System Administration device names.

Note: The *n* represents the individual number on a device.

- SCSI Cartridge Tape — `qtapen`
- SCSI 9-Track Tape — `9trackn`
- SCSI Hard Disks — `diskn`.

Depending on which backup media you select (cartridge tape, 9-track, or hard disk), you need to make sure you have adequate blank tapes or file space to accommodate the backup. The **hsbackup** display will tell you how many cartridge tapes or reels of tape you will need.

Enter the Single-User Mode—Step 2

The computer system should be in single-user mode when a backup is being performed or when a complete restore is taking place. This will ensure that no one is accessing some of the files that you are trying to save or restore. Single-user mode is reached by executing the `/etc/shutdown` command which is described in detail in your System Administration documentation.

Check File Systems—Step 3

The file systems to be saved should be checked before they are backed up. The "**fsck**" command (described in your System Administration documentation) is used to check and repair inconsistencies in file systems on a hard disk. With the exception of *root*, a file system must be unmounted before it can be checked.

Mount File Systems—Step 4

A file system has to be mounted before it can be backed up. The `/usr` file system must be mounted before you can execute any of the System Administration commands. The command used to mount all available file systems is as follows:

```
mountall /etc/fstab
```

(Mount only "/usr" and the file system to be backed up if the 9-track tape is on the same bus as the hard disk containing the file system.)

Note: The `/etc/fstab` file is discussed in detail in your System Administration documentation.

Execute the `sysadm hsbbackup` Command—Step 5

The `hsbackup` command is an interactive command which displays instructions and prompts you for input. Label each storage media as instructed. You may add other information to the labels at your discretion.

Note: The `root (/)` and `/usr` file systems cannot be backed up using the `hsbackup` command. The `root (/)` and `/usr` file systems should be backed up using the `backup` command.

The display on the next page shows the typical `hsbackup` command line entries and system responses for doing a backup of the entire `/usr2` file system on SCSI Cartridge Tape. The system is in the single-user mode with the `/usr` file system mounted at the start of the sample. The example `/usr2` file system contains 10200 blocks and was checked (`fsck`) before it was mounted.

Note: To get a list of the files to be backed up in the file system, execute the following command line (specify the desired file system):

```
find /usr2 -print
```

Performing Backups

The following is an example display of **hsbackup**:

```
# sysadm hsbackup<CR>
Running subcommand 'hsbackup' from menu 'filemgmt',
FILE MANAGEMENT

Which drive contains the file system that you want to backup?
  1 disk1      2 disk2      3 disk3
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: disk2<CR>
Select the partition you wish to backup:
[ 8(fs:usr2) 9(fs:usr3) a(fs:usr4) (q for quit)]:8<CR>

      The selected partition contains:
            File System Name "usr2"; Label Name "3.2.1"; Size = "10200"

Select which drive the file system will be copied to.
  1 9track1    2 disk1      3 disk2      4 disk3
  5 qtape1
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT:qtape1<CR>

Before inserting the first tape onto the qtape1 drive, mark it:

      Volume Backup of usr2,
      sysadm hsbackup -60M cartridge
      Tue. 07/08/86, 12:46:35 PM
      system name

Insert the tape in the qtape1 drive. Press <RETURN> when ready. [q] <CR>

(Display continued on next page.)
```

("sysadm hsbakup" display continued from previous page.)

```
*****
NOTE!!!
Before the hsbakup begins, you may receive warning messages from the "volcopy"
command. These messages will require a response of "y" to continue.

The source is disk2 drive partition 8.
This drive is known as /dev/rdisk/c2t1d0s8 by volcopy.

The destination is qtape1 drive known as /dev/rmt/c1t6d0s0 by volcopy.

The number of blocks copied will be displayed at the end.
The volcopy supports the multi-cartridge/multi-drive feature.
Please refer to the manual page "volcopy" (1M) with questions.
*****
Starting backup of usr2

Tape 3.2.1, 969 feet, 6250 BPI
You will need 1 tape(s).
(      The same size and density are expected for all tapes)
From: /dev/rdisk/c2t1d0s8, to: /dev/rmt/c1t6d0s0? (DEL if wrong)
Retensioning tape. Please wait.

Writing tape 1 of 1, Vol = 3.2.1
      END: 10200 blocks.

backup of usr2 onto /dev/rmt/c1t6d0s0 finished.
You may remove the tape when the rewind completes.
#
```

Unmount File Systems—Step 6

Unmount the */usr* file system (and any other mounted file systems other than *root*) and return the system to the normal operating configuration (multiuser mode). This two-step operation is accomplished with the following commands:

```
umountall
init 2
```

Secure the Backup Media—Step 7

When the backup operation is complete, you should store the backup tapes in a safe place. Any old backup tapes that contain obsolete data can be erased and used for other operations.

If you backed up to another file system on hard disk, you should leave the backup file system unmounted to inhibit access to the saved data until such time as it is needed.

Backups Using the backup Command

The **sysadm backup** command is used to do incremental backups of file systems to a designated backup media. The **backup** command is also used to do complete backups of the *root* and */usr* file systems.

The backup Procedure

The following procedure gives the steps for doing a **backup**. Read the entire procedure before starting any backup.

Additional information and example displays follow this procedure. For each step there is a corresponding text section. For example, Step 5 of the backup procedure says to "Execute **backup** and follow the displayed instructions." Example displays of these commands can be seen in the "Execute the **sysadm backup** Command" section.

1. Determine the number of storage media required to back up each file system. (See the section "Estimate Number of Storage Media Required for Backup.")
2. Take the system to the single-user mode.

```
shutdown -y -is
```

3. Run a check on the file system(s) to be backed up.

4. Mount the file systems. A file system must be mounted before it can be backed up.

mountall /etc/fstab

Note: The */usr* file system contains the System Administration commands and, therefore, must be mounted to execute the **sysadm** commands.

5. Execute the **sysadm backup** and follow the displayed instructions.
6. Unmount the */usr* file system (and any other file systems other than *root*) and return the system to the normal operating configuration (multiuser mode).

**umountall
init 2**

Note: The *root* file system (/) should be the only file system mounted before returning the system to the normal operating configuration (multiuser mode).

7. Store the backup media in a safe place.

Performing a backup should be relatively easy if you follow these operations carefully. Remember to read through the entire procedure before actually starting any backup.

Estimate Number of Storage Media Required for Backup— Step 1

Before you perform any backups, you should determine the size of file system to be backed up (in blocks) and the number of tapes or floppy disks that will be needed. The following paragraphs discuss how to make these calculations.

Determine the Size of a File System (Blocks)

The **du** command discussed in your 3B2 computer System Administration documentation will display the number of blocks used by the specified file system or the specified file. The following is an example of a **du** command which displays the number of blocks used for the */usr* file system and the */usr/guides/index* file.

Performing Backups

```
# du -s /usr /usr/guides/index<CR>
13294  /usr
2      /usr/guides/index
#
```

Note: The -s option gives the total block count for the specified file or file system.

Calculate Backup Media

Once you know the number of blocks in a file system and the backup media to be used, you can calculate the number of spare tapes or floppy disks that you need for the backup.

To calculate the backup media that you need, divide the blocks in the file system (product of **du -s** command) by the storage capacity of one backup media.

Note: Fraction portions should be rounded up to the next whole number. (See the following example.)

The following is an example of calculating the storage media needed to back up an entire SCSI Disk Module onto a SCSI Cartridge Tape Module. Assume the following:

- DM/300E Disk Module with 586000 blocks of data
- TM/120S SCSI Cartridge Tape Module with 245000 blocks of storage capacity per tape.

The calculated backup media is:

$$586000 / 245000 = 2.4 \text{ tapes}$$

or

3 cartridge tapes

It is recommended that in most situations you make the size of each file system less than or equal to that of your backup media. This simplifies the backup process because each time you do a backup, the entire file system

will fit on a single media. In this way you get maximum use of your backup media. (Refer to Chapter 4, "Using SCSI Hard Disks" for information on partitioning a SCSI hard disk.)

In order to comply with this recommendation, you will have to know the storage capacity of your backup media before you can set up your file system. The following paragraphs discuss the different SCSI devices that can be used as backup media.

Backup to a SCSI Cartridge Tape Module

Storage capacity on a cartridge tape depends upon the SCSI Cartridge Tape Module that you have (see below).

Tape Module	Megabytes	Blocks (512 bytes)
TM/60S	60	115000
TM/120S	120	245000

File systems larger than the capacity of a single tape can be backed up on multiple tapes.

Backup to a SCSI 9-Track Tape

The amount of data a reel of tape can store depends on the size of the reel and the format of the data written to the tape. Multiple tape reels will be required for file systems larger than the capacity of a single reel.

Enter the Single-User Mode—Step 2

The computer system should be in single-user mode when a backup is being performed or when a complete restore is taking place. This will ensure that no one is accessing some of the files that you are trying to save or restore. Single-user mode is reached by executing the `/etc/shutdown` command which is described in detail in your System Administration documentation.

Check File Systems—Step 3

The file systems to be saved should be checked before they are backed up. The "`fsck`" command (described in your System Administration documentation) is used to check and repair inconsistencies in file systems on a hard disk. With the exception of `root`, a file system must be unmounted before it can be checked.

Mount File Systems—Step 4

A file system has to be mounted before it can be backed up. The */usr* file system must be mounted before you can execute any of the System Administration commands. The command used to mount all available file systems is as follows:

```
mountall /etc/fstab
```

Note: The */etc/fstab* file is discussed in detail in your System Administration documentation.

Execute the **sysadm backup** Command—Step 5

The **backup** command will normally be used for incremental backups when SCSI devices are involved. However, a complete backup using **backup** must be performed on a file system before an incremental backup can be done.

Once you have initiated the **backup** command, follow all instructions carefully. Label each storage medium as instructed. You may add other information to the labels at your discretion.

Standard Complete Backup

The following display shows the typical command line entries and system responses for doing a standard complete backup of the */usr2* file system on 9-track tape. The system is in the single-user mode with the */usr* and */usr2* file systems mounted at the start of the sample. The */usr2* file system was checked (**fsck**) before it was mounted.

```
# sysadm backup<CR>
```

```
Running subcommand 'backup' from menu 'filemgmt',  
FILE MANAGEMENT
```

```
Available file systems:
```

```
/ /usr /usr2 ALL
```

```
Enter file system(s) you want to backup [q, ?]: /usr2<CR>
```

```
Select complete or incremental backup [c, i, q, ?]: c<CR>
```

```
Print each file name as it is copied? [q, ?] [y, n, q, ?]: y<CR>
```

```
Select which device to use:
```

```
1 9track1          2 diskette1          3 qtape1
```

```
Enter a number, a name, the initial part of a name, or
```

```
? for HELP, q to QUIT: 1<CR>
```

```
Select multiple save set or standard backup [m, s, ?, q] (default s): s<CR>
```

```
Select tape density for backup.
```

```
Available densities:
```

```
6250 1600
```

```
Enter density you want to select [6250, 1600, q, ?]: 1600<CR>
```

```
Before inserting the first tape into the 9track1 drive, mark it:
```

```
Standard
```

```
Complete Backup of: /usr2,
```

```
1600 BPI
```

```
Thu. 01/14/88, 11:27:20 AM
```

```
Part 1
```

```
Insert the tape in the 9track1 drive. Press <RETURN> when ready. [q] <CR>
```

```
/usr2/files
```

```
.  
.
```

```
83 blocks
```

```
Complete backup of /usr2 on 9track1 drive finished.
```

```
You may remove the tape when the rewind completes.
```

```
#
```

Standard Incremental Backup

The following display shows the typical command line entries and system responses for doing a standard incremental backup of the `/usr` file system on 9-track tape. The system is in the single-user mode with the `/usr` and `/usr2` file systems mounted at the start of the sample. The `/usr2` file system was checked (`fsck`) before it was mounted.

```
# sysadm backup<CR>

Running subcommand 'backup' from menu 'filemgmt',
FILE MANAGEMENT

Available file systems:
/ /usr /usr2 ALL
Enter file system(s) you want to backup [q, ?]: /usr2<CR>
Select complete or incremental backup [c, i, q, ?]: i<CR>
Print each file name as it is copied? [q, ?] [y, n, q, ?]: y<CR>
Select which device to use:
    1 9track1      2 diskette1      3 qtape1
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 9track1<CR>
Select multiple save set or standard backup [m, s, q, ?] (default s): s<CR>

    Before inserting the first removable medium into the 9track1 drive, mark it:

    Standard
    Incremental Backup of /usr2,
    1600 BPI
    Thu. 01/14/88, 11:34:23 AM to
    Sat. 01/16/88, 07:04:21 AM
    Part 1

Insert the medium in the 9track1 drive. Press <RETURN> when ready. [q] <CR>
/usr2/files
.
.

43 blocks

Incremental backup of /usr2 on 9track1 drive finished.
You may remove the tape when the rewind completes.

#
```

MSS Complete Backup

The **backup** command is used for complete MSS backups.

When you choose to perform a complete backup and select an MSS type backup, the following notice is displayed to standard output:

NOTICE: Selection of complete backup will overwrite contents of tape.

You are then asked if you wish to continue with the backup. A "y" response causes the backup to proceed, and an "n" response causes the **sysadm backup** command to terminate. No writes to the tape will be performed.

The following display shows the typical command line entries and system responses for doing a complete MSS backup of the */usr3* file system on 9-track tape. The system is in the single-user mode with the */usr* and */usr3* file systems mounted at the start of the sample. The */usr3* file system was checked (**fsck**) before it was mounted.

Performing Backups

```
# sysadm backup<CR>
```

```
Running subcommand 'backup' from menu 'filemgmt',  
FILE MANAGEMENT
```

```
Available file systems:
```

```
/ /usr /usr3 ALL
```

```
Enter file system(s) you want to backup [q, ?]: /usr3<CR>
```

```
Select complete or incremental backup [c, i, q, ?]: c<CR>
```

```
Print each file name as it is copied? [q, ?] [y, n, q, ?]: y<CR>
```

```
Select which device to use:
```

```
1 9track1      2 diskette1    3 qtape1
```

```
Enter a number, a name, the initial part of a name, or
```

```
? for HELP, q to QUIT: 1<CR>
```

```
Select multiple save set or standard backup [m, s, q, ?] (default s): m<CR>
```

```
Insert the tape in the 9track1 drive. Press <RETURN> when ready. [q] <CR>
```

```
Select tape density for backup.
```

```
Available densities:
```

```
6250 1600
```

```
Enter density you want to select [6250, 1600, q, ?]: 1600<CR>
```

```
NOTICE: Selection of complete backup will overwrite contents of tape.
```

```
Do you wish to continue with the backup? [y, n, q] y<CR>
```

```
Mark the tape in 9track1 drive after the backup has completed.
```

```
Multiple Save Set
```

```
Complete Backup of: /usr3,
```

```
1600 BPI
```

```
Thu. 01/14/88, 11:48:24 AM
```

```
Part 1
```

```
Signals will be ignored.
```

```
/usr3files
```

```
.
```

```
.
```

```
60 blocks
```

```
Complete backup of /usr3 on 9track1 drive finished.
```

```
You may remove the tape when the rewind completes.
```

```
#
```

MSS Incremental Backup

The **backup** command will normally be used for incremental MSS backups when SCSI devices are involved. However, a complete backup using **sysadm backup** must be performed on a file system before an incremental backup can be done.

Note: If additional backups are being added to multiple tape backups, be sure to use the last tape in the series. All other backup tapes should be write protected; otherwise, data could be lost.

The following display shows the typical command line entries and system responses for doing an incremental MSS backup of the */usr3* file system on 9-track tape. The system is in the single-user mode with the */usr* and */usr3* file systems mounted at the start of the sample. The */usr3* file system was checked (**fsck**) before it was mounted.

Performing Backups

```
# sysadm backup<CR>
```

```
Running subcommand 'backup' from menu 'filemgmt',
```

```
FILE MANAGEMENT
```

```
Available file systems:
```

```
/ /usr /usr3 ALL
```

```
Enter file system(s) you want to backup [q, ?]: /usr3<CR>
```

```
Select complete or incremental backup [c, i, q, ?]: i<CR>
```

```
Print each file name as it is copied? [q, ?] [y, n, q, ?]: y<CR>
```

```
Select which device to use:
```

```
1 9track1      2 diskette1    3 qtape1
```

```
Enter a number, a name, the initial part of a name, or
```

```
? for HELP, q to QUIT: 1<CR>
```

```
Select multiple save set or standard backup [m, s, q, ?] (default s): m<CR>
```

```
Insert the tape in the 9track1 drive. Press <RETURN> when ready. [q] <CR>
```

```
Mark the tape in 9track1 drive after the backup has completed.
```

```
Multiple Save Set
```

```
Incremental Backup of: /usr3,
```

```
1600 BPI
```

```
Thu. 01/14/88, 11:34:23 AM to
```

```
Thu. 01/14/88, 11:37:23 AM
```

```
Part 1
```

```
Note: In standard backup, Part 1 implies Tape 1.
```

```
With MSS, Part 1 means Part 1 of the backup being performed.
```

```
Signals will be ignored.
```

```
/usr3/files
```

```
.
```

```
.
```

```
13 blocks
```

```
Incremental backup of /usr3 on 9track1 drive finished.
```

```
You may remove the tape when the rewind completes.
```

```
#
```

Unmount File Systems—Step 6

Unmount the */usr* file system (and any other mounted file systems other than *root*) and return the system to the normal operating configuration (multiuser mode). This two-step operation is accomplished with the following commands:

```
umountall  
init 2
```

Store the Backup Media—Step 7

When the backup operation is complete, you should store the backup media in a safe place. Any backup media containing obsolete data can be erased and used for other operations.

Performing Stores

Specific directories and files can be quickly saved by using the **sysadm store** command. This method of storing data is sometimes referred to as "selective backups."

When you choose to perform an MSS type backup, you will be asked whether the store is to be added to a current MSS independent backup or if a new tape is to be created. If create is chosen, an MSS type backup is performed and the new backup is written at the Beginning-of-Tape (BOT).

Store (Selected Backup) Procedure

The general sequence for copying selected information to a storage medium is as follows:

1. Change directory (**cd**) to the desired directory.
2. If desired, check that the number of data blocks involved (**du** command) is less than the number of data blocks on the desired storage medium.
3. Label the formatted medium to indicate the directory or file.
4. Copy the selected data to the medium by using the **sysadm store** command and following the displayed instructions.

Sample Standard Store Procedure

The following screen display shows the command line entries and system responses associated with copying a selected directory of information onto a 9-track tape drive.

```
# cd /pathname<CR>
# du -s<CR>      (Optional)
144 (blocks).
# sysadm store<CR>
```

Running subcommand 'store' from menu 'filemgmt',
FILE MANAGEMENT

Select which device to use:

1 9track1 2 qtape1 3 diskette1

Enter a number, a name, the initial part of a name, or

? for HELP, q to QUIT: 9track1<CR>

Select multiple save set or standard backup [m, s, ?, q] (default s): s<CR>

1. Select a single file for storing.
2. Select all files under a directory for storing.

Enter a number [q, ?]: 2<CR>

Enter full path name of directory to be stored [q]:

/usr/dgw/guide<CR>

1. Select a single file for storing.
2. Select all files under a directory for storing.
3. List files selected so far.
4. Store selected files.

Enter a number [q, ?]: 3<CR> *Note: Listing the selected files is optional.*

4 files selected so far.

```
/usr/dgw/guide
/usr/dgw/guide/body
/usr/dgw/guide/glossary
/usr/dgw/guide/titlepage
```

1. Select a single file for storing.
2. Select all files under a directory for storing.
3. List files selected so far.
4. Store selected files.

(Display continued on next page.)

Performing Stores

("sysadm store" display continued from previous page.)

Enter a number [q, ?]: 4<CR>

4 files selected.

Print each file name as it is being stored? [y, n, q, ?] y<CR>

Before inserting the medium into the 9track1 drive, mark it:

Standard

2 Files stored on:

Tue. 07/08/86, 05:47:21 PM

1600 BPI

part 1

Insert the medium into the 9track1 drive. Press <RETURN> when ready. [q] <CR>

/usr/dgw/guide

/usr/dgw/guide/body

/usr/dgw/guide/glossary

/usr/dgw/guide/titlepage

144 blocks

Store complete.

Do you want to verify that your files were stored properly? [y, n, q, ?] y<CR>

PLEASE NOTE:

To verify that the store worked properly, you must re-insert all parts that were just written to, starting with "part 1".

Insert the medium in the 9track1 drive. Press <RETURN> when ready.[q] <CR>

144 blocks

Verification complete. You may remove the medium.

Should the stored files be removed from the built-in disk? [y, n, q, ?] y<CR>

Removal complete.

You may remove the tape when the rewind completes.

Sample MSS Store Procedure

The following screen display shows the command line entries and system responses associated with copying a selected file and directory of information onto a 9-track tape. Note that the MSS store procedure automatically verifies the information transferred to the tape, so there is no prompt asking if you want the files verified.

