User's Guide

AHA-3980/3980W/3985/3985W

PCI-to-SCSI MultiChannel RAID Adapters
With SCSI*Select*

▼▼▼▼ AHA-3980∕3980W ∕3985∕3985W

PCI-to-SCSI MultiChannel RAID Adapters
with SCSI*Select*

User's Guide

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■ For technical support, for information about the Adaptec World Wide Web (WWW) and File Transfer Protocol (FTP) Servers, the Adaptec forum on CompuServe, the Adaptec USA Bulletin Board Service (BBS), and for access to the Interactive Fax system, call 800-959-SCSI (7274) or 408-945-2550, 24 hours a day, 7 days a week. To speak with a product support representative, call 408-934-SCSI (7274), M–F: 6:00 a.m. to 5:00 p.m., Pacific Time; after these hours, on weekends, and on holidays, product support is also available for a fee at 800-416-8066.

 – The Adaptec WWW and FTP Servers, and the Adaptec forum on CompuServe provide product literature, answers to commonly asked questions, and information on software upgrades and other topics. The WWW and FTP Servers are available from the Internet 24 hours a day, 7 days a week, at http://www.adaptec.com and ftp.adaptec.com. To access the Adaptec forum on CompuServe 24 hours a day, 7 days a week, type GO ADAPTEC.

 – The Adaptec BBS provides answers to commonly asked questions and information on software upgrades and other topics. The BBS is available 24 hours a day, 7 days a week, at 408-945-7727; 1200/2400/9600/14,400/28,800 baud, 8 data bits, 1 stop bit, no parity.

 – The Adaptec Interactive Fax system provides product literature, answers to commonly asked questions, and current information about Adaptec products and services. The Adaptec Interactive Fax system is available 23 hours a day, 7 days a week. The Fax system is out of service 1 hour each day. You can call this service directly at 408-957-7150.

■ For sales information, call 800-959-SCSI (7274) or 408-945-2550, M–F: 6:00 a.m. to 5:00 p.m., Pacific Time.

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■ To request additional documentation for Adaptec products, call 800-934-2766 or 510-732-3829, M–F: 6:00 a.m. to 5:00 p.m., Pacific Time.

FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna

• Move the equipment away from the receiver

• Plug the equipment into an outlet on a circuit different from that to which the receiver is powered

• If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions

CAUTION: Only equipment certified to comply with Class B (computer input/output devices, terminals, printers, etc.) should be attached to this equipment, and must have shielded interface cables.

Finally, any changes or modifications to the equipment by the user not expressly approved by the grantee or manufacturer could void the user's authority to operate such equipment.

Each host adapter is equipped with an FCC compliance label that shows only the FCC identification number. The full text of the associated label follows:

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Canadian Compliance Statement

This Class B apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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Getting Started

This *User's Guide* explains how to install and use the Adaptec®
AHA-398x family of MultiChannel™ PCI-to-SCSI RAID adapters,
which are designed to provide powerful disk array support in
NetWare® servers that have a PCI (Peripheral Component Intercon-
nect) bus. Each AHA-398x adapter has either two or three SCSI *chan-
nels*; each channel has the equivalent functionality of a separate SCSI
bus. You can easily configure the adapter to boot the server from a
single SCSI disk drive or from an array.

There are four adapter models in the AHA-398x family:

- The AHA-3980 adapter has two Fast SCSI channels and sup-
  ports up to 14 SCSI devices

- The AHA-3980W adapter has two Fast and Wide SCSI chan-
  nels and supports up to 30 SCSI devices

- The AHA-3985 adapter has three Fast SCSI channels and sup-
  ports up to 21 SCSI devices

- The AHA-3985W adapter has three Fast and Wide SCSI chan-
  nels and supports up to 45 SCSI devices

AHA-398x adapters include software that helps you configure and
use arrays and other devices connected to the adapter. You use the
DOS-based Adaptec Initial Array Configuration Utility to prepare
an initial array and to make it bootable. You use the Copy Drivers
Utility to set up drivers for NetWare and for CD-ROM drives. You
use the console-based Administrator Utility, which runs under
NetWare, to add, delete, reconfigure, and manage arrays on an
ongoing basis.

The CI/O software allows you to monitor and manage the network from remote workstations.

System Requirements

The AHA-398x RAID adapter and software must be installed on a NetWare server that has the following system resources:

Hardware/Firmware

- An 80486DX or Pentium computer that complies with PCI Rev. 2.0

- A motherboard BIOS that supports PCI-to-PCI bridges, a 64-KByte BIOS, and multiple interrupts

  If you are not sure which features the BIOS supports, contact your vendor, or call Adaptec's Interactive Fax Service for a list of compatible motherboards. See *Adaptec Technical Support and Services* on page ii.

- An available full-length PCI slot that supports bus mastering and PCI Int B

- A 3.5-inch 1.44-MByte primary (boot) floppy disk drive

- A minimum of two SCSI disks for a RAID 0 or mirrored array; a minimum of three SCSI disks for a RAID 0 CVT, RAID 5, or RAID 5 CVT array (see *Number of Disks in an Array* on page 2-3)

- Two MBytes of hard disk space for the Adaptec RAID software

Software

- NetWare 386, version 3.11, 3.12, or 4.xx

- NetWare CLIB 3.12 or higher

- MS DOS 5.0 or above (MS-DOS 6.0 or above recommended)

- The *Adaptec Initial Array Configuration Utility* and *AHA-3980/3985 Drivers and RAID Utilities* diskettes, which are included with the AHA-398x

- To run CD-ROM drives under MS-DOS 5.0: The Microsoft CD-ROM extension, *mscdex.exe*, which is included with MS-DOS 6.0 or above. (This file is also available on Microsoft's electronic bulletin board)

If you intend to use Adaptec CI/O, it must be installed on the remote workstation from which you plan to monitor the arrays. See the Adaptec CI/O documentation to learn the hardware and software requirements for the remote workstation.

Using This Document

To use this document, first read Part 1 to learn the basics of arrays and how they are supported by AHA-398x host adapters and the supporting software. Part 1 also includes an overview of adapter features and of the software included with the adapter. Pay particular attention to *System Requirements* on page 1-2.

Next, follow the instructions in Part 2 to physically install the AHA-398x in your computer, attach the SCSI devices, prepare a boot array or boot drive, and copy DOS and NetWare drivers to the server.

Read Chapter 7 in Part 3 to learn the basics of the Administrator Utility, which runs under NetWare. Then follow the instructions in the rest of Part 3, as needed, to learn how to use this utility to monitor array performance, manage your arrays, change array configurations, add new arrays, and format arrays. Chapter 12 explains how to use Adaptec CI/O to monitor your arrays from a remote workstation.

Read Part 4 as needed to learn how to use the SCSI*Select* utility to change AHA-398x configuration parameters and how to set up a CD-ROM drive to install NetWare and other software.

Appendices A and B have troubleshooting information. Appendix C describes the drivers and other RAID-related software included with the AHA-398x.

Conventions

The following typographic conventions are used in this document:

bold
Used for key names (… press the **Enter** key …) and for options
you are directed to select (… select **SCSI Disk Utilities** …).

Helvetica
Used for screen messages (…Save changes?…) and for text
you must type exactly as shown.

Helvetica Italics
Used for program and file names when referenced in the text
(… *aspi8dos* …).