Note: If additional stores are being added to multiple tape stores, be sure to use the last tape in the series. All other backup tapes should be write protected; otherwise, data could be lost.

```
# cd /pathname<CR>
# du -s<CR>  (Optional)
240 (blocks).
# sysadm store<CR>

Running subcommand 'store' from menu 'filemgmt',
FILE MANAGEMENT

Select which drive to use:
    1 9track1      2 qtape1      3 diskette1
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 1<CR>
Select multiple save set or standard backup [m, s, ?, q] (default s): m<CR>
Insert the tape in the 9track1 drive. Press <RETURN> when ready. [q] <CR>
Select create or append mode [c, a, ?, q]: c<CR>

    1. Select a single file for storing.
    2. Select all files under a directory for storing.
Enter a number [q, ?]: 1<CR>
Enter full path name of file to be stored [q]:
    /etc/passwd<CR>

    1. Select a single file for storing.
    2. Select all files under a directory for storing.
    3. List files selected so far.
    4. Store selected files.
```

(Display continued on next page.)

Performing Stores

("sysadm store" display continued from previous page.)

Enter a number [q, ?]: 2<CR>

Enter full path name of directory to be stored [q]:

/mnt<CR>

1. Select a single file for storing.
2. Select all files under a directory for storing.
3. List files selected so far.
4. Store selected files.

Enter a number [q, ?]: 4<CR>

37 files selected.

Print each file name as it is being stored? [y, n, q, ?] n<CR>

Mark the tape in 9track1 drive after the backup has completed.

Multiple Save Set

37 Files stored on:

Thu. 01/14/88, 01:40:26 PM

1600 BPI

part 1

Signals will be ignored.

*Each dot represents a file as
it is written to the storage media.*

240 blocks

Store complete.

Should the stored files be removed from the built-in disk? [y, n, q, ?] n<CR>

#

Performing Restores

General

System Administration provides two commands for restoring files to hard disk. These commands are the **sysadm hsrestore** and **sysadm restore**. The **hsrestore** command restores file systems that have been completely backed up using the **hsbackup** command (see "Performing Backups"). The **restore** command restores file systems or files that were backed up using the **backup** or **store** commands.

The restore commands restore data that was backed up to cartridge tape(s), 9-track tape(s), hard disk(s), or floppy disk(s).

The restoral of directories and files from system backups can be done on the basis of a single file, a directory structure, or all files of a system backup.

The standard restore capabilities and interface remain unchanged. The exception for SCSI Release 3.0 or later is an added option to select a specific save set relative to the current medium position, and the ability to restore single files, directories of files, or all files from the current save set, or to restore the latest versions of these.

This option only appears for a SCSI Release 3.0 or later medium (i.e., a labeled medium). The position option allows you to position the medium to the specified save set and print the information about that save set (label information). Then you may perform a restore from the specified save set or all remaining save sets.

Positioning to save sets that are beyond the End-of-Tape (EOT) is not allowed (e.g., if the save set is on the second tape when the current position is on the first tape). In this case, the medium is positioned at the Beginning-of-Tape and you are prompted to change the tape.

After positioning the medium at a particular save set, the contents of the label are displayed.

Restore Procedure

The following procedure is applicable to both the **sysadm hsrestore** and **restore** commands. Read the entire procedure before starting any restores. Refer to the appropriate text that follows the restore procedure for additional information and example displays of **hsrestore** and **restore**.

The general sequence for restoring a file or file system from backup is as follows:

Note: You may want to notify all involved users of the need for a restore before starting the procedure.

1. Take the system to the single-user mode.

shutdown -y -is

2. Mount the file systems. A file system must be mounted before it can receive any restored data.

mountall /etc/fstab

*(For **hsrestore**, mount only "/usr" and the file system to be restored if the 9-track tape is on the same bus as the hard disk containing the file system.)*

Note: The */usr* file system contains the System Administration commands and, therefore, must be mounted before you can execute the **sysadm** commands.

3. Execute the desired System Administration restore command (**sysadm hsrestore** or **sysadm restore**) and follow the displayed instructions. (Refer to "Execute the **sysadm hsrestore** Command" or "Execute the **sysadm restore** Command" for example displays.)

4. Unmount the */usr* file system (and any other mounted file systems other than *root*) and return the computer system to the normal operating configuration (multiuser mode).

```
umountall  
init 2
```

Note: The *root* file system (/) should be the only file system mounted before returning the system to the normal operating configuration (multiuser mode).

5. Store the backup media in a safe place.

It is recommended that you read through the entire procedure before starting any restores. If you are an experienced user and are familiar with the files involved, you may not be required to go to single-user mode. However, single-user mode is recommended to avoid any use of the involved files while you are trying to restore them.

Enter the Single-User Mode—Step 1

The system should be in single-user mode whenever a major restore is being performed. This will ensure that no one is accessing some of the files that you are trying to restore. The single-user mode is reached by executing the */etc/shutdown* command, which is described in detail in your System Administration documentation.

Mount File Systems—Step 2

A file system must be mounted in order to receive any restored data. The */usr* file system must be mounted to execute any of the System Administration commands. The command to mount all available file systems is the following:

```
mountall /etc/fstab
```

Note: The */etc/fstab* file is discussed in detail in your System Administration documentation.

Execute the `sysadm hsrestore` or `sysadm restore` Command—Step 3

Execute the `sysadm hsrestore` Command

The `hsrestore` command is an interactive command which displays instructions and prompts you for input.

Note: Use the `hsrestore` command only on file systems that were backed up with the `hsbackup` command.

The following display shows the typical `hsrestore` command line entries and system responses for doing a complete restoral of the */usr2* file system from 9-track tape. The system is in the single-user mode with the */usr* and */usr2* file systems mounted at the start of the sample. The example */usr2* file system contains 10200 blocks.

```
# sysadm hrestore<CR>
```

```
Running subcommand 'hrestore' from menu 'filegmt',  
FILE MANAGEMENT
```

```
From which drive will the file system be restored?
```

```
1 9track1    2 disk1    3 disk2    4 qtape1
```

```
Enter a number, a name, the initial part of a name, or
```

```
? for HELP, q to QUIT: 9track1<CR>
```

```
Insert the medium in the 9track1 drive. Press <RETURN> when ready. [q]<CR>
```

```
Which drive will the file system be restored to?
```

```
1 disk1    2 disk2    3 disk3    4 qtape1
```

```
Enter a number, a name, the initial part of a name, or
```

```
? for HELP, q to QUIT: disk2<CR>
```

```
Which partition on disk2 drive will the file system be restored to?
```

```
8(fs:usr2) 9(fs:usr3) a(fs:usr4) (q for quit):8<CR>
```

Note: If the file system to be restored was mounted, a message indicating this would be displayed at this point. You would be given a choice to unmount the file system to continue.

```
This partition already has a file system 'usr2', labeled '3.2.1'.
```

```
Do you wish to overwrite it? [y, n, q]y<CR>
```

```
*****
```

```
NOTE!!!
```

```
Before the hrestore begins, you may receive warning messages from the "volcopy" command. These messages will require a response of "y" to continue.
```

```
The last message will be:
```

```
From: (source), to: (destination)? (DEL if wrong)
```

```
The source is 9track1 drive known as /dev/rmt/c1t6d0s0 by volcopy.
```

```
The destination is disk2 drive partition 8.
```

```
This drive is known as /dev/rdisk/c2t1d0s8 by volcopy.
```

```
(Display continued on next page.)
```

Performing Restores

("sysadm hrestore" display continued from previous page.)

```
The number of blocks copied will be displayed at the end.
Please refer to the manual page "volcopy" (1M) with questions.
*****
Starting hrestore of usr2

Tape 3.2.1, 2357 feet, 6250 BPI
From: /dev/rmt/c1t6d0s0, to: /dev/rdisk/c2t1d0s8? (DEL if wrong)

Reading tape 1 of 1, Vol = 3.2.1
    END: 10200 blocks.

Restore of usr2 onto /dev/rdisk/c2t1d0s8 finished.
You may remove the tape when the rewind completes.

The file system on partition 8 on disk2 drive must be file
system checked before it can be mounted. To check the file system
type fsck /dev/rdisk/c2t1d0s8 after exiting from the sysadm command.
#
```

Execute the sysadm restore Command

The standard **restore** command is an interactive command which displays instructions and prompts you for input.

Note: Use the **restore** command only on files that were backed up with the **backup** or **store** command.

When restoring from a complete backup, all storage media from that series must be loaded. When restoring from a standard incremental backup, all storage media containing the last complete backup plus all incremental backup media must be loaded. Even if you intend to restore only a single file, all storage media of a backup must be loaded in sequence. In all cases, the first storage medium of a series must be the first storage medium read by the standard restore process.

Sample Standard Restore

When restoring from a selective backup (**store** command), only those media used for the store operation are necessary. If you know which medium contains the desired file, that one medium is all that is required.

The following display shows the typical command line entries and system responses for restoring a single file of a file system. This file is from an incremental backup contained on a SCSI Cartridge Tape. At the start of this example, the system is in the single-user mode with the */usr* file system mounted.

Note: When restoring the *root* file system, you will receive some error messages (errno 26) due to text files being busy. These messages can be ignored.

Performing Restores

```
# sysadm restore<CR>
```

```
Running subcommand 'restore' from menu 'filemgmt',  
FILE MANAGEMENT
```

```
Select which device to use:
```

```
1 9track1      2 diskette      3 qtape1
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: qtape1<CR>
```

```
Insert the tape in the qtape1 drive. Press <RETURN> when ready. [q] <CR>  
Retensioning tape.
```

```
Select:
```

1. restore single files
2. restore directories of files
3. restore all files
4. list all the files

```
Enter a number [q, ?]: 1<CR>
```

```
Enter full path name of file(s) to be restored [q, ?]: /usr/dgw/guide/glossary<CR>
```

```
Do you want to rename the file as it is copied in? [y, n, q]: y<CR>
```

```
WARNING: Be very careful when you rename a file. Files incorrectly named  
by typing errors are difficult to find and repair. Remember that only the  
first 14 characters of each part of the  
file name (i.e., the characters between the "/"s) are significant.
```

```
You will be asked to rename each file in turn. An empty response skips that  
file. An answer of "." (period) restores the file with its original name.
```

```
Rename </usr/dgw/guide/glossary>
```

```
/usr/dgw/guide/terms<CR> Note: Must use full path name.
```

```
33 blocks
```

```
Restoration complete.
```

```
You may now remove the tape when the rewind completes.
```

```
Insert the tape in the qtape1 drive. Press <RETURN> when ready. [q] <CR>
```

```
Select:
```

1. restore single files
2. restore directories of files
3. restore all files
4. list all the files

```
Enter a number [q,?]: q<CR>
```

```
#
```

Sample MSS Restore

When restoring from a selective backup (**store** command), only those media used for the store operation are necessary. If you know which medium contains the desired file(s), that one medium is all that is required.

The following display shows the typical command line entries and system responses for restoring the */usr3* file system. These files are from a complete backup contained on a SCSI 9-Track Tape. At the start of this example, the system is in the single-user mode with the */usr* and */usr3* file systems mounted.

Note: When restoring the *root* file system, you will receive some error messages (errno 26) due to text files being busy. These messages can be ignored.

Performing Restores

```
# sysadm restore<CR>
```

```
Running subcommand 'restore' from menu 'filemgmt',  
FILE MANAGEMENT
```

```
Select which drive to use:
```

```
1 9track1      2 diskette      3 qtape1
```

```
Enter a number, a name, the initial part of a name, or
```

```
? for HELP, q to QUIT: 1<CR>
```

```
Insert the tape in the 9track1 drive. Press <RETURN> when ready. [q] <CR>
```

```
Multiple Save Set
```

```
Complete Backup of: /usr3,
```

```
1600 BPI
```

```
Thu. 01/14/88, 03:11:55 PM
```

```
Select:
```

1. restore single files
2. restore directories of files
3. restore all files
4. list all the files
5. position to a save set.

```
Enter a number [q, ?]: 2<CR>
```

```
Do you want to restore from all remaining save sets? [y, n, ?] y<CR>
```

```
Enter full path name of file(s) to be restored [q, ?]:
```

```
/usr3<CR>
```

```
Do you want to rename the file as it is copied in? [y, n, q]: n<CR>
```

```
/usr3/files
```

```
230 blocks
```

```
You may change the tape in the 9track1 drive, if needed.
```

```
Press <RETURN> when ready. [q] q
```

Sample MSS Restore Using Position to Save Set Option

The following display shows the typical command line entries and system responses for restoring the */etc/passwd* and */etc/inittab* files. These files are from an MSS incremental backup contained on a 9-track tape.

Performing Restores

```
# sysadm restore<CR>
```

```
Running subcommand 'restore' from menu 'filemgmt',  
FILE MANAGEMENT
```

```
Select which drive to use:
```

```
1 9track1      2 qtape1      3 diskette1
```

```
Enter a number, a name, the initial part of a name, or
```

```
? for HELP, q to QUIT: 1<CR>
```

```
Insert the tape in the 9track1 drive. Press <RETURN> when ready. [q] <CR>
```

```
Multiple Save Set
```

```
Incremental Backup of: /
```

```
1600 BPI
```

```
Thu. 01/14/88, 10:25:29 AM to
```

```
Thu. 01/17/88, 11:26:24 AM
```

```
Select:
```

1. restore single files.
2. restore directories of files
3. restore all files
4. list all the files
5. position to a save set.

```
Enter a number [q, ?]: 5<CR>
```

```
Select:
```

1. save set relative to the current position.
2. beginning of the tape.

```
Enter a number [q, ?]: 1<CR>
```

```
Enter the number of save sets to be skipped [?, q]: 1<CR>
```

```
You may change the tape in the 9track1 drive, if needed.
```

```
Press <RETURN> when ready. [q] <CR>
```

```
Multiple Save Set
```

```
Incremental Backup of: /
```

```
1600 BPI
```

```
Thu. 01/14/88, 10:25:29 AM to
```

```
Thu. 01/17/88, 11:26:24 AM
```

(Display continued on next page.)

("sysadm restore" display continued from previous page.)

Select:

1. restore single files
2. restore directories of files
3. restore all files
4. list all the files
5. position to a save set.

Enter a number [q, ?]: 1<CR>

Do you want to restore from all remaining save sets? [y, n, ?] y<CR>

Enter full path name of file(s) to be restored [q, ?]: /etc/passwd<CR>

Do you want to rename the file as it is copied in? [y, n, q]: n<CR>

/etc/passwd

20 blocks

You may change the tape in the 9track1 drive, if needed.

Press <RETURN> when ready. [q] <CR>

Multiple Save Set

Incremental Backup of: /

1600 BPI

Thu. 01/14/88, 10:25:29 AM to

Thu. 01/17/88, 11:26:24 AM

Select:

1. restore single files
2. restore directories of files
3. restore all files
4. list all the files
5. position to a save set.

Enter a number [q, ?]: 1<CR>

Do you want to restore from all remaining save sets? [y, n, ?] n<CR>

Enter full path name of file(s) to be restored [q, ?]: /etc/inittab<CR>

(Display continued on next page.)

Performing Restores

("sysadm restore" display continued from previous page.)

```
Do you want to rename the file as it is copied in? [y, n, q]: n<CR>
/etc/inittab
23 blocks
You may change the tape in the 9track1 drive, if needed.
Press <RETURN> when ready. [q] <CR>
  Multiple Save Set
  Incremental Backup of: /
    1600 BPI
  Thu. 01/14/88, 10:25:29 AM to
  Thu. 01/17/88, 11:26:24 AM
Select:
  1. restore single files
  2. restore directories of files
  3. restore all files
  4. list all the files
  5. position to a save set.
Enter a number [q, ?]: 5<CR>
Select:
  1. save set relative to the current position.
  2. beginning of the tape.
Enter a number [q, ?]: 2<CR>
You may change the tape in the 9track1 drive if needed.
Press <RETURN> when ready. [q] q<CR>
```

Unmount File Systems—Step 4

Unmount the */usr* file system (and any other mounted file system other than *root*) and return the system to the normal operating configuration (multiuser mode). This two-step operation is accomplished with the commands that follow:

```
umountall
init 2
```

Store the Backup Media—Step 5

The restore operation is complete. You should store the backup media in a safe place. Any backup media containing obsolete data can be erased and used for other operations.

Introduction to Manual Method of Reading MSS Backup Tapes

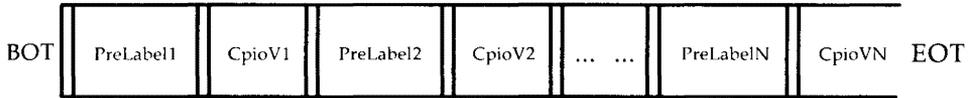
A tape created by an MSS backup is not compatible with a tape created by the standard backup because of the enhanced logical backup format. A manual method can be used to read backup tapes made using the MSS feature. This method is to position over each label (e.g., `</dev/rmt/ctlld0hn`) and then read the **cpio** copy.

Backup Format for MSS Backups

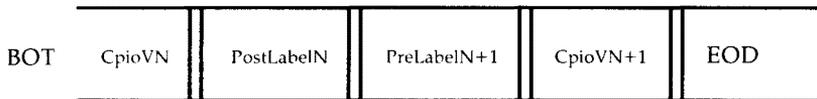
A new logical backup format for the tape medium has been adopted to manage multiple **cpio** save sets. The new format requires that a label be written prior to each **cpio** save set. This label is a single 512-byte block of information that identifies what is in the **cpio** save set. All single backup MSS tapes and the initial tape of a multiple MSS tape backup has a label written at the BOT. Backups that extend across a tape have two labels written after the completion of the **cpio** copy that crossed the tape. Multiple tapes containing cross-over data are terminated with an EOT mark. The last multiple tape is terminated with an End-of-Data (EOD) mark. The medium can be positioned at the EOD for appending.

An example tape format is shown in Figure 8-1.

TAPE 1:



TAPE 2:



LEGEND:

BOT = Beginning-of-Tape

EOT = End-of-Tape

EOD = End-of-Data

|| = Filemark

Figure 8-1: Backup Format for Multiple Backups

Manual Recovery of User Data From MSS Tapes

Manual methods of reading MSS tapes are described in the following sections. These methods of recovering data from MSS tapes are most useful when a portion of a tape has been corrupted, and you desire to salvage data from areas not affected by the corruption. Because the MSS feature allows you to put multiple backups on a single tape, there may be backups that can be recovered from a damaged tape.

Figure 8-1 shows the format of MSS tapes. After the BOT mark, notice that the first tape written in a multiple or single tape backup has a "filemark" which distinguishes it from successive tapes. Additional tapes in a multiple tape backup do not contain the BOT filemark. Filemarks also separate the data written to the tape by the "Copy File Archives In and Out" (**cpio**) command.

The position of the filemarks and the constant size, 512 bytes, of labels allow you to sequence through the contents of the tape until the desired data can be retrieved.

Recovering User Data From the First Tape

Once the tape is loaded, a "Convert and Copy a File" command (**/bin/dd**) is used to read the tape. The **dd** command is used to position the tape to the desired save set and to read the label prior to recovering user data.

Note: *Tape Devicen* in the following procedures refers to the input device file name. The format of *Tape Devicen* for a 9-track tape could be:

/dev/rmt/c?t?d?hn.

where "h" stands for high density and "n" is for "no rewind." Refer to the **dd** manual page for more details.

The following procedure can be used to recover user data from the MSS backup tape. Refer to Figure 8-1 for the backup format.

1. Load tape.
2. Position the tape after the first filemark by entering:

```
dd if=Tape Devicen of=/tmp/label bs=512<CR>
```

or

```
< Tape Devicen<CR>
```

3. Read the label at the current tape position by entering:

```
dd if=Tape Devicen of=/tmp/label bs=512<CR>
```

4. Read the displayed contents (of file */tmp/label*) and determine if this is the save set to be recovered.

5. If this is the save set to be recovered, skip this step. If this is not the save set to be recovered, enter:

```
dd if=Tape Device of=/dev/null bs=512<CR>
```

and repeat Steps 3 and 4.

6. The **cpio** command restores the save set contents into the current directory. Make sure you are in the appropriate directory before performing the restore.
7. When positioned at the correct save set and appropriate directory, recover the data by entering:

```
cpio -icdvB < Tape Device<CR>
```

Recovering User Data That Crosses Tapes

To recover data that crosses tapes, perform the following steps:

1. Load the tape containing the initial part of data that crosses to another tape.
2. Position to the last save set on the tape (as described previously in "Recovering User Data from the First Tape").
3. Restore the save set contents into the current directory by entering:

```
cpio -icdvB -ITape Device<CR>
```

4. A message will be displayed when the EOT is reached.
5. Load the next tape and follow the instructions displayed.

Recovering User Data From the Second and Successive Tapes

User data can be recovered from the second or following tapes of multiple tape backups without starting from the first tape. The recovery method is slightly different because the second and successive tapes do not contain the filemark immediately after BOT. Refer to Figure 8-1 for the tape format.

Introduction to Manual Method of Reading MSS Backup Tapes _____

Perform the following to recover user data from the second and successive MSS tapes.

1. Load tape.
2. Position to the end of the cross-over data on the tape by entering:

```
dd if=Tape Devicen of=/dev/null bs=512<CR>
```

3. Position to the first save set on the tape by entering:

```
dd if=Tape Devicen of=/dev/null bs=512<CR>
```

4. Perform the procedures from "Recovering User Data from the First Tape," beginning with Step 3.

For an alternate positioning method, refer to the **tapecntl(1M)** manual page.

Chapter 9: File System Management on SCSI Devices

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Introduction to File System Management

This chapter gives background information on management of file systems that are associated with SCSI storage devices. Previous chapters in this document have explained the process of creating and manipulating file systems. The following is a review of these chapters:

- Creating file systems—"Partitioning" in Chapter 4
- Changing file systems—"Repartitioning" in Chapter 4
- Backing up file systems—"Performing Backups" in Chapter 8
- Restoring file systems—"Performing Restores" in Chapter 8.

This chapter includes general information about file systems on SCSI devices.

SCSI File Systems

The SCSI hard disk drives are the only SCSI devices which contain mountable file systems. The other devices (SCSI Cartridge Tape and SCSI 9-Track Tape) are basically backup and transport devices.

A file system equates to one of up to eight partitioned areas on a SCSI hard disk. These file systems are generally subdivided into smaller data areas called directories or files by administrators and/or users.

Creating a File System on a SCSI Disk

File systems are created and mounted when a SCSI hard disk is partitioned (see "Partitioning a SCSI Hard Disk" in Chapter 4). System Administration allows the administrator to specify the size and name of each file system during partitioning.

Partitioning is the process of dividing the disk storage area into smaller sections by assigning each partition a certain number of blocks (1 block = 512 bytes of memory). Each partition is a file system which will be mounted for access by the users. If you need to develop a better understanding of partitioning before you proceed, refer to the Device Partitioning Appendix in the *AT&T 3B2 Computer System Administrator's Guide*.

There can be up to eight partitions (file systems) on each SCSI hard disk. A partition will generally be referred to by a device and number (hexadecimal) while file systems will be referred to by their given names. The following are examples of the partition and file system designations:

Partition - `/dev/dsk/c2t1d0s8`

where: `/dev/dsk` is the device file for a disk
`c2` is the system controller number
`t1` is the SCSI target controller number or ID
`d0` is the drive number on that controller
`s8` is the slice or partition number

File System - `/usr2`

where: `/` refers to *root*
`usr2` is the given name

The `/etc/fstab` file is an administrative file which shows the relationship of the file system and the device partitions. The following is an example of the file.

```
# cat /etc/fstab
/dev/dsk/c1d1s2    /usr    Note: /usr is located on an integral disk
/dev/dsk/c1t1d0s8 /usr2
#
```

The `/etc/fstab` is used with the **mountall** command to specify what file systems are to be mounted.

Mounting and Unmounting File Systems

To mount a file system is to announce to the operating system that a file system is present on a particular storage device. Once a file system is mounted, it is treated like any other file system which can be accessed by the users.

A command that is commonly used for mounting file systems is the **mountall** command which says to take the file systems listed in the `/etc/fstab` file and "mount" them accordingly. The following is an example of this command:

```
mountall /etc/fstab
```

When a SCSI hard disk is partitioned, the file system on that disk is automatically mounted.

A corresponding command unmounts all mounted file systems. This command is the **umountall** command which "unmounts" all user file systems including `/usr` which contains the shell scripts for SCSI. However, **umountall** does not unmount the `root (/)` file system.

The following is an example of this command:

```
umountall
```

Anytime the system is taken down to the single-user mode, all file systems except *root (/)* are unmounted.

Note: To use any of the System Administration (**sysadm**) commands referred to in this document, the */usr* file system must be mounted.

File System Checking

A checking mechanism is built into the 3B2 computer to ensure the integrity of the file system. The status of the file system is automatically checked when the 3B2 computer is powered up. If file system "status checks" indicate the need to check a file system, the **fsck** program is automatically executed.

The **fsck** program is an interactive file system check and repair program. It uses redundant structural information in the UNIX System V file system to do several consistency checks. If an inconsistency is detected, a message describing the inconsistency is output. You may elect to fix or ignore each inconsistency. The **fsck** program is frequently able to repair corrupted file systems.

Refer to the *AT&T 3B2 Computer System Administrator's Guide* for more detailed information on using **fsck**.

System Administration File Management Commands

The sysadm diskuse Command

System Administration provides a command under the File Management Menu called **diskuse**. This command reports what percentage of the hard disk is currently occupied by files. It outputs a list organized by mounted file system names. This information becomes very important when you have a large number of SCSI disk file systems to manage.

The following is an example of the **diskuse** command. In the example, *root (/)* and */usr* are located on an integral disk while */usr2* is located on a SCSI hard disk. Notice the SCSI disk */usr2* file has 10200 blocks and is virtually empty.

```
# sysadm diskuse<CR>
```

```
Running subcommand 'diskuse' from menu 'filemgmt',  
FILE MANAGEMENT
```

```
FILE SYSTEM USAGE AS OF 04/07/88 13:24:56
```

File System	Free Blocks	Total Blocks	Percent Full
/	5468	12510	56%
/usr	41054	43920	6%
/usr2	10034	10200	1%

The **sysadm fileage** Command

System Administration provides the **fileage** command under the File Management Menu. This command lists files that are older than a given date. The **fileage** command prints the names of all files older than the date you specify. If you do not enter a date, all files older than 90 days are listed. If you do not specify the directory in which to look, your login directory will be used.

This information will be very helpful in keeping track of file systems that contain data that is not being used.

The following is an example of the **fileage** command.

```
# sysadm fileage<CR>

Running subcommand 'fileage' from menu 'filemgmt',
FILE MANAGEMENT

Enter full path name of the directory to search
[?, q]: /usr2<CR>
Enter the number of days to go back (default 90) [?,q]: 10<CR>

FILES NOT MODIFIED IN THE LAST 10 DAYS IN /usr2

      file size      date of
owner  (characters)  last access  filename
-----
root          48      Jul  3 10:53
root          512     Jul  3 10:53  lost+found
#
```

The sysadm filesize Command

System Administration provides the **filesize** command under the File Management Menu. This command prints the names of the largest files in a specific directory. If you do not specify how many large files to list, ten files are listed.

The following is an example of the **filesize** command:

```
# sysadm filesize<CR>

Running subcommand 'filesize' from menu 'filemgmt',
FILE MANAGEMENT

Enter full path name of the directory to search
[?, q]: /usr<CR>
Enter the number of large files to be included in list
(default 10 largest) [q]: 5<CR>

The 5 largest files in /usr:

      file size  date of
owner (characters) last access  filename
-----
root      658432 Apr  2 15:48 /bin/src/data.cpio
bin       318056 Mar  3 15:07 lib/libcurses.a
bin       274550 Mar  3 12:58 bin/fmli
root      205412 Apr 15 19:46 lib/lpsched
lp        166544 Mar  3 13:33 lib/lpadmin

#
```

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Introduction to SCSI Shared Peripherals (SSP)

This chapter covers the following topics:

- Description of the SCSI Shared Peripherals (SSP) feature
- Components that are required to support the SSP feature
- Information for the administration and operation of the SSP feature
- Information for the administration and operation of the Enhanced Data Availability (EDA) configuration.

3B2 SSP Feature Overview

Basic Configuration

With the SSP feature, infrequently used or expensive peripherals can be shared by Version 3 computers. This feature allows up to three Version 3 computers to share a common SCSI bus. Each computer sharing the bus has access to all peripherals that are attached to that common bus.

EDA Configuration

The SSP Feature can also be used to provide a backup computer for up to four active computers. The backup computer is connected via the SCSI bus to each individual active computer that it "backs up." This is referred to as the EDA configuration. Full shared peripheral functionality is provided with this application. In the event that an active computer fails, the backup computer has access to the mass storage devices on the shared SCSI bus. This application of the SSP feature eliminates much loss of productivity due to computer failure.

System Architecture

This section describes the hardware and software components needed to support the SSP feature. In addition, the information provided in this section should enable the system administrator or system planner to:

- Develop a configuration plan that meets specific needs
- Determine what components are required for that configuration.

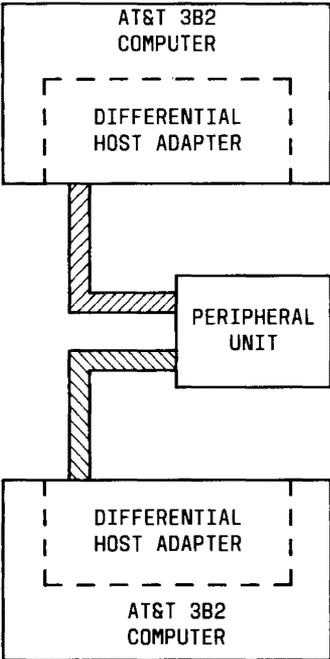
Note: For installation details, refer to the *SCSI Installation Manual*.

Basic Configuration

The SSP feature allows up to three 3B2 computers access to peripherals connected to a common SCSI differential bus. This enables 3B2 computers equipped with a differential Host Adapter to share infrequently used or expensive peripherals.

All standard SCSI configuration rules apply to the shared SCSI bus. There can be eight SCSI taps per shared SCSI bus. Each Host Adapter and each SCSI peripheral unit connected to the shared bus is considered a SCSI tap. Therefore, if three computers are connected, five taps remain for peripherals. The bus must be terminated at each end, and the bus remains a daisy-chained configuration. The two connectors of each Host Adapter or SCSI peripheral are used to provide SCSI IN and SCSI OUT. Either connector can be used for either direction.

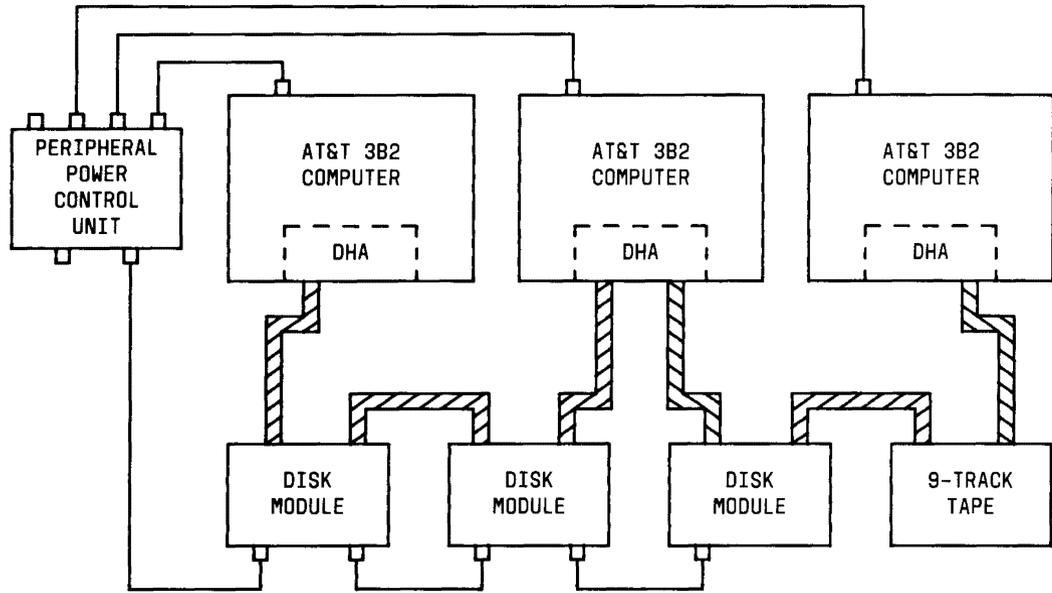
See Figures 10-1 and 10-2 for illustrations of sample SSP configurations. Figure 10-1 illustrates the simplest SSP configuration. Figure 10-2 illustrates a typical SSP configuration.



LEGEND:

 DIFFERENTIAL SCSI BUS

Figure 10-1: Minimum SSP Configuration



LEGEND:
DHA DIFFERENTIAL HOST ADAPTER
// DIFFERENTIAL SCSI BUS
— SOFT POWER

Figure 10-2: Typical SSP Configuration

Components Required to Support SSP

The following list will assist the administrator or system planner in determining what equipment and software is needed to set up 3B2 computers in a basic SSP configuration:

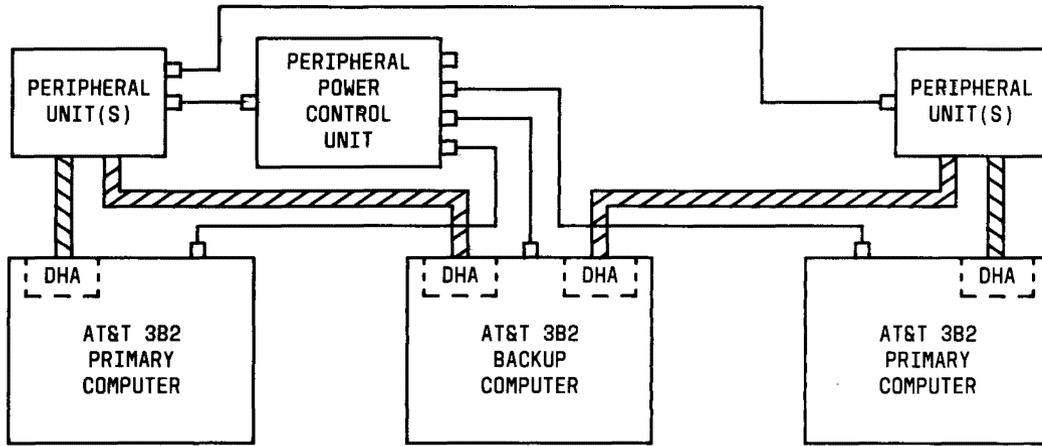
- Two or three 3B2 computers (Version 3)
- UNIX System V operating system, Release 3.2.1 or later
- SCSI Release 3.0 or later
- One SCSI Differential Host Adapter package for each computer
- SCSI peripherals
- Peripheral Power Control Unit (PPCU) package (optional).

EDA Configuration

A second application of the SSP feature is called the Enhanced Data Availability (EDA). This application of the SSP feature is used to provide a backup computer (spare) for up to four active (primary) computers. In the event that a failure occurs on an active 3B2 computer, the backup 3B2 computer can provide access to the mass storage devices on the SCSI bus which is shared between the two computers. There is a wide variability of user connection needs and computer applications. It is the system administrator's responsibility to tailor this application to meet his/her specific needs. See Figure 10-3 for an illustration of a typical EDA Configuration.

When planning for a multiple computer configuration, there are certain guidelines that should be observed:

- The backup computer should be positioned in a central location.
- When planning the configuration, take into account the size of the cabinet.
- The maximum SCSI differential bus length is 82 feet (25 meters).



LEGEND:
DHA DIFFERENTIAL HOST ADAPTER
// DIFFERENTIAL SCSI BUS
— SOFT POWER

Figure 10-3: Typical EDA Configuration

Components Required to Support EDA Configuration

The following list will assist the administrator or system planner in determining what hardware and software is needed for a primary computer used in an EDA configuration:

- UNIX System V operating system, Release 3.2.1 or later
- SCSI Release 3.0 or later
- SCSI Differential Host Adapter package
- Disk Drive for Shared SCSI bus
- Peripheral Power Control Unit (PPCU) package (optional)
- Other SCSI peripherals (optional).

The following list will assist the administrator or system planner in determining what hardware and software is needed for a backup computer used in an EDA configuration:

- UNIX System V operating system, Release 3.2.1 or later
- SCSI Release 3.0 or later
- SCSI Differential Host Adapter package; one for each active computer that the backup computer supports (maximum of 4)
- Any nonstandard hardware and software that is contained in active computers.

For a backup computer to perform all the tasks normally done by all the active computers, the backup computer must have all the equipment that is contained in the active computers. If there are four fully equipped active computers doing four different jobs, a backup computer to support them all could be impossible or the cost could be prohibitive. The system administrator must determine what resources are needed on the backup computer and equip the computer accordingly.

Operation and Administration

The system administrator is responsible for operation and administration of the SSP feature. The system administrator must be familiar with the System Administration Menu (**sysadm**) procedures, boot procedures, and SCSI administration.

The system administrator is responsible for the following:

- Determining how system resources should be shared
- Executing the procedures to allow system resources to be shared
- Determining when an EDA application should be used
- Executing the EDA procedures to move users between computers.

Installation of these features is covered in the *AT&T 3B2 Computer SCSI Installation Manual*.

Basic Configuration

With this feature, many computers can be connected together via a shared SCSI bus. **The system administrator on one computer can disrupt operation of another computer if system administrators on every computer do not work together.** Therefore, it is suggested that one system administrator be assigned responsibility for this application on all computers in a shared SCSI bus environment.

Introduction to Shared Disk Management

There are several System Administration (**sysadm**) commands that are associated with the SSP feature. These commands are contained in the Shared Disk Management (**sharedmgmt**) Menu. This menu is located under the Disk Management (**diskmgmt**) Menu. The following examples illustrate the **sysadm sharedmgmt** Menu:

```
#sysadm sharedmgmt
```

```
                SHARED DISK MANAGEMENT
```

```
1 lock           lock a SCSI drive
2 lockdisp      display locks
3 reset         clear inactive locks
4 unlock        unlock a SCSI drive
```

```
Enter a number, a name, the initial part of a name, or
? or <number>? for HELP,  q to QUIT: q<CR>
#
```

The **sysadm lock** command is used to restrict the access of a SCSI drive to a single computer. With this command, you can also add drives to a system lock list which will cause the drives to be locked each time the system is booted. The **sysadm lockdisp** command is used to display the locked SCSI drives on all shared buses and the system lock list. The **sysadm reset** command is used to clear the locks applied by another computer that is no longer active. The **sysadm unlock** command is used to release a locked drive so that other computers can access the drive. This command can also be used to remove the drives that have been added to the system lock list.

The following example shows the command line entries and system responses for using the **sysadm lock** command to lock "disk5" and enter it in the system lock list.

Note: The SCSI drive should be added to the system lock list when the drive is first locked; otherwise, the SCSI drive will need to be unlocked before it can be added to the system lock list at a later time.

```
# sysadm lock<CR>
```

```
Running subcommand 'lock' from menu 'sharedmgmt',  
SHARED DISK MANAGEMENT
```

```
NOTICE: It is recommended to lock a drive on a shared bus when  
the drive is not in use. Locking a drive that is not  
reserved and is being accessed by another machine on  
the same bus may cause failures on the other machine.
```

```
Locked SCSI drives:
```

```
disk3 : RESERVED  
disk13 : RESERVED
```

```
Locked SCSI drives on other hosts:
```

```
disk10 : RESERVED  
disk4 : RESERVED
```

```
Select which drive to lock:
```

```
1 disk11      3 disk9      5 disk6      7 disk8  
2 disk12      4 disk5      6 disk7
```

```
Enter a number, a name, the initial part of a name, or  
? for HELP, q to QUIT: 4<CR>
```

```
The disk5 drive (hardware slot 4 tc id 4 drive 0) is now locked.
```

```
System lock list contains the following drives:
```

```
disk3 (/dev/rdisk/c3t3d0s6)  
disk13 (/dev/rdisk/c3t4d3s6)
```

```
Do you want to add this drive to the system lock list? [y, n, ?, q] ?<CR>
```

```
If you answer ``yes`` to this question, the disk will be  
added to the lock list which will cause the drive to be  
locked when the system is re-booted.
```

```
If you answer ``no`` and reboot the system, the disk  
will be allowed access by another machine on the same bus.
```

```
Do you want to add this drive to the system lock list? [y, n, ?, q] y<CR>
```

```
Adding disk5 to the system lock list.
```

```
Do you want to lock another disk? [y, n, q] q<CR>
```

```
#
```

The following is an example of the command line entry and system response of a **sysadm lockdisp** command:

```
# sysadm lockdisp<CR>
```

```
Running subcommand 'lockdisp' from menu 'sharedmgmt',  
SHARED DISK MANAGEMENT
```

```
Locked SCSI drives:
```

```
disk3      : RESERVED  
disk13     : RESERVED  
disk5      : RESERVED
```

```
Locked SCSI drives on other hosts:
```

```
disk10     : RESERVED  
disk4      : RESERVED
```

```
Do you want to display the host system lock list? [y, n, q] y<CR>
```

```
System lock list contains the following drives:
```

```
disk3      (/dev/rdisk/c3t3d0s6)  
disk13     (/dev/rdisk/c3t4d3s6)  
disk5      (/dev/rdisk/c4t4d0s6)
```

```
#
```

The following is an example of the **sysadm reset** display. This example resets "disk3" which is connected to the Host Adapter located in backplane slot 3.

```
# sysadm reset<CR>

Running subcommand 'reset' from menu 'sharedmgmt',
SHARED DISK MANAGEMENT

NOTICE: It is recommended to reset drives on a shared bus when
        the bus is not in use. Resetting a drive that is being
        accessed by another machine on the same bus may cause
        failure on the other machine.

Available drives on the Host Adapter in hardware slot 3:
disk10          disk12          disk3           disk9
disk11          disk13

Available drives on the Host Adapter in hardware slot 4:
disk4           disk6           disk7           disk8
disk5

Select a drive for the bus you wish to reset:
  1 disk10      4 disk13      7 disk4        10 disk7
  2 disk11      5 disk3       8 disk5        11 disk8
  3 disk12      6 disk9       9 disk6

Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 5<CR>

SCSI warning messages expected on console:

WARNING: SCSI: Firmware warning message for slot 3,
HA FW WARNING: Sending a SCSI bus reset

NOTICE: SCSI: Restarting jobs after a SCSI Bus Reset for slot 3.

The Host Adapter in hardware slot 3 has been reset.

Do you want to clear locks on another bus? [y, n, q] q<CR>
#
```

Note: If there were any tape operations in process at the time of the reset, they will fail and not get restarted. They must be resubmitted.