Advisories

Advisories are quick notes that stress an important point or warn of
a potential hazard to the system or data. This document has three
kinds of advisories:

Note: Text set off in this way presents reminders, tips, or sug-
gestions that may simplify the use of the AHA-398x.

Caution: Failure to observe this type of advisory could result
in damage to your system, devices, or data.

WARNING: Failure to observe this type of advisory could
result in personal injury.

Use caution when handling any electrical equipment. Advisories in
this document can only cover the procedures contained here, and
not all situations may have been addressed. Adaptec does not claim
to have included every condition or situation that might require a
Caution or Warning. You must refer to the documentation for your
computer and peripheral devices when you are installing equipment
or changing its configuration.

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▾▾▾▾ Part 1

Learning the Basics

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Array Basics

Adaptec's RAID adapter and RAID software let you set up and manage disk arrays on NetWare servers. A *disk array* is a group of disks that appears to the system as a single virtual disk. This is accomplished through software. *RAID* (Redundant Array of Inexpensive Disks) refers to disk arrays in which part of the array storage capacity may be used to store redundant information. The redundant information lets you restore user data if a disk in the array fails.

A virtual disk is functionally identical to a physical disk. Depending on the array type, however, the virtual disk has advantages in fault-tolerance, cost, performance, or a combination of these. This chapter explains the different array types and the disk requirements for each type.

Array Types

Array types are defined by their RAID level, a number from 0 through 6 (a higher RAID level does not indicate a higher level of performance or fault-tolerance). Adaptec RAID software lets you create the types of arrays that have proven to be the most useful for NetWare RAID applications: RAID 0, 1, 1/0, and 5.

RAID 0 (Striped Disks)

In a RAID 0 array, data is distributed, or *striped*, across the disks in the array. The array appears to the server as one large disk with a capacity approximately equal to the combined capacity of the physical disks. Because multiple reads and writes can be handled in parallel, the input/output performance of the array is much better than that of a single physical disk.

RAID 0 arrays do not store redundant data, so they are not true RAID applications. If one disk fails, the entire array fails and all array data is lost. The fault-tolerance of a RAID 0 array, therefore, is less than that of any single disk in the array. The term RAID 0 is widely used for these arrays, however, because they are conceptually similar to true RAID applications.

RAID 1, RAID 1/0 (Mirrored Disks)

In RAID 1 and RAID 1/0 arrays (commonly called *mirrored arrays*) disks are paired, with both disks in a pair containing the same data. When data is written to a mirrored array, it is written twice—once to each disk in the pair. A RAID 1 array has only one set of paired disks. A RAID 1/0 array has multiple pairs, across which data is striped.

The read performance of RAID 1 arrays can be much better than that of a single disk, while the write performance is slightly worse. In RAID 1/0 arrays, both read performance and write performance are better than those of a single disk.

A mirrored array is also highly reliable, because both disks *in a pair* must fail for the array to fail. In an array with five pairs of mirrored disks, for example, the array can maintain its integrity if even five disks fail—as long as each pair is left with one good disk. The main disadvantage of a mirrored array is its cost. Because all disks must have a twin, you must use twice the number of disks that actually contribute to the array capacity. In an eight-disk array, for example, you have only four disks of usable capacity.

RAID 5

RAID 5 arrays contain redundant information in the form of parity data, which is calculated block by block for all user data. The parity information is distributed across the disks in the array, as in RAID 0 arrays, and occupies the equivalent capacity of about one disk. Data is interspersed with the parity information. If one disk in the array fails, the data on the failed disk can be reconstructed from the parity data and user data on the remaining disks. Two disks must fail before the entire array fails.

The read performance of a RAID 5 array is excellent—comparable to that of a RAID 0 array. Write performance is lower than that of a RAID 0 array, because write operations involve calculating and writing new parity data as well as writing the new user data.

RAID 0 CVT and RAID 5 CVT

RAID 0 CVT and RAID 5 CVT arrays are functionally identical to RAID 0 and RAID 5 arrays, but you can convert from a RAID 0 CVT array to a RAID 5 CVT array and back again without loss of data and without reformatting. The CVT formats allow you to use the more reliable RAID 5 format for normal use, then switch to RAID 0, which has higher write performance, for large data transfers (for example, restoring data from tape). After the data is transferred, you can convert back to the RAID 5 CVT format.

> **Note:** For more information on RAID levels, see *The RAID Book: A Source Book for RAID Technology,* published by the RAID Advisory Board (Lino Lakes, Minnesota: September, 1994).

Disk Requirements

An Adaptec array is an array that was set up using Adaptec's RAID software. Adaptec's RAID software lets you create up to four bootable or nonbootable arrays of SCSI disks. The following sections describe the disk requirements of Adaptec arrays.

Number of Disks in an Array

The following table shows the number of SCSI disks allowed in each type of Adaptec array. The disks can be connected to different channels of the same RAID adapter; however, they *cannot* be on different RAID adapters.

RAID Level	Minimum No. of Disks	Maximum No. of Disks
RAID 0 (striped)	2	8
RAID 0 CVT	3	8
Mirrored:		
RAID 1	2	2
RAID 1/0[1]	4	16
RAID 5	3	8
RAID 5 CVT	3	8

[1] The number of drives in a RAID 1/0 array must be even.

In addition to the main disks, you can specify up to two spare disks (*spares*) for mirrored and RAID 5 arrays. (RAID 0 arrays do not have spares.) Spares are automatically activated when an array disk fails. A spare must have at least the capacity of the smallest disk in the array.

Mixing Disks from Different Manufacturers or with Different Capacities

An array can contain different models of SCSI disks, even disks with different capacities; for example, an array can include a Quantum 340 MByte disk and a Conner 540 MByte disk. If you mix disks with different capacities, however, the smallest disk determines the logical capacity of all other disks in the array (regardless of RAID level). If a RAID 0 array contains one 340 MByte disk and four 540 MBytes disks, for example, the capacity of the array is equivalent to about five 340 MByte disks. To avoid wasted disk capacity, therefore, use disks of similar size.

Mixing Disks on Different RAID Adapter Channels

An AHA-3980/3980W RAID adapter has two channels: A and B. An AHA-3985/3985W RAID adapter has three channels: A, B, and C. Each channel acts as an independent RAID adapter, implementing a separate SCSI bus. An array can consist of disks on different channels of the same RAID adapter; however, it *cannot* include disks from two or more RAID adapters installed in the server.

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Understanding the Adaptec RAID Software

You use Adaptec's RAID software to set up and manage up to four bootable or nonbootable arrays. The following RAID software is included with your AHA-398x adapter:

- Adaptec Initial Array Configuration Utility
- Administrator Utility
- Adaptec CI/O Software
- Copy Drivers Utility
- DOS and NetWare Device Drivers

This section gives an overview of each part of the software and explains where to look for more information.

Adaptec Initial Array Configuration Utility

Use the DOS-based Adaptec Initial Array Configuration Utility to create a bootable array, if you want to boot your server from an array. You can also use this utility to create other nonbootable arrays, delete arrays, view array information, replace a drive in an existing array, and reinitialize an array.

The Initial Array Configuration Utility is described in detail in Chapter 6, *Preparing a Boot Device and Installing Drivers.*

The Administrator Utility

The NetWare-based Administrator utility lets you create and manage arrays. You can use this utility to

- Create up to four nonbootable arrays (to create bootable arrays, you must use the Adaptec Initial Array Configuration Utility)

- Format arrays

- Add, modify, or delete arrays

- View array information

- Perform routine management tasks such as testing spare disks, verifying the integrity of arrays, regenerating data on replacement disks, and reactivating off-line arrays

See Part 3 for information about the Administrator utility and instructions on how to use it.