The following is an example of the **sysadm unlock** display:

```
#sysadm unlock<CR>

Running subcommand 'unlock' from menu 'sharedmgmt',
SHARED DISK MANAGEMENT

NOTICE: It is recommended to unlock a drive on a shared bus when
        the drive is not in use. Unlocking the drive will allow
        another machine on the same bus to access this drive.

Select which drive to unlock:
  1 disk3          2 disk13          3 disk5
Enter a number, a name, the initial part of a name, or
? for HELP, q to QUIT: 1<CR>

The disk3 drive (hardware slot 3 tc id 3 drive 0) is now unlocked.

System lock list contains the following drives:

    disk3  (/dev/rdisk/c3t3d0s6)
    disk13 (/dev/rdisk/c3t4d3s6)
    disk5  (/dev/rdisk/c4t4d0s6)

Do you want to remove this drive from the system lock list? [y,n,?.q] y<CR>
Removing disk3 from the system lock list.

Do you want to unlock another disk? [y, n, q] n<CR>
#
```

Note: The SCSI drive should be removed from the system lock list when the drive is unlocked; otherwise, the SCSI drive will need to be locked before it can be removed from the system lock list at a later time.

Sharing Peripherals

It is the system administrator's responsibility to determine which computers have access to specific peripherals. Any computer on the shared SCSI bus can access any peripheral on that bus. Many peripherals should only be accessed by one computer at a time. Care should be taken to ensure that data is not lost or corrupted.

The following examples illustrate the types of access problems that can arise in a shared peripheral environment:

- **Commands could fail and give inappropriate failure messages:**
The SSP feature allows system administration to be performed on a shared drive from any one of the 3B2 computers on the shared bus. Some system commands and System Administration commands may not display the appropriate failure message when executed on a drive locked by another 3B2 computer. If a command fails on a shared bus, it is suggested to use **sysadm lockdisp** to first determine if another 3B2 computer has exclusive access to that drive. On the other hand, locking a drive when in use by another 3B2 computer may cause failures on the other computer.
- **Performing maintenance on a shared drive may disrupt another computer:**
The SSP feature allows system maintenance to be performed on a shared drive from any one of the 3B2 computers on the shared bus. Some diagnostic or preventive maintenance procedures may generate a bus reset that may disrupt the boot process or a tape process running on another 3B2 computer. It is suggested to perform system maintenance on a 3B2 computer when all other 3B2 computers on the shared bus are either turned off or sitting idle at firmware level or multiuser mode.
- **Simultaneous access to a shared tape drive may corrupt data:**
The SSP feature allows SCSI drives to be accessed by one or more of the 3B2 computers on a shared bus. Tape drives are only reserved during data transfers from one 3B2 computer at a time. Therefore, it is possible for the data stored on a shared tape drive by one 3B2 computer to be corrupted by another 3B2 computer. It is suggested to restrict simultaneous accesses to a shared tape drive from multiple 3B2 computers.

Devices with read-only permissions, such as a read-only disk, can be shared by multiple computers without fear of destroying data. However, if the device is also used for write operations, data integrity and consistency are not guaranteed automatically by the SCSI subsystem. If writes are to be performed to a shared device from more than one of the computers, a strict protocol must be negotiated and adhered to by all sharing computers to guarantee consistency and data integrity.

In the case of a disk drive, setting up file systems is also the system administrator's responsibility. Access to a disk drive can be limited to a single computer using the **sysadm lock** command. It is the responsibility of the system administrator and application software programmer to make judicious use of the **sysadm** commands that are provided for exclusive access to disk drives.

Setting Priorities

Units (computers and peripherals) on a SCSI bus are assigned priorities via the SCSI ID. In a multi-computer environment, one computer will always have the highest priority due to the strict priority nature of the SCSI bus. Under certain circumstances, the highest priority computer can generate enough traffic on the SCSI bus to affect the performance of the lower priority computers. Also, the top two priority computers can affect the performance of the lowest priority computer. Therefore, it is strongly recommended that heavily accessed devices, such as a disk drive containing a frequently accessed file system, not be placed on a shared SCSI bus.

Priorities are set via the SCSI address (0 through 7). The unit with the higher SCSI address has the higher priority. The computers attached to the SCSI bus are assigned the lower addresses (0, 1, and 2). Peripheral unit addresses are usually set in sequential order, starting with the first address not used by a computer. If three computers are attached to the bus, the first peripheral unit address is set to 3, the second is set to 4, and so on. The SCSI 9-Track Tape does not follow this pattern. The address of the manual-loading SCSI 9-Track Tape Drive is factory preset to 7. The address of the auto-loading SCSI 9-Track Tape Drive is set by the user.

EDA Configuration

Introduction to EDA Administration

All primary and backup computers must be set up properly before users can take advantage of the EDA capabilities. **It is the system administrator's responsibility to ensure all shared file systems have been set up correctly before the EDA configuration is used.** Information that is given in the "Basic Configuration" portion of this section also applies here. It is recommended that a common system administrator be responsible for all computers in the EDA configuration.

The following general rules must also be adhered to:

- All files that are needed by users, while on a backup computer, must reside on one or more peripheral units on the shared bus.
- At least one shared disk must be a boot drive. It is suggested that this shared boot drive be mirrored to the internal boot disk of the primary computer, using the AT&T 3B2 SCSI Disk Mirroring Utilities Release 1.0.
- Any feature hardware added to a primary computer must also be added to the backup computer if that feature is to be available.
- If more than one primary computer is to be supported by the backup computer, any changes made to the backup computer to support a feature on a single primary computer, must not disqualify the backup computer from supporting a different primary computer.

A backup computer should be able to perform all required functions that are performed by the primary computer(s). In the case where multiple primaries share a common backup computer, it must be realized that the primary computers can be used for completely different applications. Therefore, it is possible that the hardware and software on primary computers do not match. The system administrator must ensure that the backup computer contains the same type of hardware that the primary computer contains or the backup computer may not be able to run all operations performed by the primary computer.

The following are two examples of features that may need to be supported on the backup computer:

1. The backup computer will have access to the line printer (LP) spooling software used by the primary computer. However, the physical connection to the primary computers printer may not be available on the backup computer. The administrator may wish to consider providing this connection so that users will not lose use of their printers.
2. The backup computer will also have access to any networking software used by the primary computer, and should be configured with the necessary hardware to provide network resources. The administrator must examine each network to determine what, if any, hardware or software changes must be made on the backup computer to make the networks operational.

The backup computer must also be able to load the same software that is being used by the primary computers. The recommended way to load primary computer software on the backup computer is to boot the backup computer from a copy of the *root* and */usr* file systems located on a shared disk.

Because the backup computer will be booted with a backup copy of the primary computers boot device, there are no special files which must be set up on the backup computer. The backup computer will have its own internal *root* and */usr* file systems. These will be used for booting the backup computer as a stand-alone computer.

Note: It is important to verify that the shared SCSI bus and disks are recognized by the backup computer before it is needed. Run diagnostics on the backup computer, including file system checks, to ensure that the backup computer is operational and is working properly.

It is suggested that the backup computer remain ready and idle in multiuser mode unless it is undergoing diagnostics or preventive maintenance. This will allow the system administrator to quickly take the first steps required to move the users to the backup computer if a primary computer fails.

Note: Full shared peripheral functionality is provided with this configuration. The EDA configuration does not preclude the backup computer from any SSP features.

The system administrator must determine the steps to reroute users connections to the backup computer. How this is done is dependent on the method used to provide terminal-to-computer connectivity. For example, if DATAKIT* virtual circuit switch is used to provide terminal-to-computer connections, the terminals should be rerouted by changing the DATAKIT data base.

When the backup computer is supporting the user community of a primary computer, the primary standard disk backups may not run while on the backup computer. If any shared disks must be backed up while they are owned by the backup computer, a special backup routine should be provided for this purpose.

When to Use EDA

When a primary computer fails, the system administrator should first attempt to determine and remedy the cause of the failure. In many cases, it will be faster to repair the primary computer than to move users to the backup computer.

Diagnose the SCSI bus from the primary computer via the firmware **dgn** command. Determine if the shared SCSI bus and disks will be recognized by the backup computer before you continue. Refer to Chapter 11 "SCSI Trouble Clearing and Diagnostics," for more information on SCSI diagnostics.

The administrator should make at least one attempt to reboot the primary computer before moving users to the backup computer.

* Registered trademark of AT&T

The following is a listing of the types of failures that make it necessary to move users:

- If the primary computer has failed due to hardware or power problems (other than input power).
- If the Host Adapter which controls the shared SCSI bus has failed.

The following is a listing of the types of failures when it is not necessary to move users:

- If the problem can be repaired through file system checks.
- If the primary boot device on the primary computer has been corrupted and the primary computer cannot be booted, boot the primary computer off of the shared bus.
- If the shared SCSI bus/peripheral has failed, the users should NOT be moved to the backup computer because the disks will not be accessible.
- If AC power is lost.

Once the system administrator has determined that the users should be moved to the backup computer, the backup computer must be checked to make sure it is not already supporting a user group from another primary machine.

The following sections describe two procedures that can be used to invoke the EDA feature on your systems. The backup method assumes that copies of the primary file systems are saved on shared disks, while the mirroring method assumes that the SCSI Disk Mirroring Utilities are present and being used.

Backup EDA Procedure

If the AT&T 3B2 SCSI Disk Mirroring Utilities Release 1.0 are not present on a primary computer, a simple backup method can be used to make a copy of the primary computer file systems on shared disks every night. The system administrator may need to make corresponding changes to the backup file systems in between full backups to ensure that the backup of *root* and */usr* are always up-to-date.

Setting Up the Primary Computer

The backup computer will be booted from a backup copy of the primary computer boot device during this procedure; therefore, a shared disk must be made bootable. The shared disk that is selected must be Logical Unit (LU) 0 even if more than one LU is supported by the target controller.

The following information is a step-by-step procedure and example commands for setting up shared disks on a primary computer:

1. On the primary computer console, use **fmthard(1M)** to populate a VTOC on the shared boot disk. Use **prtvtoc(1M)** to verify that the shared boot disk has been partitioned as a bootable device. Check that partitions 0 and 2 (*root* and */usr*) are the same size or larger than the corresponding partitions on the internal boot device.

```
$ fmthard -c0 /dev/rdisk/c#t#d0s6
```

\$ denotes system prompt (do not enter),

denotes devices on the shared bus.

2. Use **newboot(1M)** to place the boot files on the boot special section (partition 7) of the new bootable shared disk.

```
$ newboot -y /lib/lboot /lib/mboot /dev/rdisk/c#t#d0s7
```

It is suggested that the location of the shared boot disk be logged in the backup computer log book for each of the primary computers that it supports.

3. Use **volcopy(1M)** to make a literal copy of *root* and */usr* on the bootable shared disk. Review all other file systems on the primary computer. If there are any file systems which will be needed by the users while on the backup computer, these file systems must also be copied to a shared disk. If the source file system is mounted, it is suggested to execute a **sync(1M)** to ensure file system integrity. Use

fsck(1M) to perform file system checks on all file systems that have been copied to ensure sanity.

```
$ sync
```

```
$ volcopy fsname /dev/rdisk/c?t?d?s? - /dev/rdisk/c#t#d#s# -
```

```
$ fsck /dev/rdisk/c#t#d#s#
```

? denotes local devices on the primary computer,

denotes devices on the shared bus.

If backup copies of *root* and */usr* are not made to the shared disk every night, modify/automate your system backup procedures to perform this. This will ensure that the backup computer has a recent copy of any administrative files that may change daily.

Moving Users to the Backup Computer

Once you have determined that the backup computer is idle and ready to support users, do not continue maintenance on the primary computer. The primary computer must remain in firmware mode until after the backup computer is booted on the shared boot disk.

The following information is a step-by-step procedure for moving users to a backup computer:

1. On the backup computer console, use **mount(1M)** to access the *root* file system (partition 0) on the shared boot disk.

Note: If the shared boot disk cannot be accessed by the backup computer, you may need to execute the **sysadm reset** command to clear any locks (reservation conditions) applied by the primary computer on the shared bus.

If there are any other shared disks in the primary computer system lock list, then use the **sysadm lock** command (to relock the disk) to prevent the primary computer from interrupting the procedure.

Copy the */etc/fstab* file to */etc/fstab.eda*. Edit *fstab* and change the special device file entries to reflect the location of these areas on the backup computer. Since a backup computer can support more

than one primary computer, the Host Adapters may be configured in different slots. Also, remove any device file entries that are local to the primary computer.

```
$ mount /dev/dsk/c#t#d0s0 /mnt
$ cp /mnt/etc/fstab /mnt/etc/fstab.eda
$ vi /mnt/etc/fstab
```

Remove the */dev/root* device file associated with the primary computer. Create a new device file using the "major" number of the shared root device on the backup computer. The "major" number can be obtained using the **ls(1)** command on the shared root device.

```
$ rm /mnt/dev/root
$ mknod /mnt/dev/root b major 0
```

2. Use the **shutdown(1M)** command with the **-i5** option to shut down the backup computer to firmware mode. The failed primary computer and the backup computer must both be in firmware mode before users can be moved to the backup computer. In the example, no grace period is specified for shutdown from multiuser to firmware mode.

```
$ shutdown -y -i5 -g0
```

3. Change terminal-to-computer connections to reroute users to the backup computer. If terminals are hard-wired to a computer, Input/Output (I/O) cards must be moved.
4. Boot the backup computer using */etc/system* as the executable program from the primary computer shared boot disk. It may be necessary to look up the location of the shared boot disk in the backup computer log book.

Enter name of program to execute []: **/etc/system**

If the primary and backup computers do not contain the same hardware, the backup computer will not be able to run all operations performed by the primary computer.

The */etc/rc2* file will attempt to start up processes in */etc/rc.d*. If the backup computer does not have the hardware needed by a process, an error message will be displayed on the console and the process will not be started. The backup computer will continue into multiuser mode. An example of this is starting up AT&T 3BNET software.

If the backup computer does not have 3BNET hardware, the network software will not start.

After the backup computer has booted successfully, perform any necessary maintenance on the primary computer.

Warning: If you are using soft power or you are not using the Peripheral Power Control Unit (PPCU), DO NOT REMOVE AC POWER OR YOU WILL LOSE YOUR SHARED DISKS!

Note: Be sure to disallow the primary computer from interrupting the backup computer during any stages of maintenance. Interruption of the backup computer could cause data corruption.

Moving Users Back to their Primary Computer

Once the primary computer is fully repaired and configured, users can be moved back to the primary computer. All information written to the shared disks will be brought back with them.

File systems will have been changed while in use by the backup computer, either through deliberate administrator action or through normal operations. These changes can be transferred to the primary computer by copying the backup file systems over the local file systems after rebooting the primary computer from the shared boot disk.

The following information is a step-by-step procedure and example commands for moving users back to a primary computer:

1. On the backup computer console, move the `/etc/fstab.eda` file to `/etc/fstab`. This will restore the original file-system-table.

```
$ mv /etc/fstab.eda /etc/fstab
```

Remove the `/dev/root` device file on the backup computer. Create a new device file using the "major" number of the shared root device on the primary computer. The "major" number can be obtained using the `ls(1)` command on the shared root device.

```
$ rm /mnt/dev/root  
$ mknod /mnt/dev/root b major 0
```

2. Use the **shutdown(1M)** command with the **-i5** option to shut down the backup computer to firmware mode. The repaired primary computer and the backup computer must both be in firmware mode before users can be moved back to the primary computer.

```
$ shutdown -y -i5
```

3. On the primary computer console, boot the primary computer on the shared boot disk using */etc/system* when prompted. It is important not to use */unix* if the hardware configurations of the backup and primary computers are different or the hardware on the primary computer was changed during maintenance.

Enter name of program to execute []: **/etc/system**

4. Use **volcopy(1M)** to replace all local disk copies of the *root*, */usr* and any other *user* file systems from the backup copy of the file systems to the primary computer. If the source file system is mounted, it is suggested to execute a **sync(1M)** to ensure file system integrity. Check the new copy of each file system with the **fsck(1M)** command to ensure sanity.

```
$ sync
```

```
$ volcopy fsname /dev/rdisk/c#t#d#s# - /dev/rdisk/c?t?d?s? -
```

```
$ fsck /dev/dsk/c?t?d?s?
```

5. Use the **shutdown(1M)** command with the **-i5** option to shut down the primary computer to firmware mode.

```
$ shutdown -y -i5 -g0
```

6. Change terminal-to-computer connections back to the primary computer, using procedures defined by the system administrator for your computer center.
7. Reboot the primary computer on the internal disk using */etc/system*. It is important not to use */unix* if the hardware configurations of the backup and primary computers are different or the hardware on the primary computer was changed during maintenance.

Enter name of program to execute []: **/etc/system**

After the primary computer has completely booted, make the necessary hardware changes, if any, on the backup computer. Then reboot the backup computer on the internal disk using */etc/system* to support the next primary computer.

Mirrored Disk EDA Procedure

The shared disks will contain exactly the same information that is located on the internal disks of the primary computer if the AT&T 3B2 SCSI Disk Mirroring Utilities Release 1.0 are used. Using this method provides an added fault tolerance and data integrity feature to EDA and eliminates the need for daily EDA administration.

Setting Up the Primary Computer

The backup computer will be booted from a mirrored copy of the primary computer boot device; therefore, a shared disk must be made bootable. The shared disk that is selected must be LU 0 even if more than one LU is supported by the target controller.

The following information is a step-by-step procedure with example commands for setting up a primary computer shared boot disk:

1. Use the **sysadm mirpartition** command to format (partition) the shared boot disk. The partitions should be the same size as the primary boot disk.

\$ sysadm mirpartition

2. Configure the system to support mirroring of disk partitions. Use the **sysadm rootsetup** command to perform the steps necessary to support mirroring for *root* and *usr* (refer to Chapter 5, "Mirroring SCSI Hard Disks").

\$ sysadm rootsetup

3. In order for the mirroring to become effective, you must reboot the system. Use the **shutdown(1M)** command with the **-i6** option to "auto boot" the primary computer.

\$ shutdown -y -i6

4. If there are any user file systems which will be needed by the users while on the backup computer, it is suggested that they be added to the */etc/scsi/mirlist* file. Use the **sysadm mirror** command.

\$ sysadm mirror

Moving Users to the Backup Computer

Once you have determined that the backup computer is idle and ready to support users, do not continue maintenance on the primary computer. The primary computer must remain in firmware mode until after the backup computer is booted on the shared boot disk.

The following information is a step-by-step procedure with example commands for moving users to a backup computer:

1. On the backup computer console, perform the following steps on the *root* file system (partition 0) to set up the shared boot disk for the backup computer. A shell script can be used to perform these steps automatically.

Note: If the shared boot disk cannot be accessed by the backup computer, you may need to execute the **sysadm reset** command to clear any locks (reservation conditions) applied by the primary computer on the shared bus.

If there are any other shared disks in the primary computer system lock list, then use the **sysadm lock** command (to relock the disk) to prevent the primary computer from interrupting the procedure.

Save copies of the original */etc/system*, */etc/fstab*, and */etc/scsi/mirlist* files on the shared boot disk. These files contain device specifications that are not compatible on the backup computer.

```
$ fsck /dev/dsk/c#t#d0s0
$ mount /dev/dsk/c#t#d0s0 /mnt
$ mkdir /mnt/eda
$ cp /mnt/etc/fstab /mnt/etc/system /mnt/eda
$ mv /mnt/etc/scsi/mirlist /mnt/eda
```

Remove the mirror device entries placed in the */etc/system* and */etc/fstab* files by the **sysadm rootsetup** command on the primary computer. This will allow the backup computer to be booted from the

shared boot disk. The location of the **ROOTDEV**, **PIPEDEV**, and **SWAPDEV** devices will be determined from the VTOC on the shared disk.

```
$ cd /mnt/eda
$ egrep -v '^MIRRORDEV|^PIPEDEV|^ROOTDEV|^SWAPDEV' system \
> ../etc/system
$ cat fstab | sed 's/mir001/c#t#d0s2/' > ../etc/fstab
```

Remove the `/dev/root` device file associated with the mirror device file on the primary computer. Create a new device file using the "major" number of the shared root device on the backup computer. The "major" number can be obtained using the `ls(1)` command on the shared root device.

```
$ rm /mnt/dev/root
$ mknod /mnt/dev/root b major 0
```

2. Use the `shutdown(1M)` command with the `-i5` option to shut down the backup computer to firmware mode. The failed primary computer and the backup computer must both be in firmware mode before users can be moved to the backup computer.

```
$ shutdown -y -i5 -g0
```

3. Change terminal-to-computer connections to reroute users to the backup computer. If terminals are hard-wired to a computer, I/O cards must be moved.
4. Boot the backup computer using `/etc/system`. It may be necessary to look up the location of the shared boot disk in the backup computer log book.