> **Note:** Depending on the task, the Administrator utility may call other utilities, such as the Format utility. This happens in the background, so you do not need to understand the other utilities. If you are curious about these utilities, however, see Appendix C, *Glossary of RAID Software*.

The Adaptec CI/O Software

Use Adaptec CI/O to monitor SCSI subsystems, including Adaptec arrays, from a remote workstation. Adaptec CI/O also lets you remotely access the Administrator utility, making all Administrator utility functions available at the remote workstation. For an overview of Adaptec CI/O capabilities, see Chapter 12, *Working from a Remote Workstation*. This chapter also explains how to set up the Adaptec RAID software for use with Adaptec CI/O.

AHA-398x RAID adapter kits include Adaptec CI/O (the single server version). If you purchased the RAID adapter separately, you can obtain Adaptec CI/O by calling the sales order line at the number listed on page ii.

The Copy Drivers Utility

Use the DOS-based Copy Drivers Utility to copy DOS and NetWare drivers from the AHA-3980/3985 Drivers and RAID Utilities diskette to the server's hard disk drive. The drivers are automatically copied to the appropriate directory. You may need to edit your *config.sys*, *autoexec.bat*, or *startup.ncf* files in order to load the drivers.

The Copy Drivers Utility is described in detail in *Copying Drivers* on page 6-8.

DOS and NetWare Device Drivers

You must use the Copy Drivers Utility to copy Adaptec device drivers for DOS and NetWare to your hard disk. The AHA-3980/3985 Drivers and RAID Utilities diskette includes files for NetWare 3.11, 3.12, and 4.xx. Also, DOS CD-ROM drivers are included so you can connect a SCSI CD-ROM drive to the AHA-398x host adapter and use it to load operating system software.

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Understanding the AHA-398x Adapter

Adaptec's AHA-398x adapter is a multichannel PCI-to-SCSI RAID adapter for disk arrays. As a host adapter, the AHA-398x provides the interface between your computer's PCI bus and your SCSI drives. As a RAID adapter, the AHA-398x lets you create and operate arrays of SCSI disks. The AHA-398x has special onboard features that speed many RAID read and write operations.

Multiple Independent Channels

Each AHA-3980/3980W adapter has two SCSI channels: A and B. Each AHA-3985/3985W adapter has three channels: A, B, and C. Each channel functions as an independent RAID adapter.

The AHA-3980 and AHA-3985 are 8-bit adapters. Each channel on these adapters supports up to seven 8-bit Fast SCSI devices. The AHA-3980W and AHA-3985W are 16-bit adapters. Each channel on these adapters supports up to 15 SCSI devices. All 15 devices can be 16-bit, or you can combine 8-bit and 16-bit devices. If you combine devices, a maximum of seven can be 8-bit devices.

The channels have the following connectors:

- Channel A: One internal and one external SCSI connector
- Channel B: One internal SCSI connector
- Channel C (AHA-3985/3985W only): One internal SCSI connector

Standard SCSI and SCSI-2 Features

AHA-398x adapters support all SCSI functions supported by Adaptec's other host adapters, including the following SCSI-2 features:

- Scatter/Gather: Allows high performance even in computers with fragmented memory buffers

- Disconnect/Reconnect: Maximizes SCSI bus usage in systems with multiple targets

- Tagged Command Queuing: Allows a SCSI device to return data in a different order than that requested by the adapter

In addition, AHA-398x adapters

- Provide continuous termination power to the SCSI bus

- Let you enable or disable SCSI termination for each separate AHA-398x channel

- Generate and check parity on the SCSI bus. Parity checking can be disabled if a device on the bus does not support it (see Chapter 13, *Configuring the Adapter with SCSISelect*).

Synchronous and Asynchronous Data Transfers

The AHA-398x allows both synchronous and asynchronous data transfers on a channel. The maximum transfer speeds are as follows:

- AHA-3980/3985 Synchronous: Up to 10.0 MBytes/sec per channel

- AHA-3980/3985 Asynchronous: Up to 3.0 MBytes/sec per channel

- AHA-3980W/3985W Synchronous: Up to 20.0 MBytes/sec per channel

- AHA-3980W/3985W Asynchronous: Up to 6.0 MBytes/sec per channel

By default, the AHA-398x negotiates for synchronous transfers with each device; you can disable synchronous negotiation for devices that accept only asynchronous transfers (see Chapter 13, *Configuring the Adapter with SCSISelect*). The AHA-398x always accepts negotiations for synchronous transfers initiated by a SCSI device.

The SCSI*Select* Configuration Utility

The AHA-398x includes the onboard SCSI*Select* configuration utility. SCSI*Select* allows you to change AHA-398x settings, such as channel termination and parity checking, without changing switches or jumpers on the board. SCSI*Select* also provides utilities for formatting SCSI disk devices and scanning them for defects. See Chapter 13, *Configuring the Adapter with SCSISelect.*

NetWare and DOS Support

The AHA-398x is intended primarily to support disk arrays on systems operating under NetWare 3.11, 3.12, or 4.xx. However, it also supports SCSI hard drives and CD-ROM drives operating under MS-DOS 5.0 or above. Limited disk array functionality is supported under DOS, including RAID 5 operation with a failed drive.[1] The DOS support also allows you to install NetWare from a CD-ROM drive attached to the AHA-398x. (The DOS-based NetWare installation program is usually distributed on CD-ROM.)

The AHA-398x package includes NetWare software drivers. It also includes drivers needed to operate CD-ROM drives under NetWare and DOS. The drivers are on a disk labeled *AHA-3980/3985 Drivers and RAID Utilities.*

Upgrading Your AHA-3980/3985 Adapter

If you own a previously purchased Adaptec AHA-3980 ⁄ 3985 RAID adapter with software version 1.01 or earlier, you can obtain a free upgrade kit from Adaptec to add bootable array support to your adapter. Contact Adaptec Technical Support for this BIOS and software upgrade kit. The kit includes instructions on how to install the upgrade.

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[1] Using arrays for long-term DOS or Windows operation is not recommended.

Supported SCSI Devices

AHA-398x RAID adapters support *single-ended* SCSI devices (to determine whether a device is single-ended, check the device documentation). AHA-3980 ⁄ 3985 adapters support 8-bit SCSI devices and AHA-3980W ⁄ 3985W adapters support both 8-bit and 16-bit SCSI devices. The following sections describe SCSI device support under NetWare and under MS-DOS.

Devices Supported under NetWare

The AHA-398x supports all SCSI devices supported by NetWare 386 3.11, 3.12, and 4.xx. This includes SCSI hard drives, tape drives, juke-boxes, and removable-media disk drives (for example, magneto-optical drives). Removable-media drives are treated as standard SCSI hard disk drives, with these exceptions:

- The AHA-398x recognizes and registers only media with 512 bytes ⁄ sector.

- You can mount, dismount, lock, and unlock the media. These options are supported by NetWare's *monitor.nlm* program. (See the NetWare documentation.)

- Do not use removable media devices in arrays.

To operate CD-ROM drives under NetWare, you must install *aspicd.dsk*, the CD-ROM driver for NetWare (see *Using a CD-ROM Drive under NetWare* on page 14-5). This driver enables the AHA-398x to support most popular CD-ROM drives.

Devices Supported under MS-DOS

Under MS-DOS 5.0 and above, the AHA-398x BIOS supports up to eight standard devices—for example, IDE or EIDE drives —and SCSI hard drives and arrays without the need for drivers, as long as the drives support Int 13h. (To verify that your drives support Int 13h, read your device documentation or check with your vendor.) The AHA-398x BIOS supports disk drives as large as 8 GBytes.

If you install *aspi8dos* and *aspicd.sys*, the AHA-398x also supports CD-ROM drives. For information on using *aspicd.sys*, see *Using a CD-ROM Drive under DOS* on page 14-1.

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Setting Up Arrays

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Installing the AHA-398x and the SCSI Drives

This chapter explains how to physically install an AHA-398x adapter in your computer and connect SCSI drives to it. The chapter takes you through each of the following steps:

- Installing the AHA-398x in a PCI slot in your computer

- Connecting the SCSI drives to the AHA-398x

- Terminating the SCSI bus

- Setting SCSI IDs and preparing a boot device

- Connecting the LED light that indicates activity on the AHA-398x

The chapter also describes special cases such as installing multiple AHA-398x adapters, combining the AHA-398x with ISA- or EISA-based host adapters, and sharing SCSI devices between two computers.

AHA-398x RAID adapters are configured to provide optimum performance for most systems. Read Chapter 13, *Configuring the Adapter with SCSISelect,* to learn about situations in which you may need to change the configuration. You can change the configuration after you install the AHA-398x and attach the SCSI devices.

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Print Spec Number: 493479-00
Current Date: 3/1/99   ECN Date: 3/19/96

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Installing the AHA-398x and the SCSI Drives

This chapter explains how to physically install an AHA-398x adapter in your computer and connect SCSI drives to it. The chapter takes you through each of the following steps:

- Installing the AHA-398x in a PCI slot in your computer

- Connecting the SCSI drives to the AHA-398x

- Terminating the SCSI bus

- Setting SCSI IDs and preparing a boot device

- Connecting the LED light that indicates activity on the AHA-398x

The chapter also describes special cases such as installing multiple AHA-398x adapters, combining the AHA-398x with ISA- or EISA-based host adapters, and sharing SCSI devices between two computers.

AHA-398x RAID adapters are configured to provide optimum performance for most systems. Read Chapter 13, *Configuring the Adapter with SCSISelect,* to learn about situations in which you may need to change the configuration. You can change the configuration after you install the AHA-398x and attach the SCSI devices.

AHA-398x Layout

Figures 5-1 and 5-2 (and the tables following each figure) identify the major AHA-398x components. You may find it helpful to refer to this information while installing the adapter and attaching the SCSI devices.
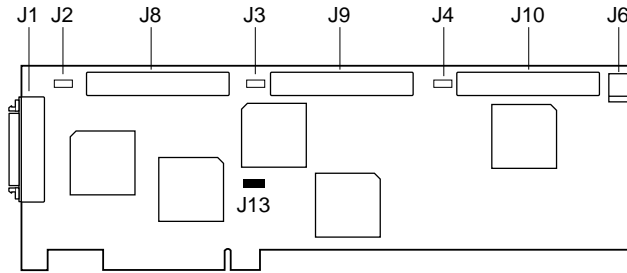
Figure 5-1. AHA-3980/3985 Board Layout

Location	Description
J1	External 50-pin high-density SCSI connector - Channel A
J2	Multiple computer termination jumper - Channel A[1]
J3	Multiple computer termination jumper - Channel B[1]
J4	(AHA-3985 only) Multiple computer termination jumper - Channel C[1]
J6	LED connector
J8	Internal 50-pin SCSI connector - Channel A
J9	Internal 50-pin SCSI connector - Channel B
J10	(AHA-3985 only) Internal 50-pin SCSI connector - Channel C
J13	PCI interrupt jumper

[1] See *Sharing SCSI Devices with a Second Computer* on page 5-18.

Figure 5-2. AHA-3980W/3985W Board Layout

Location	Description
J2	Multiple computer termination jumper - Channel A[1]
J3	LED connector
J4	Internal 68-pin high-density SCSI connector - Channel A
J5	Multiple computer termination jumper - Channel B[1]
J6	Internal 68-pin high-density SCSI connector - Channel B
J7	(AHA-3985W only) Multiple computer termination jumper - Channel C[1]
J8	(AHA-3985W only) Internal 68-pin high-density SCSI connector - Channel C
J10	PCI interrupt jumper
J12	External SCSI connector - Channel A

[1] See *Sharing SCSI Devices with a Second Computer* on page 5-18.

Installing the AHA-398x in a PCI Slot

Follow the steps in this section to install the AHA-398x in your computer. *Be sure your computer meets the minimum hardware and software requirements before you begin installation* (see *System Requirements* on page 1-2).

⚡ **WARNING:** Be sure the power is turned OFF and the computer is unplugged before you continue.

1 Remove the cover from the computer case.

2 Locate an unused, unobstructed 5-volt PCI bus slot that supports bus mastering. PCI bus slots are typically white or ivory and are shorter than ISA or EISA slots. Usually, there are three PCI slots. One of these may be a *shared slot*—that is, it may have both an ISA connector and a PCI connector—but only one kind of board can be inserted in the slot at any one time.

> **Caution:** Some slots may be blocked by the host processor. *Do not force* the AHA-398x into a slot. Many motherboards only allow one full-length slot. If this slot is already occupied, move the short card to another slot.

3 Remove the metal bracket that covers the slot opening in the computer case. Keep the screw that held the metal bracket in place; you will need it later.

> **Caution:** Before proceeding with the next step, ground yourself by touching an unpainted surface on the computer chassis. Otherwise, you may damage the AHA-398x.

4 Carefully remove the AHA-398x from its package.

> **Note:** If you need to use PCI interrupts B, C, and D, remove the PCI interrupt jumper (for the jumper location, see the diagrams on pages 5-2 and 5-3). We recommend that you leave the jumper in place if your computer supports only PCI interrupts A and B. (This is the default for most PCI computers.)

5 Position the AHA-398x directly over the PCI slot. If your computer has a card guide to align the AHA-398x, be sure to insert the end of the adapter in the card guide.

6   Carefully press the connector on the bottom of the AHA-398x into the slot, as shown in Figure 5-3, until the metal contacts on the bottom of the AHA-398x are securely seated in the slot.
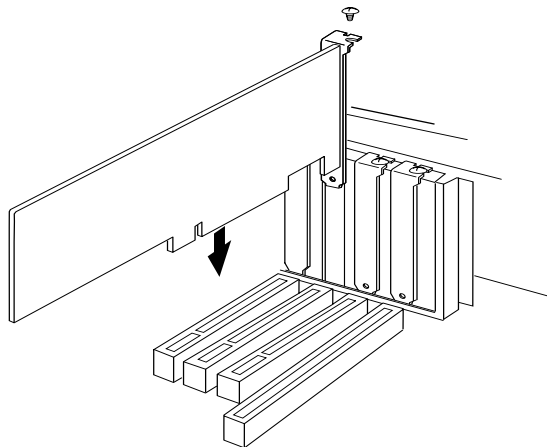
Figure 5-3. Inserting the AHA-398x

7   Attach the AHA-398x bracket to the computer chassis with the screw from the expansion slot cover that you removed.

Note: *Do not* put the computer cover back on or reconnect the power yet!