Enter name of program to execute []: `/etc/system`

If the primary and backup computers do not contain the same hardware, the backup computer will not be able to run all operations performed by the primary computer.

The `/etc/rc2` file will attempt to start up processes in `/etc/rc.d`. If the backup computer does not have the hardware needed by a process, an error message will be displayed on the console and the process will

not be started. The backup computer will continue into multiuser mode.

After the backup computer has booted successfully, perform any necessary maintenance on the primary computer.

Warning: Be sure to restrict access to the backup devices so the primary computer will not interrupt service during maintenance. Interrupting the backup computer could cause data corruption.

Warning: If you are using soft power or you are not using the Peripheral Power Control Unit (PPCU), DO NOT REMOVE AC POWER OR YOU WILL LOSE YOUR SHARED DISKS!

Moving Users Back to their Primary Computer

Once the primary computer is fully repaired and configured, users can be moved back to the primary computer. All information written to the shared disks, will be brought back with them.

File systems will have been changed while in use by the backup computer, either through deliberate administrator action or through normal operations. These changes will be transferred to the primary computer by mirroring the backup file systems over the local file systems after rebooting the primary computer from the shared boot device.

The following information is a step-by-step procedure with example commands for moving users back to a primary computer:

1. On the backup computer console, perform the following steps on the files saved in the */eda* directory to set up the shared boot disk for the primary computer. A shell script can be used to perform these steps automatically.

Edit the *system* and *mirlist* files to remove all local (nonshared) device entries. This will prevent the data on the local (nonshared) boot device from being overwritten when the primary machine is booted from the shared boot disk.

```
$ cat /eda/system | sed 's/\\dev\\rdsk\\c?t?d0s0//' > /etc/system
$ cat /eda/mirlist | sed 's/\\dev\\rdsk\\c?t?d0s2//;s/\\dev\\rdsk\\c?t?d0s1//' \
> /etc/scsi/mirlist
```

Warning: Be careful when editing these system files. If the primary computer device entries are not removed, the file systems on the shared disks may be overwritten when the system is rebooted.

Move back the original *fstab* file saved in the */eda* directory.

```
$ mv /eda/fstab /etc
```

Remove the */dev/root* device file associated with the root device file on the backup computer. Create a new device file using the "major" number of the mirror device file (*/dev/dsk/mir000*) on the primary computer.

```
$ rm /dev/root
$ mknod /dev/root b major 0
```

2. Use the **shutdown**(1M) command with the **-i5** option to shut down the backup computer to firmware mode. The repaired primary computer and the backup computer must both be in firmware mode before users can be moved back to the primary computer.

```
$ shutdown -y -i5
```

3. Change terminal-to-computer connections back to the primary computer, using procedures defined by the system administrator for your computer center.
4. On the primary computer console, boot the primary computer OFF THE SHARED BOOT DISK using */etc/system*.

Enter name of program to execute []: */etc/system*

Warning: Be careful when selecting the boot device. If the primary computer is booted from the internal boot device, the file systems on the shared disk will be overwritten by **mirrestore** (in the */etc/rc2.d/S80restore* script) when the system is booted.

5. Perform the following steps to restore the shared boot disk for the primary computer. A shell script can be used to perform these steps automatically.

Move back the original */etc/system* and */etc/scsi/mirlist* files saved in the */eda* directory.

```
$ mv /eda/system /etc
$ mv /eda/mirlist /etc/scsi
```

Use the **mirror(1M)** command to relink the file systems on the shared disks to the local disks on the primary computer. The complete list of devices to mirror (excluding *root*) can be found in the *mirlist* file. To update the contents of the local disks, execute the *S80restore* script. The *S80restore* script performs a **mirrestore** on the *mirlist* files when the system boots.

```
$ /etc/scsi/mirror /dev/rdisk/mir000 /dev/rdisk/c#t#d0s0 /dev/rdisk/c?t#d0s0
$ /etc/rc2.d/S80restore
```

After the primary computer has completely booted, make the necessary hardware changes, if any, on the backup computer. Reboot the backup computer on the internal disk using */etc/system* to support the next primary computer.

Optional EDA Steps

There are many variations to the Backup or Mirroring EDA procedures. The system administrator must determine the appropriate steps to take on each primary computer.

The following information will be helpful when planning the EDA procedure for your system:

1. If the system displays error messages during the boot sequence but continues to go to multiuser mode, go to single-user mode immediately by executing the following command:

```
$ shutdown -is -y -g0
```

This will prevent users from logging on to a system that may have problems.

2. When running on a backup computer, you may want to change */etc/motd* to an appropriate message for the users.

The message-of-the-day should include warnings that users should not change their passwords. The old password may be needed to log in to the backup computer if the password has been changed on the primary computer since the last backup of */etc/passwd*. The administrator may also wish to include a list of resources, such as networks, which are not available while on the backup computer and any changes in printout locations.

3. The backup computer may have the same *uname* as the primary computer. If the primary computer must be booted to multiuser mode for any length of time during maintenance, be sure to change the *uname* while in single-user mode, or stop any network applications which may be running on the primary computer.
4. All files which must be saved from the primary computer nonbackup *root* and */usr* file systems must be moved to a temporary storage place. The system administrator must identify which files should be saved for a particular primary computer. Files which are candidates are log files such as */usr/lib/uucp*, */usr/mail*, */etc/utmp*, */etc/wtmp*, and the */usr/adm* files. Use **cp(1)** and **cpio(1)** to copy these files. An appropriate temporary save area is the scratch partition on the local boot device. These files can be edited to include only those entries which must be added to the corresponding files on the backup *root*.

Troubleshooting A Shared Bus

Problems may occur on a shared bus when switching cables and rebooting processors. This will require the system administrator to do some troubleshooting on the failing computer. Some possible problems are listed as follows:

1. Shared disks are not recognized by a computer. This problem can be caused by incorrect information in the Equipped Device Table (EDT). Issue the firmware **filledt** command from firmware mode to include the SCSI bus in the configuration table of the computer. Use the firmware **edt** or the UNIX system **prtconf(1M)** command to display the EDT and verify that the new shared SCSI bus and peripherals are recognized by the computer.
2. Unable to access file systems on shared disks. Use **sysadm lockdisp** to check that the disk is not reserved by another host computer on the shared bus. Check and correct any incorrect system device specifications in the system lock list file. Reboot the system.

Chapter 11: SCSI Trouble Clearing and Diagnostics

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General Troubleshooting Procedure

In the normal course of SCSI operation or when installing SCSI, you may encounter a problem interfacing with SCSI or one of its devices. The problem may be characterized by various error messages or simply no response at all. The following is a list of general suggestions that may help in locating your problem. The point at which to call service for assistance depends on your willingness to pursue the problem and how much downtime you can tolerate.

1. Attempt to localize the problem. If the problem seems to be with the entire 3B2 computer, refer to the "Trouble Clearing" chapter in the *Owner/Operator Manual*.
2. If the problem seems to be with SCSI, look for the obvious trouble such as a loose cable, missing terminator, SCSI ID or LU ID switch set incorrectly, etc.
3. Check power indicators on front panels of SCSI devices; one of the power switches may have been shut off accidentally.
4. Review all error messages with the *AT&T 3B2 Computer Error Message Manual* or Appendix B, "SCSI Error Messages."
5. If the system is operational, attempt to clear a problem by power cycling the system using the following procedure:
 - a. While logged in as *root*, power off the system by executing the following command:

```
shutdown -y -i0
```
 - b. Power up the system again by momentarily pressing the power switch on the 3B2 computer to the ON position.

General Troubleshooting Procedure

This procedure may clear a problem that occurred as a result of a power transient or someone accidentally shutting off a SCSI device.

Note: If after following this procedure, any or all of the DCMs, DMs, or SCSI XMs do not power back up, the system should be shut down again and all device power cords should be disconnected from the AC power and then reconnected. These devices should then power up once the system is brought up again.

6. If the system will not pass diagnostics or if the previous steps in this procedure yield no clues, you may find the information in the following section on diagnostics helpful in locating the problem.

Diagnostics

This section presents the component level diagnostic descriptions for the SCSI software.

All diagnostics are functionally organized into groups called phases. Each phase consists of one or more diagnostic tests. There are 24 diagnostic phases (1 through 24) run on the 3B2 computer SCSI subsystem.

Diagnostic code is stored as */dgn/SCSI* and */dgn/X.SCSI* files on the system hard disk. The control program for diagnostics runs in the firmware mode. Therefore, to run diagnostics, the 3B2 computer must be in the firmware mode. No other users can be logged on while the system is in this mode.

The diagnostic phases are run as a sequential operation. This means that once all of the tests of one diagnostic phase are completed, the next phase is started. Once an individual phase is started, its tests continue until all the tests pass or one test fails. Failure of a test prevents subsequent phases from running (command options are available which cause testing to continue even if a phase fails).

Each diagnostic phase generates a report of its activity. These reports are displayed as diagnostic messages on the system console. Each message reports the phase and test number(s) and whether the phase passed or failed.

Phase Type Description

The 3B2 computer has three types of diagnostic phases which are described in the following paragraphs.

Normal Diagnostics

Normal diagnostic phases are the standard (automated) diagnostics that run each time the system is powered up or taken to the firmware mode and rebooted. The System Board (SBD) and each feature card in the 3B2 computer have a set of normal diagnostics. You can also manually request normal diagnostics to run using the Diagnostic Monitor (DGMON) firmware program.

Demand Diagnostics

Demand diagnostic phases consist of more extensive tests. Some of the demand diagnostics check optional 3B2 computer hardware; others require more system resources to run. For these reasons, demand diagnostics are not run during powerup. You can only run demand diagnostics with the DGMON firmware program.

Interactive Diagnostics

Interactive diagnostics must also be requested manually with the DGMON firmware program. The interactive diagnostics consist of tests that require your input and/or special test conditions.

Diagnostic Phase Table

Figure 11-1 lists the different phases of diagnostics that are provided for the SCSI subsystem.

PHASE#	TYPE	PHASE DESCRIPTION
1	Demand	Phase 1—CIO Sanity Test
2	Demand	Phase 2—Upper RAM Write/Read Test
3	Demand	Phase 3—Lower RAM Write/Read Test
4	Demand	Phase 4—ROM Checksum Test
5	Demand	Phase 5—CPU Chip Select Test
6	Demand	Phase 6—CPU DMA Internal Test
7	Demand	Phase 7—CPU Timer Test
8	Demand	Phase 8—CPU Interrupt Controller
9	Demand	Phase 9—CPU Lower Chip Select Test
10	Demand	Phase 10—Programmed I/O Byte
11	Demand	Phase 11—Programmed I/O Word
12	Demand	Phase 12—DMA Transfer Byte Test
13	Demand	Phase 13—DMA Transfer Word Test
14	Demand	Phase 14—SCSI FIFO Test
15	Demand	Phase 15—SCSI DMA Controller Test
16	Demand	Phase 16—SCSI Controller IC Test
17	Demand	Phase 17—SCSI Controller Reset Test
18	Demand	Phase 18—AT&T Controller Buffer Access Test
19	Demand	Phase 19—AT&T Controller Self-Test
20	Demand	Phase 20—AT&T Disk Controller and Media Test
21	Interactive	Phase 21—AT&T Tape Controller and Media Test
22	Demand	Phase 22—SCSI Disk Write/Read Test
23	Interactive	Phase 23—Interactive Disk Write/Read Test
24	Normal	Phase 24—Controller Status Test

Figure 11-1: SCSI Diagnostic Phases

Diagnostic Execution

Enter Diagnostic Mode

The following procedures and sample displays tell how to enter the interactive diagnostic mode.

1. Change directory to the *root* directory..
2. Enter the **shutdown** command to enter the firmware mode as shown in the following display:

```
#shutdown -y -g0 -i5<CR>

Shutdown started.      date

Broadcast Message from root (console)  date
THE SYSTEM IS BEING SHUT DOWN NOW !!!
Log off now or risk your files being damaged.

INIT: New run level: 5
The system is coming down.  Please wait.
System services are now being stopped.

The system is down.

SELF-CHECK

FIRMWARE MODE
```

3. Enter **mcp** (default firmware password) or the current firmware password if it was changed as shown in the following display.

<mc><CR>

Note: If DEMON EPROMs are installed, the following message appears after entering mc.

3B2 Monitor/Control Program-erase '^H', kill '@'
Physical Mode

>boot<CR>

Enter boot<CR> and the response will be:

Enter name of program to execute []:

4. Enter **dgmon**<CR> at this point to enter the diagnostics mode.

Enter name of program to execute []:dgmon<CR>

Possible load devices are:

Option Number	Slot	Name
0	0	FD5
1	0	HD30
2	2	SCSI

Enter Load Device Option Number [1 (HD30)]:1<CR>

Enter 1<CR> and the response will be:

3B2 DIAGNOSTICS MONITOR
DGMON>

You are now in the diagnostics monitor mode. You can execute commands to run diagnostics at this point.

Run SCSI Diagnostics

Once in the diagnostics mode, you can initiate diagnostics to be run on SCSI for the Normal, Interactive, and Demand phases.

List Diagnostic Phases

To print a list of all the phases for SCSI (similar to Figure 11-1), enter the following command:

```
l scsi <CR> (That is, lowercase "L" scsi.)
```

Run Normal Diagnostics

To run normal diagnostics on SCSI, enter the following command line:

```
DGMON>dgn scsi<CR>
```

```
<<<  DIAGNOSTICS MODE  >>>
```

```
SCSI 0 (IN SLOT 1) DIAGNOSTICS PASSED
```

Run Phase Diagnostics

To run a specific phase(s) of diagnostics, enter a similar command line:

```
DGMON>dgn scsi ph=17<CR>

    <<<  DIAGNOSTICS MODE  >>>

Phase # 17
Test: SCSI Reset Test
Tests : 4                Time : 60 seconds
Configuration:
ID# 0  Host Adapter
ID# 1  Disk Controller  LU0 LU1 LU2
*** PHASE - ATP ***

    SCSI 0 (IN SLOT 2) DIAGNOSTICS PASSED

DGMON >
```

Verify that the configuration the system is reporting agrees with the configuration you wanted to set up. (See the "Diagnostic Output" section of this chapter for more information.)

Exit Diagnostic Mode

The sequence of commands for exiting the diagnostics mode and returning to the normal run level is shown in the following display. (Remember your inputs are in **bold.**)

```
DGMON>quit<CR>
```

```
Enter name of program to execute [ ]:unix<CR>
```

```
Possible load devices are:
```

Option Number	Slot	Name
0	0	FD5
1	0	HD30
2	2	SCSI

```
Enter Load Device Option Number [1 (HD30)]:1<CR>
```

A series of messages will appear reporting the progress of the system as it comes up.

```
Console Login:
```

Diagnostic Phase Summary

The SCSI diagnostic software provides 24 phases of testing. Phases 1 through 16 will use the standard diagnostic output that has been displayed on past 3B2 computer feature card developments. However, Phases 17 through 24 require that the diagnostics display the configuration of the SCSI subsystem. This display is imperative because diagnostics will only test what it perceives to be in the system. It is up to the user to determine if the configuration displayed is complete.

Host Adapter Diagnostic Phases

Phases 1 through 16 test the Host Adapter card. If diagnostics report failure in one of these phases, the problem is internal to the Host Adapter card and you should call your AT&T Service Representative or authorized dealer for assistance.

SCSI Bus Diagnostic Phases

Phases 17 through 24 perform diagnostics to the SCSI bus. The configuration of the bus is evaluated and displayed at the beginning of each phase. The user must visually verify that this configuration is correct. It is important for you to realize that diagnostics will only exercise what it perceives to be on the SCSI subsystem. For example, if power is missing from a DCM, the diagnostics display will not show the DCM or its associated logical units in the configuration. Diagnostics will not fail because the DCM is missing.

- **Phase #17—SCSI Controller Reset Test**

Phase Name: SCSI Controller Reset Test

Phase Type: Demand

Function: To display configuration of the bus to the user and to diagnose and report any errors that the disk/tape controller reset diagnostics may find.

Tests: This program will issue a reset to all controllers on the bus. Controllers will run their reset tests, and results from each controller will be returned.

■ Phase #18—AT&T Controller Buffer Access Test

Phase Name: SCSI Controller Buffer Test

Phase Type: Demand

Function: The primary function of this phase is to exercise the SCSI cable by sending data blocks across the bus to the controllers on the bus.

Tests: This program does a write and read pattern to a controller's buffers.

■ Phase #19—AT&T Controller Self-Test

Phase Name: Disk/Tape Controller Self-Test

Phase Type: Demand

Function: To have disk/tape controllers run their self-tests.

Tests: This program will issue a Send Diagnostic self-test to each controller. Any failure results will be returned.

■ Phase #20—AT&T Disk Controller and Media Test

Phase Name: Disk Controller and Media Test

Phase Type: Demand

Function: Diagnose and report any errors in the functionality of a disk controller or media which it controls.

Tests: This program does a Send Diagnostic (with media access) SCSI command to all random access logical units on the SCSI bus.

■ Phase #21—AT&T Tape Controller and Media Test

Phase Name: SCSI Tape Test

Phase Type: Interactive

Function: Diagnose and report any errors in the functionality of a tape controller or media which it controls. This phase verifies the data path between the Host Adapter and the tape media.

Tests: This program does write/read pattern testing to tape units. The user will be instructed to insert a scratch tape when running this phase.

■ Phase #22—SCSI Disk Write/Read Test

Phase Name: Disk Write/Read Test

Phase Type: Demand

Function: Diagnose and report any errors when writing and reading a disk. This phase verifies data path between the Host Adapter and the disk(s).

Tests: This program verifies that a valid Physical Description (PD) sector exists, and then does a normal write/read pattern test to a diagnostic area of the disk.

■ Phase #23—Interactive Disk Write/Read Test

Phase Name: Disk Write/Read Test

Phase Type: Interactive

Function: This is a more extensive version of Phase 22. The disk and data paths to and from the Host Adapter are more heavily exercised in this phase.

Tests: This program verifies that a valid PD sector exists and then does a normal write/read pattern test to a diagnostic area of the disk.

■ Phase #24—Controller Status Test

Phase Name: Controller Status Test

Phase Type: Normal

Function: This phase displays how the system perceives the SCSI bus configuration to be. This phase is automatically executed when the machine is turned on to test that a valid SCSI subsystem exists (that is, at least one target controller and an associated logical unit are seen on the bus). If the configuration displayed does not match the configuration displayed in Phases 17 through 23, a **filledt** should be performed. See **filledt(8)** for more information.

Tests: This test evaluates bus data generated by Host Adapter Read Only Memory (ROM) to assure basic functionality.

Diagnostic Output

The diagnostic output displayed of the SCSI subsystem is very important for locating any hardware faults that may exist and in making sure the actual configuration of the system matches the configuration displayed by the output of Diagnostic Phases 17 through 24.

A sample display of Phase 19 is shown below, along with some reasons why a particular phase may have failed.

```
Phase # 19
Name: AT&T Controller Self-Test.
Test Count: 8      Time: 80 sec.
Configuration:
ID# 1 Disk Controller  LU0
ID# 5 Disk Controller  LU0 LU1
ID# 7 Tape Controller  LU0
***PHASE - ATP***
```

This example shows a disk controller at SCSI ID#1 with one disk at LU0. SCSI ID#5 is another disk controller with two disks at LU0 and 1. A tape controller is found at SCSI ID#7 with one tape drive. The phase completes ATP (all tests passed).

The following display is an example of a failing phase.

```
Phase # 17
Name: SCSI Controller Reset Test.
Test Count: 5      Time: 80 sec.
Configuration:
ID# 1 Disk Controller
ID# 5 Disk Controller  LU0 LU1
ID# 7 Tape Controller  LU0
** ERROR Target ID 1 has no LUs **
```

This example shows a diagnostic error because the disk controller at SCSI ID#1 has no disk drives. This could be caused by improper installation (improper cabling), no power, or a defective disk drive.