Connecting SCSI Devices

SCSI devices are connected by cables in one continuous line called the *SCSI bus.* Each channel on the adapter implements a separate SCSI bus. You can attach internal SCSI devices to Channel A, B, or C. You can only attach external devices to Channel A, because it is the only channel with an external SCSI connector.

Each channel on an AHA-3980 or AHA-3985 supports up to seven 8-bit SCSI devices. For example, if you attach two SCSI devices to the internal connector of Channel A, you can attach up to five devices to the external connector—a total of seven devices on the channel. On an AHA-3980W or AHA-3985W, each channel supports up to 15 SCSI devices—either 16-bit devices alone or a combination of 16-bit and up to seven 8-bit devices.

5-5

This section explains how to connect both internal and external SCSI devices to the channel connectors. When you attach the SCSI devices, remember the following constraints:

■ If you combine 8-bit and 16-bit devices on an external AHA-3980W or AHA-3985W channel, you must attach the 8-bit devices *after* the 16-bit devices; once you use a 68-to-50-pin converter to step down to an 8-bit device, you cannot step back up to a 16-bit device because the high bits are terminated. (You can order a 68-to-50-pin converter from Adaptec by calling the phone number listed on page ii.)

■ If you combine 8-bit and 16-bit devices on an internal AHA-3980W or AHA-3985W channel, you must attach the 8-bit devices before the 16-bit devices.

■ On each channel, the total length of cabling (internal and external) should not exceed

– three meters (9.8 feet) if you use 8-bit or 16-bit Fast SCSI data transfer rates, such as the default rate

– six meters (19.7 feet) if you use 5 MByte/sec asynchronous or synchronous data transfer rates

■ If you plan to boot the computer from a stand-alone SCSI drive, connect the drive to Channel A of the adapter. If you plan to boot the computer from an array, connect at least one of the drives for this array to Channel A.

Caution: AHA-398x RAID adapters support only *single-ended* SCSI devices. *Differential* SCSI devices may be damaged if you connect them to the AHA-398x bus. Read your SCSI device documentation to determine whether a device is single-ended or differential.

Choosing SCSI Cables

Always use high-quality SCSI cables to connect the AHA-398x to devices on the SCSI bus. Poor-quality cables can cause data corruption, parity errors, and other problems. High-quality cabling is especially critical if you use Fast SCSI data transfer rates.

The cables used for external SCSI devices vary widely in quality and electrical characteristics. Use external SCSI cables that

- Meet SCSI-2 standards (your cable vendor can tell you this)

- Have a single-ended impedance range of 80-110 ohms

Adaptec sells high-quality internal and external SCSI-2 cables, which you can purchase by calling Adaptec at the number listed on page ii.

Connecting Internal SCSI Devices

Use the SCSI ribbon cables included with the AHA-398x kit to connect internal devices to the adapter. Each AHA-398x ribbon cable has several connectors, including connectors at each end of the cable. The connector at one end is attached to a passthrough terminator (for information on termination, see *Terminating the SCSI Bus* on page 5-12). You can attach this connector to a SCSI device, even with the terminator in place.

Note: If you need more cables, you can purchase them from Adaptec by calling the number listed on page ii.

Follow these steps to connect internal SCSI devices to the internal connectors on the AHA-398x:

1 If you need to physically install the SCSI device inside your computer before attaching the cables, follow the installation instructions in the device documentation.

2   Plug the SCSI connector at one end of the ribbon cable (the end without the passthrough terminator) into one of the AHA-398x's internal SCSI connectors, as shown in Figure 5-4.
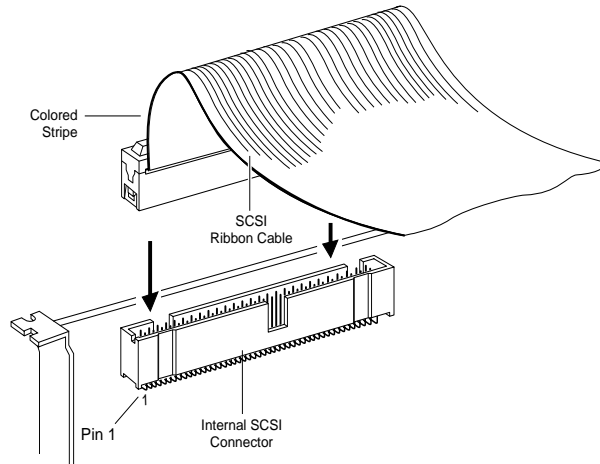
Figure 5-4. Internal SCSI Ribbon Cable to AHA-398x

The colored stripe on one side of the ribbon cable must match up with the number 1 printed on the AHA-398x beneath the connector. This is called maintaining proper *pin-1 orientation*.

3   Plug a SCSI connector on the internal cable to the SCSI connector on the first SCSI device, as shown in Figure 5-5. Match pin 1 on the ribbon cable to pin 1 on the connector. (Pin 1 is usually marked by a triangle or a 1.)
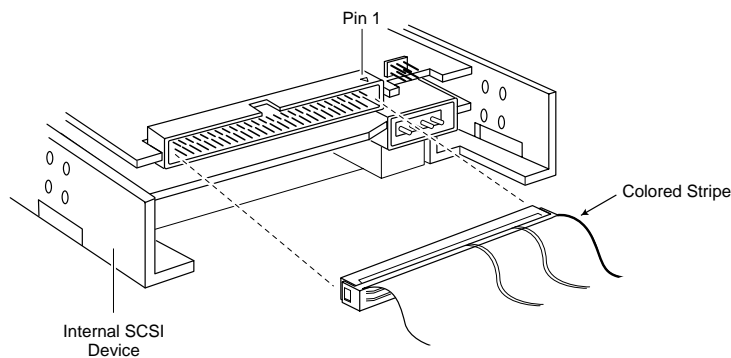
Figure 5-5. Internal SCSI Ribbon Cable to Internal SCSI Device

4   To connect other internal SCSI devices, plug the devices into the other connectors on the ribbon cable, as shown in Figure 5-6.
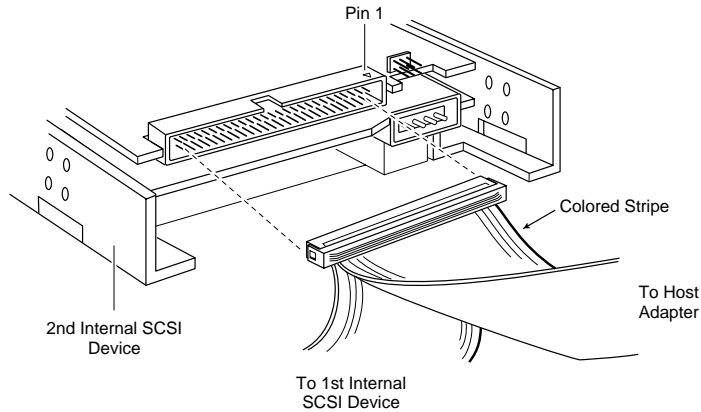
Figure 5-6. Connecting a Second Internal SCSI Device

5   Disable SCSI termination on all internal devices. If the internal cable does not have a passthrough terminator, terminate the last SCSI device on the cable. (See *Terminating the SCSI Bus* on page 5-12.)