Reasons for Diagnostic Failures

The most common cause of diagnostics failures on the SCSI subsystem will be configuration and connection problems. The following is a list of some of these possible problems:

- No target controller—Each Host Adapter must have at least one target controller connected to the bus.
- No Logical Units—Each Target Controller must have at least one Logical Unit (for example, a DCM must have at least one Disk Module connected to it).
- No terminators—The SCSI bus must be terminated at both ends of the bus.
- Two SCSI controllers with the same SCSI ID—Each SCSI controller (including the Host Adapter card) must have a different SCSI ID.
- Single-ended/differential mismatches—Failures occur if a single-ended terminator is connected to a differential bus and visa versa.

APPENDIX A: Supplemental Information

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Introduction to Supplemental Information

The SCSI information in this section should be used to supplement or update information found in other 3B2 computer System Administration documentation.

SCSI Device Names and Designators

The device files for the SCSI devices are found under the */dev* directory. The device file naming convention for the SCSI devices is slightly different from other 3B2 computer devices. The following list gives the naming convention for each SCSI device:

SCSI Hard Disk Drives

The device file names for the SCSI hard disks are of the form:

`/dev/dsk/c?t*d#s&` or `/dev/rdisk/c?t*d#s&`

where: ? = Slot number for Host Adapter
* = Target Controller SCSI ID
= Hard disk LU ID
& = Partition number.

SCSI Cartridge Tape Drives

The device file names for the SCSI Cartridge Tape are of the form:

`/dev/rmt/c?t*d0s#n`

where: ? = Slot number for Host Adapter
* = Target Controller SCSI ID
0 = Logical Unit number
= 0 for 60 megabytes, 1 for 120 megabytes
n = No rewind (optional).

SCSI 9-Track Tape Drives

The device file names for the SCSI 9-Track Tape are of the form:

`/dev/mt/c?t*d0&n` or `/dev/rmt/c?t*d0&n`

where: ? = Slot number for Host Adapter
* = Target Controller SCSI ID
0 = Logical Unit number
& = Tape density:
 m = medium density [1600 bpi (bits-per-inch)]
 h = high density [6250 cpi (characters-per-inch)]
n = No rewind (optional).

SCSI Configuration Chart

The purpose of the SCSI Configuration Chart is to help you keep track of the SCSI peripherals that you add to your 3B2 computer. It is important to keep this chart current. Whenever you add a new SCSI peripheral, make the appropriate entries in this chart. It is best to use a pencil to make the entries so you can make changes at a later date.

The layout of the chart is a close approximation of the format used by Diagnostic Phase 17 to report the SCSI configuration. The chart contains the SCSI ID number, a space to write in the name of the peripheral, the Logical Unit ID number, and a space for notes. The NOTES section should include the names of the different file systems on each SCSI hard disk.

One item that is included in the chart that is not reported by the diagnostic phase is the label that System Administration assigns to the Disk Module. You will need to know these disk assignments when using System Administration to do tasks such as formatting a disk and partitioning a disk.

Figure A-1 is an example of the configuration chart that should have been completed when SCSI was originally installed. This chart should be updated each time you make a change to your SCSI system.

The *AT&T 3B2 Computer SCSI Installation Manual* contains additional copies of this chart, or Figure A-1 can be used to make more copies.

Note: The UNIX System V **dsconfig** command can be used to display the entire system configuration. See the *AT&T 3B2 Computer SCSI Release Notes* for more information on the **dsconfig(1)** command.

SCSI Configuration Chart

SCSI CONFIGURATION CHART

SCSI BUS _____

SCSI ID#	PERIPHERAL	LOGICAL UNIT ID#	SYSTEM ADMIN LABEL	NOTES
0	Host Adapter			
1				
2				
3				
4				
5				
6				
7				

Figure A-1: SCSI Configuration Chart

Rewriting the Physical Description Sector

When using a SCSI hard disk, there is a remote possibility that the Physical Description (PD) sector may get corrupted while the remainder of the data on the disk remains intact. In general, if a problem exists with the PD sector, it is very likely that the entire disk will be unusable. However, if a message is output to the console which indicates a problem with reading the PD sector, an attempt can be made to correct the PD sector. If the PD sector can be successfully rewritten, data on the disk may not be lost. The following is an example of the message which is output if the PD sector is corrupted:

WARNING: SD00: Bad sanity word in the physical description sector on disk 1, tc 1, slot 3.

In order to attempt to rewrite the PD sector, the 3B2 computer must be put into the single-user mode and the **format -n** command (see *AT&T 3B2 Computer SCSI Release Notes*) must be executed. The procedure for rewriting the PD sector is as follows:

1. Execute the **mount** command and record the device file names for both the problem device and the device with the */usr* file system. (Refer to the "SCSI Device Names and Designators" section of the Appendix for help in translating from the error message to the device file name.)
2. Shut down the system to the single-user mode by the following:

```
shutdown -y -g0 -is
```

3. Mount the */usr* file system. The following is an example:

```
mount /dev/dsk/c1d0s2 /usr
```

4. Execute the **format -n** command. The following is an example for rewriting the PD sector on the disk in the error message given above:

```
format -n /dev/rdisk/c3t1d0s6
```

Note: If another PD sector error message is output, then the rewrite failed and your AT&T Service Representative or authorized dealer should be contacted.

Additional Hard Disk Partitions

Chapter 4, "Using SCSI Hard Disks," of this manual shows how to partition a SCSI hard disk using System Administration. Although System Administration makes partitioning very easy to do, you can only allocate eight partitions (8 through 15) per disk. If necessary, you can define more partitions per disk by working outside System Administration.

The 3B2 computer limit is 16 partitions per hard disk. Depending on the disk application, some of these partitions are already defined and should not be used. For example, partition 6 (s6) is defined as the entire disk and partition 7 (s7) is the boot block. However, the other 14 SCSI disk partitions are normally undefined.

The following list indicates the operations that have to be done to repartition a disk outside System Administration. Refer to your System Administration documentation for more information on the different operations.

- Using **prtvtoc**, get a copy of a VTOC for a SCSI device.
- Modify the VTOC to include the desired number of partitions.

Note: You must be prepared to input the sector count information. Remember, partitions must end on cylinder boundaries.

- Use the **fmthard** command with **-s** and **-m** options to install the new VTOC and partition the disk.
- Use the **labelit** to change or add new file system names.
- Modify **/etc/fstab** to change or add new file systems to be mounted.
- Use **mkdir** to add new mount points under the *root (/)* directory.

APPENDIX B: SCSI Error Messages

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APPENDIX B: SCSI Error Messages

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Introduction to SCSI Error Messages

This appendix contains descriptions of the error messages that are displayed if a problem occurs with a SCSI device and the action to take (if any).

Normally there are several parts, or fields, to an error message. The first field is always the severity class. There are three severity classes: **NOTICE**, **WARNING**, and **PANIC**.

An error message prefaced by **NOTICE** provides system status information. These messages can help you take preventive measures before a problem occurs.

An error message prefaced by **WARNING** indicates that the operating system may stop functioning if corrective action is not taken. This class of message usually requires some immediate corrective action.

A **PANIC** error message indicates a problem so severe that the UNIX operating system must stop. The cause is usually a system hardware problem or a problem in the kernel software. Any programs running when a **PANIC** occurs are lost and some file systems may become corrupt. The UNIX system checks for file system damage when the system is restarted.

The field following the severity class identifies the SCSI peripheral that caused the error message. One of the following identifiers will appear in this field:

- SD01** - SCSI Disk Target Driver error messages
- ST00** - SCSI 9-Track Tape Driver error messages
- ST01** - SCSI Cartridge Tape Driver error messages
- SCSI** - Host Adapter error messages.

Other fields will contain identifiers to further define the source of the error. Identifiers associated with SCSI error messages are listed below: (The *n* represents a variable number.)

TC *n* - Target Controller ID on the SCSI bus (0-7)

slot *n* - Host Adapter slot number on the I/O bus

LU *n* - Logical Unit number (0-3)

Unit *n* - Disk number (0-3).

This appendix covers three categories of error messages:

SCSI Host Adapter Error Messages

SD01 Disk Target Driver Error Messages

SCSI Tape Driver Error Messages.

SCSI Host Adapter Error Messages

Error Messages Prefaced by NOTICE

The SCSI Host Adapter error message is displayed when problems occur with SCSI Host Adapter hardware and software. The following section defines some of these error messages and gives a description and action to take.

Error Message (Prefaced by NOTICE)	Description/Action
SCSI: Restarting jobs after a SCSI Bus Reset for slot <i>n</i> .	The SCSI driver has detected a hung job and has reset the SCSI bus. This has in turn stopped jobs until the reset has completed. This notice means that the reset has completed normally and jobs will be continued normally. No action.
SCSI: Suword failed.	The call to the kernel suword routine failed. This should never happen on a sane system. Reboot the system. If the error message is repeated, you probably have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i> . If the problem still exists, contact your AT&T Service Representative or authorized dealer.

Error Messages Prefaced by WARNING

Error Message (Prefaced by WARNING)	Description/Action
SCSI: lu <i>n</i> , tc <i>n</i> , slot <i>n</i> was busy during the close.	<p>The SCSI device specified by the device number was still active when a close to the device was attempted. This should never be seen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Fault on board in slot <i>n</i> .	<p>The SCSI board in the specified slot has returned a fault return code during the pump process. This should never be seen from a board that is operating normally.</p> <p>Repump the SCSI board. If the error message is repeated, you may have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Qfault on board in slot <i>n</i> .	<p>The SCSI board in the specified slot has returned a qfault return code during the pump process. This should never be seen from a board that is operating normally.</p> <p>Repump the SCSI board. If the error message is repeated, you may have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
<p>SCSI: Firmware warning message for slot <i>n</i>, HA FW FATAL: <i>followed by message string</i>:</p> <p style="padding-left: 20px;">dma. . . failed. poll_pgm_xfer(): . . . sync_eval: . . . xfer_one_byte(): . . . synchronous negotiations failed. Message out and nothing to send. Timeout waiting . . .</p>	<p>These messages are encountered when some type of protocol error sequence has appeared on the bus.</p> <p>Repump the associated SCSI board and send a sbusclr command to the associated SCSI bus.</p>
<p>SCSI: Firmware warning message for slot <i>n</i>, HA FW FATAL: <i>followed by message string</i>:</p> <p style="padding-left: 20px;">scsi_init(): reset still active. scsi_init(): single ended bus may be connected. Scsi reset won't clear.</p>	<p>Indicates a probable loose connection or mistermination of the SCSI bus.</p> <p>Check all SCSI bus connections and associated terminations and repump the associated SCSI board.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Firmware warning message for slot <i>n</i> , HA FW FATAL: <i>followed by message string:</i> NO Control Blocks Available. fserv_attn(): DMA list too big. Zero completion queue entries. Completion queue to big.	These errors are associated with the HA firmware and HA driver interface. If these errors are encountered, the associated board should be repumped. If this fails, the system should be rebooted.
SCSI: Firmware warning message for slot <i>n</i> , HA FW FATAL: Illegal internal 80186 interrupt seen.	The Host Adapter CPU encountered an error condition. The board should be repumped if this condition occurs. If this error happens frequently, the HA should be replaced.
SCSI: Firmware warning message for slot <i>n</i> , HA FW WARNING: <i>followed by message string:</i> Sending a SCSI bus reset. SCSI bus reset received.	These messages are seen during normal activity and do not in themselves indicate a failure.
SCSI: Firmware warning message for slot <i>n</i> , HA FW WARNING: serv_attn(): Select failed.	The peripheral is not responding to the systems request to start a job. If this message is encountered, the particular device should be checked for loss of power or improper SCSI ID setting.

Error Message (Prefaced by WARNING)	Description/Action
<p>SCSI: Firmware warning message for slot <i>n</i>, HA FW WARNING: <i>followed by message string:</i> arb_sync: non supported message. parity error . . . synchronous phase error. synchronous transfer period error. synchronous transfer offset error. target mode SPC_ERROR. Timeout waiting . . . tm_xfer_one_byte(): timeout waiting ACK. Transfer error from system board. transfer counter parity error.</p>	<p>These messages may be encountered when a SCSI protocol error is encountered on the SCSI bus.</p> <p>If these messages are persistently seen, the system should be brought down and the cabling and termination for the associated bus should be checked.</p>
<p>SCSI: Firmware warning message for slot <i>n</i>, HA FW WARNING: Main store address out of range.</p>	<p>Indicates that the address given to the firmware to send the job is out of range. The job will be retried.</p>
<p>SCSI: Firmware warning message for slot <i>n</i>, HA FW WARNING: NMI Interrupt seen.</p>	<p>Indicates that the system board address seen by the firmware is out of range or a parity error occurred during the transfer and the job will be reissued.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Firmware panic occurred on board in slot <i>n</i> , taking board off line.	<p>A panic has occurred in the SCSI board firmware. This should never be seen from a sane SCSI board that is using sane AT&T specified peripherals.</p> <p>Reboot the system. Manually run all the diagnostic phases to verify the sanity of the system. If the error message is repeated, there is probably a Target Controller which is doing something illegal on the SCSI bus. Remove the Target Controllers from the bus one at a time until the problem goes away.</p>
SCSI: Firmware sent illegal panic code for slot <i>n</i> .	<p>A panic has occurred in the SCSI board firmware. This should never be seen from a sane SCSI board that is using sane AT&T specified peripherals.</p> <p>Reboot the system. Manually run all the diagnostic phases to verify the sanity of the system. If the error message is repeated, there is probably a Target Controller which is doing something illegal on the SCSI bus. Remove the Target Controllers from the bus one at a time until the problem goes away.</p>
SCSI: Unexpected interrupt from firmware in slot <i>n</i> .	<p>The SCSI driver has detected an unexpected interrupt from the firmware in the given slot. This message should never be seen on a sane system with a sane SCSI board.</p> <p>Repump your SCSI board. If the error message is repeated, reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Unexpected completion reported for lu <i>n</i> , tc <i>n</i> , clot <i>n</i> .	<p>The SCSI device has received a job completion for an idle device. This message should never be seen on a sane system with a sane SCSI board.</p> <p>Repump your SCSI board. If the error message is repeated, reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Illegal type returned during SFB operation to lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>The type field of the SCSI control block was not correct for the type of job that was received. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Illegal type returned during SCB operation to lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>The type field of the SCSI control block was not correct for the type of job that was received. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, contact your AT&T Service Representative or authorized dealer.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Unknown status (<i>n</i>) returned by firmware for lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>The status returned from the firmware was not a known status for the driver; hence the firmware or the driver has been corrupted. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Illegal opcode returned from firmware on board in slot <i>n</i> .	<p>The opcode returned from the firmware was not a known opcode for the driver; hence the firmware or the driver has been corrupted. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Corrupted address returned during pass through operation.	<p>The addresses within the SCSI control block have been corrupted while the job was in firmware. This implies either kernel or firmware corruption has occurred. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Bad completion code returned during pass through operation.	<p>The completion code did not get modified during the SCSI operation. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Job timeout for lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>A SCSI job failed to complete in its allotted amount of time. This should never be seen from a sane SCSI board that is using sane AT&T specified peripherals.</p> <p>Manually run all the diagnostic phases to verify the sanity of the system and then reboot the system. If the error message is repeated, there is probably a Target Controller which is faulty. Contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Job timeout in request queue for lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>A SCSI job failed to complete in its allotted amount of time due to the fact that it could not be processed by the SCSI board. This should never be seen from a sane SCSI board that is using sane AT&T specified peripherals.</p> <p>Manually run all the diagnostic phases to verify the sanity of the system and then reboot the system. If the error message is repeated, there is probably a Target Controller which is faulty. Contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Recovering from job mismatch on lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>The SCSI driver is recovering from a job mismatch during a SCSI bus reset. This message should never be seen on a sane system with a sane SCSI board.</p> <p>If the message is repeated repump the SCSI board.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Recovering from SFB job mismatch on lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>The SCSI driver is recovering from a function job mismatch during a SCSI bus reset. This message should never be seen on a sane system with a sane SCSI board.</p> <p>If the message is repeated repump the SCSI board.</p>
SCSI: Illegal type on SCB job list for lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>The SCSI driver has detected an illegal job type on its job queue during a SCSI bus reset or a queue flush operation. This message should never be seen on a sane system with a sane SCSI board.</p> <p>Reboot the system. If the error is repeated, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Illegal type on SFB job list for lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	<p>The SCSI driver has detected an illegal job type on its job queue during a SCSI bus reset or a queue flush operation. This message should never be seen on a sane system with a sane SCSI board.</p> <p>Reboot the system. If the error is repeated, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Illegal type found during timer operation for board in slot <i>n</i> .	<p>The SCSI control block type field is unknown by this SCSI driver. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Firmware on board in slot <i>n</i> is not responding, please repump the board.	<p>The SCSI firmware in the given slot has panicked. This should never happen on a sane system.</p> <p>Repump the SCSI board. If the error message is repeated, you may have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: No boards recognized by lboot.	<p>The SCSI driver's init routine was called when there were zero SCSI cards recognized by lboot during the boot process. This should never happen on a sane system.</p> <p>Reboot the system. Run filledt manually. Manually run all the diagnostic phases. If they all pass, boot <i>/etc/system</i>. If the error message is repeated, you may have a corrupted system disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Sysgen failed for board in slot <i>n</i> .	<p>The sysgen operation during the pump of the SCSI board failed. This should never happen on a sane system.</p> <p>Repump the SCSI board. If repeated, you may have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Read edt timed out for slot <i>n</i> .	<p>The extended Equipped Device Table could not be read from the SCSI board. This should never be seen from a sane SCSI board that is using sane AT&T specified peripherals.</p> <p>Run filedt manually. Manually run all the diagnostic phases to verify the sanity of the system and then reboot the system. If the error message is repeated, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: The extended edt on the board in slot <i>n</i> is insane.	<p>The extended Equipped Device Table in firmware is corrupted. This is filled in during boot time and should never be corrupted on a sane system.</p> <p>Reboot the system. Run filedt manually. Manually run all the diagnostic phases. If they all pass, boot <i>/etc/system</i>. If the error message is repeated, you may have a corrupted system disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: The number of external major numbers (<i>n</i>) does not match the number of boards (<i>n</i>).	<p>The number of devices recognized by lboot is different than the number of major numbers allocated by lboot. This should never happen on a sane system.</p> <p>Reboot the system. Run filledt manually. Manually run all the diagnostic phases. If they all pass, boot <i>/etc/system</i>. If the error message is repeated, you may have a corrupted system disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_send called with an illegal pointer.	<p>The sdi_send function was called with an invalid type or with a NULL pointer. This should never happen on a sane system.</p> <p>Reboot the system. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_send SCB not allocated by SCSI driver.	<p>The SCSI driver has detected a SCSI Control Block which was not allocated by the SCSI driver. This should never be seen on a sane system with sane AT&T supplied software. This is due to some non-AT&T supplied software not following the AT&T SCSI Open Architecture Requirements or a corrupted system.</p> <p>Reboot the system.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: sdi_send called with an illegal major number of <i>n</i> .	<p>The sdi_send function was called with a major number that was not configured into the extended Equipped Device Table information. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_send called with a negative timeout value.	<p>The sdi_send function was called with a SCSI control block that contained a negative time-out value. This is not allowed. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_icmd called with an illegal pointer.	<p>The sdi_icmd function was called with a NULL pointer. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: sdi_icmd SCB not allocated by SCSI driver.	<p>The SCSI driver has detected a SCSI Control Block which was not allocated by the SCSI driver. This should never be seen on a sane system with sane AT&T supplied software. This is due to some non-AT&T supplied software not following the AT&T SCSI Open Architecture Requirements or a corrupted system.</p> <p>Reboot the system.</p>
SCSI: sdi_icmd called with an illegal major number of <i>n</i> .	<p>The sdi_icmd function was called with a major number that was not configured into the extended Equipped Device Table information. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_icmd called with an illegal opcode of <i>n</i> .	<p>The sdi_icmd function was called with a SCSI control block that contained an unsupported opcode. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: sdi_icmd called with a negative timeout value.	<p>The sdi_icmd function was called with a SCSI control block that contained a negative time-out value. This is not allowed. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_icmd called with an illegal type of <i>n</i> .	<p>The sdi_icmd function was called with an invalid type field in the SCSI control block. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_name called with an illegal major number of <i>n</i> .	<p>The sdi_name function was called with a major number that was not configured into the extended Equipped Device Table information. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
<p>SCSI: sdi_getdev called with an illegal major number of <i>n</i>.</p>	<p>The sdi_getdev function was called with a major number that was not configured into the extended Equipped Device Table information. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
<p>SCSI: sdi_getblk called with a corrupted free list.</p>	<p>The sdi_getblk function was called with the free list of SCSI control blocks corrupted. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
<p>SCSI: sdi_freeblk called with an illegal pointer.</p>	<p>The sdi_freeblk function was called with a NULL pointer. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
<p>SCSI: sdi_freeblk SCB not allocated by SCSI driver.</p>	<p>The SCSI driver has detected a SCSI Control Block which was not allocated by the SCSI driver. This should never be seen on a sane system with sane AT&T supplied software. This is due to some non-AT&T supplied software not following the AT&T SCSI Open Architecture Requirements or a corrupted system.</p> <p>Reboot the system.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: sdi_freeblk called with a corrupted free list.	<p>The sdi_freeblk function was called with the free list of SCSI Control Blocks corrupted. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: sdi_translate called with an illegal pointer.	<p>The sdi_translate function was called with a NULL pointer. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Linked commands NOT available.	<p>The sdi_translate function was called with a non-NULL link field in the SCSI control block. This is not supported by the current driver. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you may have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Tried to pump an invalid id <i>n</i> , slot <i>n</i> .	<p>The device number used by the pump command was not directed to the SCSI board. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Ram address is not on a page boundary for pumping board in slot <i>n</i> .	<p>The RAM address specified in the pump download memory command was not on a page boundary. This is not allowed. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Board in slot <i>n</i> was busy during an FCF.	<p>The system must be corrupted at this point. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Pass-thru was tried with an illegal id <i>n</i> , slot <i>n</i> .	<p>The pass-through command was attempted with an illegal device number.</p> <p>Check the pass-through code. If using format, hdefix, or any supported utility when this happens, reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Unexpected failure from sdi_freeblk during pass-through to id <i>n</i> , slot <i>n</i> .	<p>The sdi_freeblk routine did not return successfully at the end of a SCSI pass-through operation. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Corrupted address from physio.	<p>The address used for pass-through was corrupted during the call to physio in the kernel. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Edsd was tried with an illegal id <i>n</i> , slot <i>n</i> .	<p>The B_EDSD ioctl was attempted with an illegal device number.</p> <p>Check the program doing the EDSD. If it is a supported AT&T command, reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Edsd failed for id <i>n</i> , slot <i>n</i> .	<p>The B_EDSD ioctl was run while another process was talking to the same device. This is not allowed by the SCSI driver. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Edsd request too large for id <i>n</i> , slot <i>n</i> .	<p>The B_EDSD ioctl request was for more memory than one buffer's worth of memory. The command will return only one buffer's worth to the user.</p> <p>Check the program doing the EDSD. If it is a supported AT&T command, reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Edsd timed out for slot <i>n</i> .	<p>The B_EDSD ioctl timed out while in firmware. This implies the firmware has panicked. This should never happen on a sane system.</p> <p>Repump the SCSI board. If the problem is repeated, you have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Redt was tried with an illegal id <i>n</i> , slot <i>n</i> .	<p>The B_REDT ioctl was attempted with an illegal device number.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Redt failed for id <i>n</i> , slot <i>n</i> .	<p>The B_REDT ioctl was run while another process was talking to the same device. This is not allowed by the SCSI driver. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Redt request was too large for id <i>n</i> , slot <i>n</i> .	<p>The B_REDT ioctl was for more memory than one buffer's worth of memory. The command will return only one buffer's worth to the user.</p> <p>Check the program calling the REDT programs, such as prtconf, getmajor, etc. Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Redt timed out for slot <i>n</i> .	<p>The B_REDT ioctl timed out while in firmware. This implies the firmware has panicked. This should never happen on a sane system.</p> <p>Repump the SCSI board. If the error message is repeated, you may have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: GETVER timed out for slot <i>n</i> .	<p>The Host Adapter version could not be determined. This should never be seen from a sane SCSI board that is using sane AT&T specified peripherals.</p> <p>Run filledt manually. Manually run all the diagnostic phases to verify the sanity of the system and then reboot the system. If the error message is repeated, contact your AT&T Service Representative or authorized dealer.</p>