Connecting External SCSI Devices

The AHA-398x external connector is on Channel A, which also has an internal connector. With the AHA-3980 and AHA-3985 host adapters, you can connect to a total of seven 8-bit SCSI devices to the Channel A connectors. With the AHA-3980W and AHA-3985W adapters, you can connect a total of fifteen 8-bit and 16-bit devices.

Follow these steps to connect external SCSI devices to Channel A:

1 Attach one connector of the external SCSI cable to the external SCSI connector, as shown in Figure 5-7. External cable connectors can be plugged in only one way; pin-1 orientation is automatic.

> ⚠ **Caution:** The external SCSI cables must meet the guidelines listed on page 5-7.

External SCSI Connector

External SCSI Cable
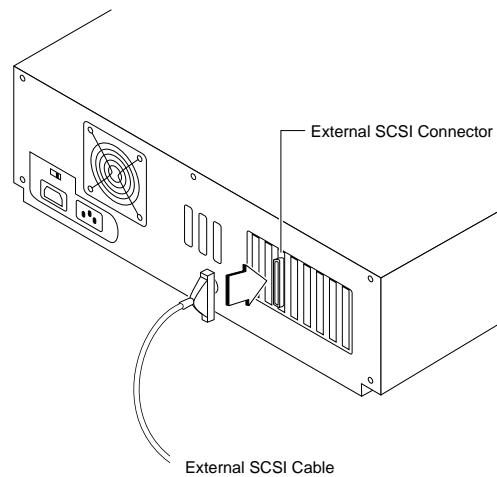
Figure 5-7. External Cable to AHA-398x

2 Attach the connector at the other end of the external cable to either one of the SCSI connectors on the external SCSI device, as shown in Figure 5-**8**.

External
SCSI Cable

External SCSI Device
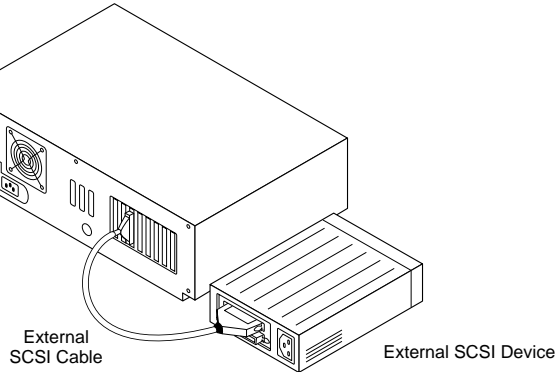
Figure 5-8. External Cable to External SCSI Device

3 To connect other external SCSI devices, daisy chain each device to the previous device until all external SCSI devices have been connected, as shown in Figure 5-9.

External
SCSI Cables
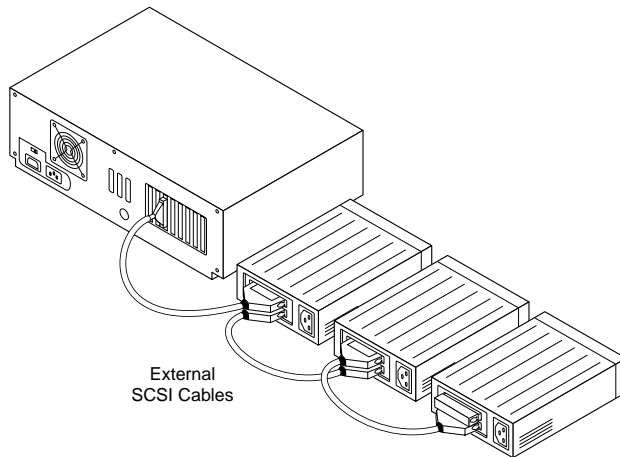
Figure 5-9. Daisy Chaining External SCSI Devices

⚠ **Caution:** Be careful not to exceed the SCSI bus cable length limitations. (The total bus length includes any cabling inside the case of external devices.)

Note: The computer in which the AHA-398x is installed can share external SCSI devices with another computer. For more information, see *Sharing SCSI Devices with a Second Computer* on page 5-18.

Terminating the SCSI Bus

SCSI bus terminators must be either installed in, or enabled on, the first and last SCSI devices on each AHA-398x channel; otherwise, the devices will not operate properly. Terminators on all other devices must be removed or disabled.

AHA-398x termination is *enabled* by default on all adapter channels. At the other end of the SCSI bus, termination is usually provided by the passthrough terminator (for the internal channels) or an external SCSI device (if devices are attached to the external connector of Channel A).

The following sections describe termination for each of the channels. In reading the instructions, note that termination on most SCSI disk drives, CD-ROM drives, and other SCSI devices is controlled by a jumper or switch close to the SCSI connector. Some SCSI devices have a resistor module that you insert or remove to control termination. See your device documentation for details.

Note: Some SCSI disk drives allow their terminators to receive termination power from the SCSI bus instead of from the drive's power supply. AHA-398x RAID adapters support this option, because they always supply termination power on the SCSI bus.

Terminating Channels B and C

Follow these steps to terminate the end devices on Channel B or C (see Figure 5-10):

1 Leave the AHA-398x channel termination enabled (the default).

2 Leave the passthrough terminator in place to terminate the other end of the channel. (If you do not use the passthrough terminator, you must install a terminator, or enable termination, on the last SCSI device attached to the channel.)

> ⚠ **Caution:** The passthrough terminator for the internal SCSI channels helps ensure that termination is maintained constantly, which is important for disk arrays. Without the passthrough terminator, an internal SCSI device must provide termination. If that device is removed because of failure, the bus is no longer terminated and the array may be compromised. We strongly recommend using the terminator.

3 Remove the terminator, or disable termination, on all other SCSI devices on the channel.
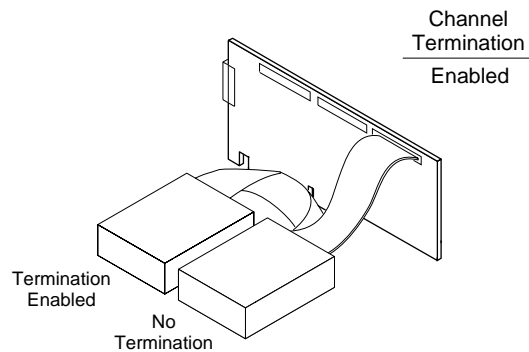
Figure 5-10. Termination on SCSI Channel B or C

Terminating Channel A

The procedure for terminating Channel A depends on whether you use one or both of the Channel A connectors. If you use only one of the connectors (that is, the internal *or* the external connector, but not both), the termination procedure is the same as that just described for Channels B and C.

If you attach SCSI devices to both Channel A connectors, the steps for terminating the channel are as follows (see Figure 5-11):

1 Leave the passthrough terminator in place to provide termination at the internal end of the bus.

2 Install a terminator, or enable termination, on the last SCSI device attached to the *external* channel connector.

3 Disable AHA-398x termination for Channel A, following the instructions in *Changing the AHA-398x Settings* on page 13-7.