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Wedt was tried with an illegal id <i>n</i> , slot <i>n</i> .	<p>The B_WEDT ioctl was attempted with an illegal device number. Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Wedt failed for id <i>n</i> , slot <i>n</i> .	<p>The B_WEDT ioctl was running while another process was talking to the same device. This is not allowed by the SCSI driver. This should never happen on a sane system.</p> <p>Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i>. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>
SCSI: Wedt timed out for slot <i>n</i> .	<p>The B_WEDT ioctl timed out while in firmware. This implies the firmware has panicked. This should never happen on a sane system.</p> <p>Repump the SCSI board. If the error message is repeated, you may have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.</p>

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Wedt request was too large for id <i>n</i> , slot <i>n</i> .	The B_WEDT ioctl was for more memory than one buffer's worth of memory. The command will write only one buffer's worth to the firmware. Check the pass-through code. If using format, hdefix, or any supported utility when this happens, reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i> . If the problem still exists, contact your AT&T Service Representative or authorized dealer.
SCSI: Breset was tried with an illegal id <i>n</i> , slot <i>n</i> .	The SDI_BRESET ioctl was attempted with an illegal device number. Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i> . If the problem still exists, contact your AT&T Service Representative or authorized dealer.
SCSI: Breset failed for id <i>n</i> , slot <i>n</i> .	The SDI_BRESET ioctl was run while another process was talking to the same device. This is not allowed by the SCSI driver. This should never happen on a sane system. Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i> . If the problem still exists, contact your AT&T Service Representative or authorized dealer.

SCSI Host Adapter Error Messages

Error Message (Prefaced by WARNING)	Description/Action
SCSI: Breset timed out for slot <i>n</i> .	The SDI_BRESET ioctl timed out while in firmware. This implies the firmware has probably panicked. This should never happen on a sane system. Repump the SCSI board. If the error message is repeated, you may have a corrupted pump file. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, contact your AT&T Service Representative or authorized dealer.
SCSI: Treset was tried with an illegal id <i>n</i> , slot <i>n</i> .	The SDI_TRESET ioctl was attempted with an illegal device number. Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i> . If the problem still exists, contact your AT&T Service Representative or authorized dealer.
SCSI: Tried to delete an invalid entry from the timeout list for lu <i>n</i> , tc <i>n</i> , slot <i>n</i> .	The time-out list has been corrupted. This should never happen on a sane system. Reboot the system. If the error message is repeated, you probably have a corrupted SCSI driver or kernel. Reinstall the SCSI Host Adapter Utilities. If the problem still exists, try to rebuild <i>/unix</i> by booting <i>/etc/system</i> . If the problem still exists, contact your AT&T Service Representative or authorized dealer.

Error Messages Prefaced by PANIC

Error Message (Prefaced by PANIC)	Description/Action
SCSI: Bad address returned by VTOP.	The kernel VTOP function failed. This should never happen on a sane system. Reboot the system. If the error message is repeated, you probably have a corrupted kernel on your core disk. Try to rebuild <i>/unix</i> by booting <i>/etc/system</i> . If the problem still exists, contact your AT&T Service Representative or authorized dealer.

SD01 Disk Target Driver Error Messages

NOTICE: SD01: slot *n*, tc *n*, Unit *n*, job queue is full.
Err: 0dd02001

Description

0dd02001

The addressed disk queue was filled up. This is caused by overloading the disk or the disk not executing jobs.

Action

If the condition continues, verify that the disk is executing requests.
If it is, decrease the load.

NOTICE: SD01: The driver is out of jobs. Err: 2dd02002

Description

2dd02002

The SCSI disk controller ran out of job structures for I/O requests.
It is caused by a large number of outstanding disk I/O requests.

Action

If the error occurs often, increase the **Sd01jcnt** parameter in
/etc/master.d/sd01.

WARNING: SD01: Bad type from host adapter! Err: 8dd23001

Description

8dd23001

The Host Adapter called this function due to a fault condition on the SCSI bus but passed an unknown parameter to this function.

Action

Contact your AT&T Service Representative or authorized dealer.

WARNING: SD01: Bad type to host adapter. Err: *n**Description***8dd04001**

The Host Adapter rejected a request from the SCSI disk driver. This is caused by a parameter mismatch within the driver.

8dd0e002

The Host Adapter rejected a request from the SCSI disk driver. This is caused by a parameter mismatch within the driver. The system should be rebooted.

8dd0f002

The Host Adapter rejected a request from the SCSI disk driver. This is caused by a parameter mismatch within the driver.

8dd11001

The Host Adapter rejected a request from the SCSI disk driver. This is caused by a parameter mismatch within the driver.

8dd12004

The Host Adapter rejected a Request Sense job from the SCSI disk driver. The original job will also be failed. This is caused by a parameter mismatch within the driver.

8dd13001

The Host Adapter rejected a Request Sense job from the SCSI disk driver. The original job will also be failed. This is caused by a parameter mismatch within the driver.

8dd24001

The Host Adapter rejected a function request to Suspend the LU queue for the current device. The disk driver cannot proceed with the handling of the fault, so the original I/O request will be failed.

8dd25003

The Host Adapter rejected a Request Sense job from the SCSI disk driver. The original job will also be failed.

8dd27001

The Host Adapter rejected a Request Sense job issued by the SCSI disk driver. The original job will also be failed.

8dd27002

The Host Adapter rejected a Reserve job issued by the SCSI disk driver. The original job will also be failed.

Action

If the condition persists without system activity, then the system should be rebooted.

WARNING: SD01: I/O error. slot n , tc n , Unit = n , Err: n

SDI return code:0n

Note: block= n , count= n are also displayed if a read or write job fails.

Description

4dd0f001

A SCSI disk driver function request was retried. The retry was performed because the Host Adapter driver detected an error.

4dd12003

The SCSI disk driver is retrying an internal Request Sense job which failed because of an error detected by the Host Adapter driver.

4dd13002

The SCSI disk driver is retrying an I/O request because of a fault which was detected by the Host Adapter driver.

6dd0e001

An I/O request failed due to an error returned by the Host Adapter. All recovery action failed, and the I/O request was returned to the requester.

6dd0f003

A SCSI disk driver function request failed because the Host Adapter driver detected a fatal error or the retry count was exceeded. This failure will cause the affected unit to hang.

6dd12002

An internal SCSI disk target Request Sense job failed because of an error detected by the Host Adapter driver. The original I/O request will be failed.

Action

See Reference Table C, "Err Code Descriptions," at the end of this Appendix for a description of the SDI return codes. If the condition persists without system activity, the system should be rebooted. If the problem still exists, contact your AT&T Service Representative or authorized dealer.

WARNING: SD01: I/O error. slot *n*, tc *n*, Unit = *n*, Err: *n*

Sense key: *n*, Extended sense: *n*, Op code: *n*

Note: block=*n*, and count=*n* are also displayed if a read or write job fails.

Description

4dd12001

The SCSI disk driver is retrying an I/O request because of an error detected by the Target Controller.

4dd12005

The disk controller performed retry or ECC which was successful.

4dd25001

The SCSI disk driver retried a function request. The retry was performed because the Host Adapter detected an error.

6dd25002

The Host Adapter detected an error with the SUSPEND function request and the retry count has already been exceeded.

6dd27003

The Host Adapter detected a failure in the last Reserve job issued by the SCSI disk driver. The retry count has been exceeded so the original job has been failed.

6dd27006

The RESERVE command caused the bus to reset and has exceeded its maximum retry count. The original job will be failed and the error handling code will be exited.

4dd2b001

The SCSI disk driver is retrying an I/O request because of an error detected by the Target Controller.

4dd2b002

The disk controller performed retry or ECC which was successful.

6dd29001

The SCSI disk driver was unable to re-reserve a device. Some hardware problem, or the device was reserved by some other host, is probably causing the driver to fail in its attempt to reserve the device.

Action

Contact your AT&T Service Representative or authorized dealer.

**WARNING: SD01: I/O error. slot n , tc n , Unit = n ,
Err: 4dd13003**

Target controller status: n

Description

4dd13003

The addressed SCSI disk returned an unusual status. The job will be retried later. This condition is usually caused by a problem in the Target Controller.

Action

Contact your AT&T Service Representative or authorized dealer.

WARNING: SD01: slot *n*, tc *n*, Unit *n*, Err: 6dd1f001

Description

6dd1f001

The physical descriptor sector is bad on the addressed disk. The disk must be formatted before it can be accessed for normal use.

Action

Format disk. See **format (1M)**.

WARNING: SD01: slot *n*, tc *n*, Unit *n*, Err: 6dd1f002

Description

6dd1f002

The Volume Table of Contents is bad on the addressed disk. The disk must be partitioned before it can be accessed for normal use.

Action

Partition disk. See **fmthard (1M)**.

SCSI Tape Driver Error Messages

SCSI tape driver error messages are displayed when problems occur with SCSI tape driver hardware and/or software. There are three basic formats for SCSI tape driver error messages:

- (1) **WARNING: ST nn : Slot n : TC n : LU n : Err n : CMD n : Sense Key n**
- (2) **WARNING: ST nn : Slot n : TC n : LU n : Err n**
- (3) **WARNING: ST nn : Slot n : TC n : LU n : Err n : CMD n : Err Code n .**

Each SCSI tape driver error message format contains five common fields:

ST nn Identifies the type of device that is sending the error message:
ST00 for a 9-track tape and **ST01** for a cartridge tape

Slot n Host Adapter slot number on the I/O bus

TC n Target Controller ID on the SCSI bus (0-7)

LU n Logical Unit number (0-3)

Err n Identifies the error message number.

The SCSI Tape Driver Error Message tables define **Err n 's** (error numbers) that are associated with each format type and suggest a corrective action to take. All the messages having the same format are grouped together.

Two of the error message formats contain error detection codes in addition to the common fields. These error detection codes, which are listed below, give additional information about the cause of the error.

CMD n A hexadecimal number assigned to the command that was being executed when the failure occurred

Sense Key n A hexadecimal number assigned to the Sense Key error that occurred

Err Code n An SDI error code that references a description of the occurring error.

SCSI Tape Driver Error Messages

The error detection code variables are defined in the following Reference Tables that are found at the end of this appendix:

- **Table A: CMD n Description**
- **Table B: Sense Key Description**
- **Table C: Err Code Descriptions.**

This first section covers SCSI tape driver error messages that have the following format:

Warning: ST00: TC *n* LU *n*: Err *n* CMD *n* Sense Key *n*

The following table defines the error numbers (**Err *n***) found in messages with this type of format:

Number	Definition/Action
60503003	The tape device was not able to perform the SCSI WRITE FILEMARKS commands. The tape device is suspect. Either the driver is in a fault state or the command is not supported by that device. The sense key provides more information about the error. (See Table B.) Perform diagnostics to verify the state of the tape device.
60503005	An attempt to access the tape device has failed. The tape device or medium is suspect. Refer to the SCSI sense key descriptions to obtain a detailed description of the error state. (See Table B.) Diagnostics should be performed in order to identify the problem.

SCSI Tape Driver Error Messages

This section covers SCSI tape driver error messages that have the following format:

Warning: ST00: TC *n* LU *n*: Err *n*

The following table defines the error numbers (Err *n*) found in messages with this type of format:

Number	Definition/Action
60503001	The status information returned as a result of a SCSI REQUEST SENSE command is not in the SCSI defined extended sense format. Either the device does not correctly support the format or the device does not support the extended sense format at all, or the data has been corrupted. Perform diagnostics to verify that the device is operating correctly. Otherwise, reboot the system.
60503004	The attempted SCSI tape command is not supported by that tape device, or the device may be failing. Perform diagnostics to verify the state of the device. If the problem still exists, this may not be an AT&T supported tape device.
60509001	Cannot open requested device. Error has occurred because of a system power failure. Perform the powerup procedure for the system and device before accessing the device.
60509002	Cannot open device. The device address passed to the tape driver is not within the bounds of the device structures defined for the tape. Reboot the system and ensure the tape feature is configured in the system and the device nodes are created correctly.
6050B002	The tape device does not support the block size required by the system for block mode transfers. The tape device and system block size are not compatible; thus, the tape device cannot be used in this mode. Perform diagnostics on the device to verify it is operating properly. If diagnostics fail, the device or configuration is suspect. If this passes, the tape device may not be an AT&T supported device.
80502001	The SCSI subsystem is not operational. An invalid job block address has been returned to the tape driver from the SCSI subsystem. Reboot the system.

SCSI Tape Driver Error Messages

Number	Definition/Action
80504001	The SCSI subsystem is not operational. An unknown SDI type job has been returned by the SCSI subsystem to the tape driver. Reboot the system.
80505001	The SCSI subsystem is not operational. The expected SCSI REQUEST SENSE job was not returned from the SCSI subsystem. Reboot the system.
80506001	The SCSI subsystem is not operational. The job returned to the driver from the SDI subsystem is either out of sequence or unknown. Reboot the system.
80508002	The SCSI subsystem is not operational. The SDI subsystem cannot free the job block (memory) passed to it by the tape driver. This could indicate that a bad address was returned by the tape driver. Reboot the system.
80508003	The SCSI subsystem is not sane. The tape subsystem cannot free the job block (memory) returned to it by the SCSI subsystem. This could indicate that a bad address was returned by the SCSI subsystem. Reboot the system.
8050A001	The SCSI subsystem is not sane. The SCSI subsystem could not release the requested job block (memory) to the free list that was passed to it by the tape driver. Reboot the system to clear this condition.
8050A002	The SCSI subsystem is not sane. The tape subsystem could not release the requested job block (memory) to the free list that was returned to it by the SCSI subsystem. Reboot the system to clear this condition.
8050C001	A system power failure has occurred. The driver is not allowed to access any tape device in this condition. The powerup sequence must be performed prior to accessing this device.
8050D001	A system power failure has occurred. The driver is not allowed to access any tape device in this condition. The powerup sequence must be performed prior to accessing this device.
8050E001	A system power failure has occurred. The driver is not allowed to access any tape device in this condition. The powerup sequence must be performed prior to accessing this device.

SCSI Tape Driver Error Messages

This section covers SCSI tape driver error messages that have the following format:

Warning: ST00: TC *n* LU *n*: Err *n* CMD *n* Err Code *n*

The following table defines the error numbers (**Err *n***) found in messages with this type of format:

Number	Definition/Action
60504003	The SDI type job did not complete successfully. The SDI command type is (CMD <i>x</i>) and the Err Code field provides a reference to describe the state in more detail. The SCSI subsystem is not sane. Reboot the system.
60505003	The SCSI Request Sense command did not complete successfully. The Err Code provides a description of the error type. Recovery action should be based on the Err Code value. (See Table C.) Suggested recovery actions are to run diagnostics on the tape device or reset the SCSI bus.
60506003	The device, that an attempt is being made to access, is in use (RESERVED) by another initiator (user) on the SCSI bus. This requires that the bus support multiple initiators. Access cannot be made to that device until the other initiator (user) releases that device from use. You must be sure that the other host system on the SCSI bus has released the device; that is, no one is using the device, or the device is not locked by the other system.
60506004	The SCSI command (CMD <i>x</i>) was returned with an error from the SCSI subsystem. The SCSI subsystem detected an error while processing the command. The Err Code defines the error type. (See Table C for description of the Err Code.) Perform diagnostics on the device. If the diagnostics fail, the device or configuration is suspect. If diagnostics pass, reboot the system.
80503002	The tape driver is not able to send the SCSI type command (CMD <i>x</i>) to the device through the SCSI subsystem. An Err Code (0 <i>x</i> 1) indicates the job was returned with a retry status, and an Err Code (0 <i>xfffffff</i>) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.

Number	Definition/Action
80503006	The tape driver is not able to send the SDI type command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.
80505002	The tape driver is not able to send the SDI type command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.
80506002	The tape driver is not able to send the SDI type command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.
80506005	The tape driver is not able to send the SDI type command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.

SCSI Tape Driver Error Messages

Number	Definition/Action
80506006	The tape driver is not able to send the SCSI REQUEST SENSE command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system to attempt to clear the condition.
80507001	The tape driver is not able to send the SCSI type command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.
80508001	The tape driver is not able to send the SCSI type command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.
8050B001	The tape driver is not able to send the SCSI type command (CMD x) to the device through the SCSI subsystem via the immediate queue. An Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. Reboot the system in an attempt to clear the condition.
8050F001	The tape driver is not able to send the SCSI type or SDI command (CMD x) through the SCSI subsystem via the immediate queue. An Err Code (0x1) indicates the job was returned with a retry status, and an Err Code (0xffffffff) indicates that the job was returned with an error (for example, a bad type in the SB structure). In either case, the error should not normally occur. You should reboot the system in an attempt to clear the condition.

Equipped Device Table Error Messages

**EDTGEN: SLOT n, FILE SYSTEM IS INACCESSIBLE.
CONTROL WILL RETURN TO MAINTENANCE CONTROL PROGRAM.**

Description: The initialization routines used prior to accessing the boot file system failed. This should never happen, since the edtgen program must have been read in through the file system just prior to this failure.

Action: The disk must be rebuilt.

References: xedtgen.c

EDTGEN: SLOT n, CANNOT FIND FILE: /edt/SCSI/edt_data

Description: The file specified could not be found in the boot file system. This would happen if the file was removed.

Action: The file must be restored to the boot disk.

References: xedtgen.c

EDTGEN: SLOT n, CANNOT LOAD FILE: /edt/SCSI/edt_data

Description: The file specified could not be loaded from the boot file system. This would happen if the file permissions were changed to make it unreadable.

Action: The file must be restored to the boot disk.