4 Remove the terminators, or disable termination, on all other SCSI devices attached to the internal and external connectors.
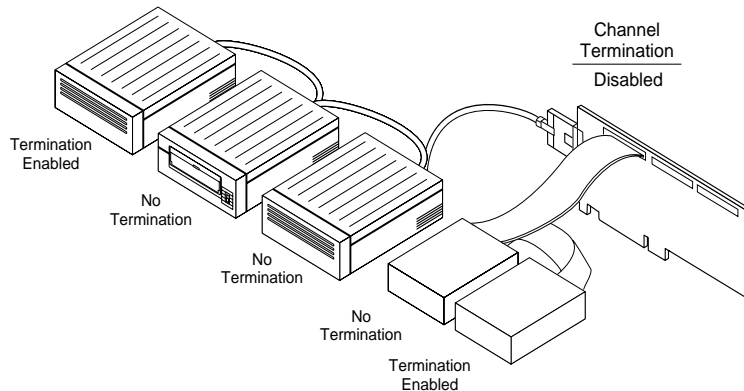
Figure 5-11. Internal and External Devices on SCSI Channel A

Setting SCSI IDs and Preparing a Boot Device

Each device on the SCSI bus, including the AHA-398x, must have a unique SCSI ID. SCSI IDs uniquely define each SCSI device on the bus and determine which device has priority when two or more devices try to use the SCSI bus at the same time.

SCSI IDs on one channel do not interfere with IDs on another channel. IDs on one AHA-398x (or channel) do not interfere with those on other installed adapters (or channels), as long as the adapters (or channels) implement different SCSI buses.

Allowable SCSI IDs are 0 through 7 for devices on the AHA-3980∕3985. ID 7 has the highest priority, and ID 0 has the lowest. On the AHA-3980W∕3985W, allowable IDs are 0 through 15. The priority of the remaining IDs, in descending order, is 6 to 0, then 15 to 8.

Setting SCSI IDs is a three-step process:

1 Determine which ID each device on the SCSI bus already has.

The default ID for Channels A, B, and C on the AHA-398x is ID 7. To determine the IDs of disk drives and other SCSI devices, read their documentation and examine their switch or jumper settings.

2 Change the IDs (if needed) so that no two devices on the same SCSI channel have the same ID. (Leave the channel IDs at the default of SCSI ID 7.)

If a second AHA-398x or a different SCSI host adapter shares the same SCSI bus, make sure its ID is not also 7. If necessary, change either the channel ID or the adapter ID to 6. (See *Host Adapter (Channel) SCSI ID* on page 13-2.)

3 If you plan to boot the computer from an array connected to the AHA-398x adapter, assign SCSI ID 0 to one of the drives you will use for that array and connect it to channel A. If you plan to boot the computer from a stand-alone SCSI drive, assign SCSI ID 0 to that drive. (See Chapter 6, *Preparing a Boot Device and Installing Drivers*, for more information.)

If you are installing *two or more* AHA-398x adapters, be sure the boot drive or array is connected to the adapter that is scanned first. See *Installing Multiple Adapters* on page 5-17 for more information.

Connecting the SCSI Bus Activity Light

An LED light on the front panel of most computers indicates activity on the disk. If you disconnect the cable from the motherboard and attach it to the LED connector on the AHA-398x, the LED will light whenever there is activity on any of the SCSI channels.

> **Note:** You may not want to change the connection if your computer system includes non-SCSI disk drives, because the LED will no longer light when these drives are active.

Follow these steps to connect the LED cable to the AHA-398x:

1 Refer to your computer's documentation to locate the LED cable, and unplug it from the connector on the system board.

2 Connect the LED cable to the SCSI activity LED connector on the AHA-398x, as shown in Figure 5-12.
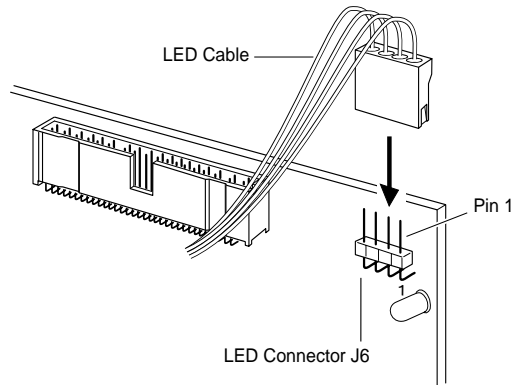
Figure 5-12. SCSI LED Connector

If the computer has a two-position LED cable, connect it to pins 1 and 2 of the LED connector (pin 1 is the pin nearest the edge of the board, as shown in Figure 5-12).

Installing Multiple Adapters

You can install multiple AHA-398x RAID adapters in the same computer. You can also install an AHA-398x in computers that have other PCI-, ISA-, or EISA-based host adapters. However, keep the following considerations in mind:

- All drives in an array must be connected to the same host adapter. A single array cannot include drives from two or more host adapters.

- If you are booting from a SCSI disk drive or array, it must be connected to the adapter that the computer scans first. Usually, you need to determine by experimentation which PCI slot the computer scans first and then make sure the adapter with the boot device is installed in that slot. Some computers boot from the device with the lowest PCI device number; others boot from the device with the highest number. If the system does not boot from the host adapter you want, move that host adapter to a different PCI slot and try again. Alternatively, you can disable the BIOS on host adapters that are scanned before the desired boot host adapter.

- In systems with EISA- and ISA-based host adapters, the boot host adapter must have the lowest BIOS base address. The system BIOS automatically controls the AHA-398x base address (the user has no control over the assigned address).

Sharing SCSI Devices with a Second Computer

The AHA-398x adapter and an Adaptec host adapter in a second computer can share the same SCSI devices without constantly changing the cable configuration. In this arrangement, one of the two computers can be powered at any one time, and that computer can then access the devices. The host adapter in the unpowered computer acts as a terminator at one end of the SCSI bus.

> **Note:** The Adaptec host adapter in the second computer need not be an AHA-398x, but it must be capable of active termination when it is not powered. Most Adaptec host adapters have this capability. Read the host adapter documentation if you are not sure.

To allow computers to share SCSI devices, follow these steps:

1 On the AHA-398x, install a jumper shunt on one or more of the following jumpers, depending on the channel to be shared (Figure 5-1 on page 5-2 and Figure 5-2 and on page 5-3 show the jumper locations):

To connect a second host adapter in another computer to the Channel A bus:
> **J2** for all AHA-398x adapters

To connect a second host adapter in another computer to the Channel B bus:
> **J3** for AHA-3980 ⁄ 3985; **J5** for AHA-3980W ⁄ 3985W

To connect a second host adapter in another computer to the Channel C bus:
> **J4** for AHA-3985; **J7** for AHA-3985W

2 Install the AHA-398x as described in *Installing the AHA-398x in a PCI Slot* on page 5-3.

3   Connect the AHA-398x channel, the SCSI devices, and the host adapter in the second computer as shown in Figure 5-13.
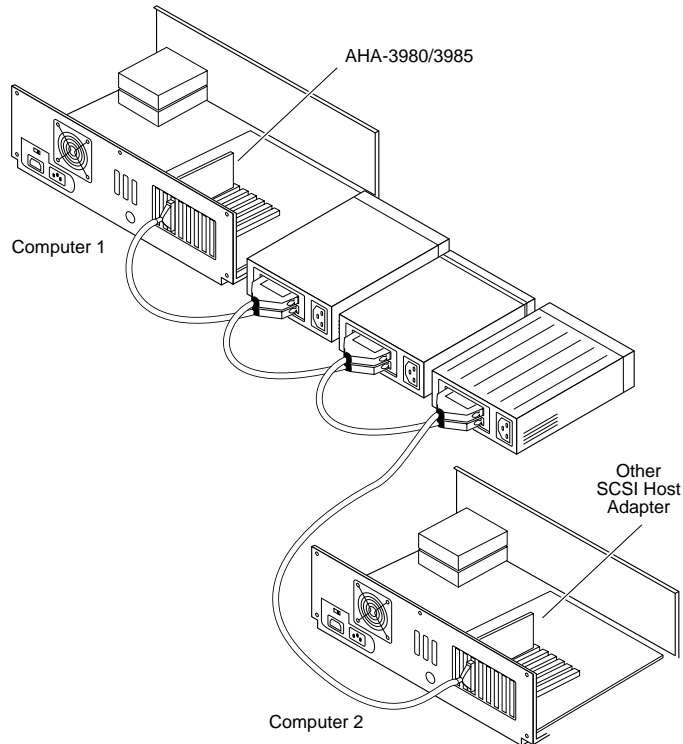
Figure 5-13. SCSI Devices Shared by Two Computers

4   Assign different SCSI IDs to the AHA-398x channel and the host adapter in the second computer (see *Host Adapter (Channel) SCSI ID* on page 13-2). IDs 6 and 7 are preferable, since they have highest priority on the SCSI bus.