References: xedtgen.c

EDTGEN: SLOT n, SYSTEM FAILED

Description: The sysgen to the specified slot failed. This would happen if the specified slot had a hardware or firmware problem, or if the interface to the board was corrupted.

Action: Replace the HA card.

References: xedtgen.c

EDTGEN: SLOT n, EXTENDED DSD FAILED

Description: The Determine Sub Device command to the specified slot failed. This would happen if the specified slot has a hardware or firmware problem, or if the interface to the board was corrupted.

Action: Replace the HA card.

References: xedtgen.c

EDTGEN: SLOT n, NO LUS EQUIPPED FOR TC n

Description: A Target Controller with no Logical Units attached was found which ROM had not previously found. If this happens, the edtgen program will continue to process the remaining Target Controllers, but will NOT configure the Target Controller specified in the error message. This should not happen with properly configured systems.

Action: Check the Target Controller by running diagnostics.

References: xedtgen.c

EDTGEN: SLOT n, ID MATCH WITH HA CARD FOR TC n

Description: An inquiry to the Host Adapter ID returned something other than a selection time out. This should only happen if there is another Target Controller on the SCSI bus with the same ID as the Host Adapter card.

Action: Make sure the IDs of each device on the SCSI bus are independent.

References: xedtgen.c

**EDTGEN: SLOT n, INQUIRY RETURNED BAD STATUS FOR TC n,
LU n, STATUS=0x%x**

Description: An inquiry returned a non-normal status byte for the specified Target Controller and Logical Unit. The value returned in the status byte is printed out. This should only happen if a Target Controller does not handle the inquiry as specified by the AT&T SCSI Definition.

Action: Check the Target Controller by running diagnostics.

References: xedtgen.c

**EDTGEN: SLOT n, INQUIRY TIMED OUT AFTER SELECTION FOR TC n,
LU n**

Description: An inquiry timed out after the selection phase had completed successfully. This should only happen if a Target Controller does not handle the inquiry as specified by the AT&T SCSI Definition.

Action: Check the Target Controller by running diagnostics.

References: xedtgen.c

EDTGEN: SLOT n, JOB TIMED OUT FOR TC n, LU n

Description: A job which was sent to the firmware was never completed. This should never happen on a sane system.

Action: Check the Host Adapter by running diagnostics.

References: xedtgen.c

**EDTGEN: SLOT n, UNKNOWN RETURN CODE FOR TC n, LU n,
RETURN CODE=0x%x**

Description: The firmware returned an error code which was not recognized by the edtgen code. This should never happen on a sane system.

Action: Check the Host Adapter by running diagnostics.

References: xedtgen.c

**EDTGEN: SLOT n, INQUIRY RETURNED BAD STATUS FOR TC n,
STATUS=0x%x**

Description: An inquiry returned a non-normal status byte for the specified Target Controller and Logical Unit. The value returned in the status byte is printed out. This should only happen if a Target Controller does not handle the inquiry as specified by the AT&T SCSI Definition, and the status has changed since the ROM did its self configuration.

Action: Check the Target Controller by running diagnostics.

References: xedtgen.c

EDTGEN: SLOT n, INQUIRY TIMED OUT AFTER SELECTION FOR TC n

Description: An inquiry timed out after the selection phase had completed successfully after it had previously passed during ROM self configuration.

Action: Check the Target Controller by running diagnostics.

References: xedtgen.c

EDTGEN: SLOT n, SELECTION TIME OUT FOR TC n

Description: A selection time-out occurred on a Target Controller after it had previously passed during ROM self configuration.

Action: Check the Target Controller by running diagnostics.

References: xedtgen.c

EDTGEN: SLOT n, JOB TIMED OUT FOR TC n

Description: A job which was sent to the firmware was never completed. This should never happen on a sane system.

Action: Check the Host Adapter by running diagnostics.

References: xedtgen.c

EDTGEN: SLOT n, UNKNOWN RETURN CODE FOR TC n, RETURN CODE=0x%x

Description: The firmware returned an error code which was not recognized by the edtgen code. This should never happen on a sane system.

Action: Check the Host Adapter by running diagnostics.

References: xedtgen.c

EDTGEN: SLOT n, "inquiry string" TC n NOT FOUND

Description: The specified inquiry string returned for the specified Target Controller was not found in the `/edt/SCSI/edt_data` file. This will happen when attaching new Target Controllers to the SCSI bus prior to installing the appropriate software. The inquiry string contains the Vendor Identification in the first 8 bytes and the Product Identification in the next 16 bytes.

Action: Add the inquiry string to the `/edt/SCSI/edt_data` file by using the `/etc/scsi/edittbl` command. This is done during installation of the software corresponding to the new device.

References: xedtgen.c

EDTGEN: SLOT n, WRITE EXTENDED EDT FAILED

Description: The write of the extended EDT failed. This should never happen on a sane system.

Action: Replace the HA card.

References: xedtgen.c

EDTGEN:RESET OF THE BOOT DEVICE FAILED

Description: The call to reset the boot device failed.

Action: The disk must be rebuilt.

References: xedtgen.c

Reference Tables

Table A: CMD *n* Descriptions

CMD <i>n</i> (Hex)	Command Executing at Time of Failure	Description
00	Test Unit Ready	Checks to see if the tape drive is ready.
01	Rewind	Requests that the Target Controller rewind the tape drive to the beginning-of-medium or load point. Prior to executing the rewind operation, the Target Controller writes any buffered data to the medium.
03	Request Sense	Requests that the Target Controller transfer sense data to the initiator.
05	Read Block Limits	Requests that the Target Controller capability for block length limits be returned for the tape device.
08	Read	Transfers one or more block(s) to the initiator beginning with the next block on the tape drive.
0A	Write	Transfers one or more block(s) from the initiator to the current position on the tape drive medium.

Table A: CMD *n* Descriptions (Contd)

CMD <i>n</i> (Hex)	Command Executing at Time of Failure	Description
0B	Track Select	Requests that the track specified be selected.
0F	Read Reverse	Functions identically to the READ command except that the medium motion is in the reverse direction. Thus blocks, and bytes within the blocks, are transferred in the reverse order.
10	Write Filemarks	Causes the specified number of filemarks to be written, beginning at the current medium position on the tape drive. If an error occurs during this operation, buffered data may not have been completely transferred to the medium.
11	Space	Allows you to move forward and backward through your medium.
12	Inquiry	Requests that information regarding parameters of the Target Controller and its attached peripheral device(s) be sent to the initiator.

Table A: CMD n Descriptions (Contd)

CMD <i>n</i> (Hex)	Command Executing at Time of Failure	Description
13	Verify	Verifies one or more block(s) beginning with the next block on the tape drive medium.
14	Recover Buffered Data	Reads data that has been transferred to a target buffer but has not been written onto the medium.
15	Mode Select	Allows the initiator to specify tape drive, medium, or peripheral device parameters to the Target Controller.
16	Reverse Unit	Reserves the specified tape drive for exclusive use by the requesting initiator, or if third party reservation option is implemented, to another specified SCSI device.
17	Release Unit	Releases the tape drive if it is currently reserved by the requesting initiator.
18	Copy	Copies data from one tape drive to another or to the same tape drive.

Table A: CMD *n* Descriptions (Contd)

CMD <i>n</i> (Hex)	Command Executing at Time of Failure	Description
19	Erase	Causes all or part of the remaining medium to be erased, beginning from the current logical position.
1A	Mode Sense	Allows a Target Controller to report its tape drive, medium, or peripheral device parameters to the initiator. This is a complimentary command to the MODE SELECT command.
1B	Load/Unload	Requests that the Target Controller enable or disable the tape drive for further operations.
1C	Receive Diagnostic Results	Requests that analysis data be sent to the initiator after completion of a SEND DIAGNOSTIC command.
1D	Send Diagnostic	Requests the Target Controller to perform diagnostic tests on itself or the attached peripheral devices, or on both.
1E	Prevent/Allow Medium Removal	Requests that the Target Controller enable or disable the removal of the medium in the tape drive.

Table B: Sense Key Descriptions

Sense!Key! (hex)	Descriptions
0	NO SENSE. Indicates that there is no specific sense key information to be reported for the designated Logical Unit. This is the case for a successful command or a command that received a CHECK CONDITION status because one of the FM, EOM, or ILI bits is set to one.
1	RECOVERED ERROR. Indicates that the last command completed successfully with some recovery action performed by the Target Controller. Details may be determinable by examining the additional Sense Bytes and the Information Bytes.
2	NOT READY. Indicates that the Logical Unit addressed cannot be accessed. Operator intervention may be required to correct this condition.
3	MEDIUM ERROR. Indicates that the command terminated with a nonrecovered error condition that was probably caused by a flaw in the medium or an error in the recorded data.
4	HARDWARE ERROR. Indicates that the Target Controller detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self-test.

Table B: Sense Key Descriptions (Contd)

Sense!Key! (hex)	Descriptions
5	ILLEGAL REQUEST. Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands (FORMAT UNIT, SEARCH DATA , etc.). If the Target Controller detects an invalid parameter in the command descriptor block, then it terminates the command without altering the medium. If the Target Controller detects an invalid parameter in the additional parameters supplied as data, then the Target Controller may have already altered the medium.
6	UNIT ATTENTION. Indicates that the removable medium may have been changed or the Target Controller has been reset.
7	DATA PROTECT. Indicates that a command that reads or writes the medium was attempted on a block that is protected from this operation. The read or write operation is not performed.
8	BLANK CHECK. Indicates that a write-once read-multiple device or a sequential-access device encountered a blank block while reading or a write-once read-multiple device encountered a nonblank block while writing.

Table B: Sense Key Descriptions (Contd)

Sense!Key! (hex)	Descriptions
9	Vendor unique. This sense key is available for reporting vendor unique conditions.
A	COPY ABORTED. Indicates a COPY , COMPARE , or COPY AND VERIFY command was aborted due to an error condition on the source device, the destination device, or both. (See COPY command for additional information about this sense key.)
B	ABORTED COMMAND. Indicates that the Target Controller aborted the command. The initiator may be able to recover by trying the command again.
C	EQUAL. Indicates a SEARCH DATA command has satisfied an equal comparison.
D	VOLUME OVERFLOW. Indicates that a buffered peripheral device has reached the end-of-medium and data remains in the buffer that has not been written to the medium. A RECOVER BUFFERED DATA command(s) may be issued to read the unwritten data from the buffer.
E	MISCOMPARE. Indicates that the source data did not match the data read from the medium.
F	This sense key is reserved.

Table C: Err Code Descriptions

Err Code	Message	Description
00000000	This block is not allocated	This block has not been allocated by the Host Adapter driver. The target drivers should never detect this <i>sc_comp_code</i> ; a target driver should probably PANIC if it received a block with <i>sc_comp_code</i> set to SDI_NOALLOC. The <i>sc_comp_code</i> is set to this value when the SB is freed.
00000001	Job completed normally	All seems well means that the job has completed and no errors were detected.
00000002	Linked command done without flag	Indicates that this linked command completed normally and the SCSI command flag bit was zero.
00000003	Linked command done with flag	Indicates that this linked command completed normally and the SCSI command flag bit was one.
00000013	Job in progress	Indicates that the job has not completed yet.

Table C: Err Code Descriptions (Contd)

Err Code	Message	Description
00000014	Job not in use	This code is for use by the target driver when it is not using the control structure. The Host Adapter driver will set the <i>sc_comp_code</i> to this value when it allocates a SCSI Block for the target driver.
10000000	Processing has been suspended	The Host Adapter driver has suspended job processing for this device.
20000000	A message has been sent	A message regarding this event has already been printed on the console and logged.
40000000	Retry the job	The error was probably unrelated to the job. Retry the job.
80000000	An error was detected	Indicates there was an error.
8000000A	Addressed device not present	This error code is returned when the Host Adapter driver believes that the device addressed is not connected.
8000000F	SCSI Control Block (SCB) error	The SCSI Control Block (SCB) contains an error or invalid type. The target driver is insane, reload the target driver.

Table C: Err Code Descriptions (Contd)

Err Code	Message	Description
80000017	More than one immediate request	This error code is returned when more than one immediate request has been sent.
80000019	SCSI Function Block (SFB) error	There is an error in the field of the SFB. The target driver is insane, reload the target driver.
A0000008	vtop failed	Indicates that the virtual to physical address translation failed.
A000000C	Memory Fault	Indicates there was a memory fault while accessing the data area of the job.
A000000D	SCSI bus error	The Host Adapter encountered a problem on the SCSI bus and all recovery action failed. A controller with a faulty bus could cause such an error.
D0000007	Reset was caused by this unit	The Host Adapter driver was working on this job and a fatal protocol error was detected, which caused the Host Adapter driver to reset the SCSI bus.

Table C: Err Code Descriptions (Contd)

Err Code	Message	Description
D0000009	Job timed out	This error code is returned when the Host Adapter driver times out a job.
D000000E	Target returned check status	The status byte should be checked. This error is returned when the Target Controller returns a status other than <i>GOOD</i> .
D0000011	The SCSI bus select failed	The Host Adapter driver timed out trying to select the controller.
D0000012	Parameter mismatch	The controller attempted to perform an operation that did not agree with the data in the SCB, i.e., the controller attempted a data-in transfer and the <i>SCB_READ</i> flag was not set.
E0000004	Job was flushed	When the target driver requests that the job queue for a device be flushed, all jobs in the queue are returned with this completion code.

Table C: Err Code Descriptions (Contd)

Err Code	Message	Description
80000017	More than one immediate request	This error code is returned when more than one immediate request has been sent.
80000019	SCSI Function Block (SFB) error	There is an error in the field of the SFB. The target driver is insane, reload the target driver.
A0000008	vtop failed	Indicates that the virtual to physical address translation failed.
A000000C	Memory Fault	Indicates there was a memory fault while accessing the data area of the job.
A000000D	SCSI bus error	The Host Adapter encountered a problem on the SCSI bus and all recovery action failed. A controller with a faulty bus could cause such an error.
D0000007	Reset was caused by this unit	The Host Adapter driver was working on this job and a fatal protocol error was detected, which caused the Host Adapter driver to reset the SCSI bus.

Table C: Err Code Descriptions (Contd)

Err Code	Message	Description
D0000009	Job timed out	This error code is returned when the Host Adapter driver times out a job.
D000000E	Target returned check status	The status byte should be checked. This error is returned when the Target Controller returns a status other than <i>GOOD</i> .
D0000011	The SCSI bus select failed	The Host Adapter driver timed out trying to select the controller.
D0000012	Parameter mismatch	The controller attempted to perform an operation that did not agree with the data in the SCB, i.e., the controller attempted a data-in transfer and the <i>SCB_READ</i> flag was not set.
E0000004	Job was flushed	When the target driver requests that the job queue for a device be flushed, all jobs in the queue are returned with this completion code.

Table C: Err Code Descriptions (Contd)

Err Code	Message	Description
E000000B	Host Adapter error	Indicates that there is some problem between the Host Adapter driver and the Host Adapter controller. Possible causes are a 3B I/O bus parity or an insane Host Adapter.
F0000005	Command was aborted	Indicates that this job was aborted by the target driver.
F0000006	Reset was detected on the bus	When the Host Adapter driver detects a reset on the SCSI bus, it will return all outstanding and queued jobs to the target drivers with this condition code. This code is also returned when a target driver requests that a Target Controller be reset.

Glossary

This glossary defines terms and acronyms used in this document that may not be familiar to you. The glossary is divided into two parts: the List of Acronyms and Terminology.

List of Acronyms

AC	— Alternating Current
ANSI	— American National Standard Institute
ATP	— All Tests Passed
BOT	— Beginning-of-Tape
bpi	— Bits Per Inch
BPI	— Bytes Per Inch
CPU	— Central Processor Unit
CTC	— Cartridge Tape Controller
CTRL	— Control
CYL	— Hard Disk Cylinder
DC	— Direct Current
DCM	— SCSI Disk Controller Module
DGMON	— Diagnostics Monitor
DM	— SCSI Disk Module
DMA	— Direct Memory Access
EDA	— Enhanced Data Availability
EDT	— Equipped Device Table
EOT	— End-of-Tape
EPROM	— Erasable Programmable Read Only Memory
ESDI	— Enhanced Small Disk Interface
FIFO	— First In, First Out
GCR	— Group Coded Recording
HA	— SCSI Host Adapter
ID	— Identification

LU	— Logical Unit
MSS	— Multiple Save Sets
PE	— Phase Encoded
PPCU	— Peripheral Power Control Unit
SBD	— System Board
SCSI	— Small Computer System Interface
SSP	— SCSI Shared Peripherals
TM/S	— SCSI Cartridge Tape Module
VTOC	— Volume Table of Contents
XM	— SCSI Expansion Module

Terminology

Backup	A spare copy of data or software that you keep in case the original is damaged or lost.
Bridge Controller	An intelligent (microprocessor-based) circuit board (controller) that is physically separate from both the peripheral and the host computer. The bridge controller is one of three types of units on the SCSI bus that controls peripherals.
Command	A command is an instruction used to tell the computer to perform a function or carry out an activity.
Configuration	Configuration is the way that the computer is set up to allow for particular uses or situations.
Copy	Copy means to duplicate information.
Device	The term used to refer to the peripheral itself, for example, a hard disk or a tape drive. A peripheral is sometimes referred to as a subdevice or a Logical Unit (LU).

Embedded Controller	An embedded controller is an intelligent controller that is physically part of the peripheral device. An embedded controller controls only one device; the device with which it is packaged.
Enhanced Data Availability	EDA is an application of shared peripherals that allows a 3B2 computer to act as a backup for other 3B2 computers.
Error Message	An error message is a response from a program indicating that a problem has arisen or something unexpected has happened, requiring your attention.
External Connector	An external connector is outside the cabinet and is accessible to the user without having to open any doors, remove any panels, or remove any cabinet covers.
Gigabyte	1 Gigabyte = 10^9 bytes
Hard Disk	Hard disk is a device that stores operating systems, programs, and data files.
Host Adapter	The HA1 or HA2 feature card that plugs into the 3B2 computer backplane is used as an interface between the host computer system and the SCSI bus.
Install	Install involves the procedures used to set up the hardware and software of a computer so that it can be used. Installing often includes customizing the system for a particular situation or user.
Logical Unit	The term used to refer to a peripheral device such as a disk drive.
Megabyte	1 Megabyte = 10^6 bytes

- Mirrored Disks** The mirroring feature allows one driver to write to two separate disk partitions at once, provided they are available on the same processor. In mirroring, the data is written not to a single disk but automatically to disks on each of two independent buses, making all data saved to disk available at two physical locations. When one disk or a bus goes down, system operation continues uninterrupted, and the faulty component can be replaced or repaired.
- Mirrored Partitions** A pair of disk partitions that contain identical data to provide increased data integrity. Whenever data is written, it is written to both partitions. Whenever data is read, it is read from one partition of the pair, alternating partitions with each read.
- Multiple Save Sets** Multiple save sets allows a user to produce multiple `cpio(1)` type backups on a single and multiple cartridge or 9-track tape medium.
- Operating System** The software that controls and allocates the resources, such as memory, disk storage, and the screen display for the computer.
- Option** A UNIX system option is an addition to a command to improve or provide an extra enhancement to the command. The option is usually depicted with a minus (-) sign in front of it.
- Partition** A partition is a section of the hard disk that is used to store an operating system and data files or programs. By dividing the disk into partitions, you can use the space allocated in a more efficient and organized manner.

SCSI Bus	An industry standard peripheral bus that is used to connect intelligent peripherals to a host computer. It uses a daisy-chained cabling arrangement that originates at the Host Adapter to interconnect up to seven intelligent peripheral controllers on the bus.
SCSI Differential Bus	A version of the SCSI bus designed to support cable lengths up to 25 meters. It is not compatible with the single-ended version of the SCSI bus.
SCSI ID	Each tap on the SCSI bus is required to have a unique identification or address, which is the SCSI ID. The ID is set by a switch located on each controller. In the AT&T implementation, two are preset: the Host Adapter card (with a SCSI ID of 0) and the manual-loading 9-track tape (with a SCSI ID of 7). The rest can be set with external "push buttons." Users never have to open a chassis or touch a circuit-board switch.
SCSI Single-Ended Bus	A version of the SCSI bus designed minimize cost and space. Cable lengths up to 6 meters are supported. It is not compatible with the differential version of the SCSI bus.
Shared Peripherals	The shared peripherals feature allows up to three 3B2 computers to share a common SCSI bus. Each computer sharing the bus has access to all peripherals that are attached to that common bus.
Syntax	Syntax is the format of a command line.
System	System is a general term for a computer and its software and data.
Tap	A tap is any intelligent (microprocessor-based) controller connected to the SCSI bus.

Glossary

UNIX system	The UNIX system is a general-purpose, multiuser, interactive, time-sharing operating system, used with your computer.
Utilities	Utilities are a group of programs combined into a package that represent a specific application available with your computer.
Utility	Utility is a program, usually from a set of programs, that represents a specific application available with your computer.
VTOC	The Volume Table of Contents lists the beginning and ending points of the disk partitions by the system administrator for a given disk.

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