5   If necessary, change the IDs of the shared SCSI devices so no devices have the same ID (see *Setting SCSI IDs and Preparing a Boot Device* on page 5-15).

5-19

Completing AHA-398x Installation

To complete installation of the AHA-398x RAID adapter, follow
these steps:

1   Replace and secure the cover of the computer case.

2   Reconnect the power cords to all external SCSI devices and the
computer.

3   Turn ON the power to all external SCSI devices. (You *must* turn
on the SCSI devices before you turn on the computer.)

4   Turn ON the computer.

As the computer boots, look for an onscreen message from the
AHA-398x BIOS (see Figure 5-14). If it does not appear, your system
did not recognize the AHA-398x. Turn OFF the computer, make sure
the AHA-398x is properly seated in the PCI slot, and then turn ON
the computer again. If the AHA-398x BIOS message still does not
appear, your system probably does not support PCI-to-PCI bridges.
For additional information, read the troubleshooting information in
the *3980note.txt* file on the AHA-3980/3985 Drivers and RAID Utili-
ties diskette included with the AHA-398x.

```
Adaptec AHA-3980/3985 BIOS v1.50
(c) 1995 Adaptec, Inc. All Rights Reserved


◄ ◄ ◄      Press <Ctrl> <A> for SCSISelect (TM) Utility!   ► ► ►

AIC-7870/Sequencer Diagnostics Passed

[List of SCSI Devices]
         .
         .
         .

BIOS Installed Successfully!
```
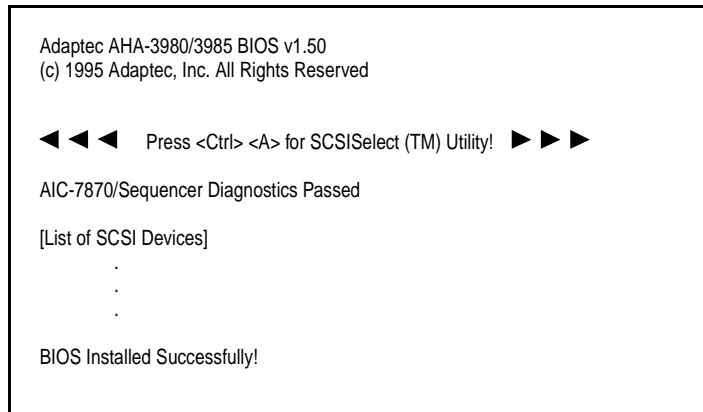
Figure 5-14. AHA-398x BIOS Message

▾▾▾▾6

Preparing a Boot Device and Installing Drivers

This chapter explains how to prepare a boot device connected to your AHA-398x adapter and how to install the DOS and NetWare drivers you will need to load software and to use arrays.

The boot device can be an array or a stand-alone disk drive. We recommend that you boot your computer from an array, because you can take advantage of the data redundancy provided by most levels of RAID. (See Chapter 2, *Array Basics*, to learn about the features of different RAID levels.) If you boot from a stand-alone disk drive, you can use a SCSI drive connected to the AHA-398x adapter or a non-SCSI drive (usually an IDE or EIDE drive).

If a non-SCSI drive is installed in your computer, the computer will always attempt to boot from that drive and will never boot from a SCSI drive or array.

Getting Ready to Prepare a Boot Device

Follow these steps, regardless of whether you plan to boot from an array or from a stand-alone disk drive. We assume here that MS-DOS and NetWare are *not* already installed on the computer with the AHA-398x adapter. You will need to have access to a second computer.

1   Complete the hardware installation steps in Chapter 5.

2   Be sure the intended boot drive—or at least one drive that will be in the boot array—is connected to Channel A of the AHA-398x.

If your computer has two or more PCI adapters, the boot device must be connected to the adapter in the PCI slot that is scanned first. See page 5-17 for more information.

3 Be sure the boot drive (or a drive that will be part of the boot array) has been assigned SCSI ID 0 on channel A.

4 Obtain a licensed copy of MS-DOS, and boot the computer from Disk 1 - the *Setup* disk.

5 Press **F3** twice to exit from the MS-DOS Setup program, then remove the MS-DOS disk from the disk drive.

Do not turn the computer off.

6 Go to a computer on which DOS 5.0 or above (preferably DOS 6.0 or above) is already installed, type format a: /s at the DOS prompt, and press **Enter**.

7 Insert a blank floppy diskette in the *A* drive of this computer and press **Enter** again. This command makes the diskette bootable.

8 When the formatting is completed, copy the *fdisk.exe* and *format.com* files from the computer's DOS directory to the newly formatted floppy diskette.

9 Copy the files on the Adaptec Initial Array Configuration Utility diskette to the newly formatted diskette that has the *fdisk.exe* and *format.com* files.

Put the original Adaptec Initial Array Configuration Utility diskette in a safe place.

10 Remove the new diskette from the disk drive of the second computer.

If you plan to boot from an *array,* continue with the next section, *Creating an Array with the Initial Array Configuration Utility*.

If you plan to boot from a *stand-alone disk drive,* skip to *Formatting and Partitioning the Array or Drive* on page 6-7.

Creating an Array with the Initial Array Configuration Utility

You can also create arrays with the Administrator Utility described in Part 3 of this document. However, if you want to install NetWare on the array, you must create it with the Initial Array Configuration Utility. This section describes only the Initial Array Configuration Utility options that are required to create an array. For information about other options, see *Other Initial Array Configuration Utility Options* on page 6-14.

1   Insert the new diskette in drive *A* of the computer with the AHA-398x adapter.

2   Type a:arconfig at the DOS prompt and press **Enter** to start the Initial Array Configuration Utility.

If only one AHA-398x RAID adapter is installed, the Main Menu shown in Figure 6-15 appears. If there are two or more AHA-398x adapters, an intermediate menu appears from which you select the adapter for which you want to create the array.

```
┌──────── Adaptec Initial Array Configuration Utility ────────┐
│                                                             │
│                                                             │
│              ┌──────── Array Menu ────────┐                 │
│              │                            │                 │
│              │  Display Arrays            │                 │
│              │  Add New Array             │                 │
│              │  Delete Array              │                 │
│              │  Replace Array Drive       │                 │
│              │  Initialize Array          │                 │
│              │                            │                 │
│              └────────────────────────────┘                 │
│                                                             │
│                                                             │
└─────────────────────────────────────────────────────────────┘
```
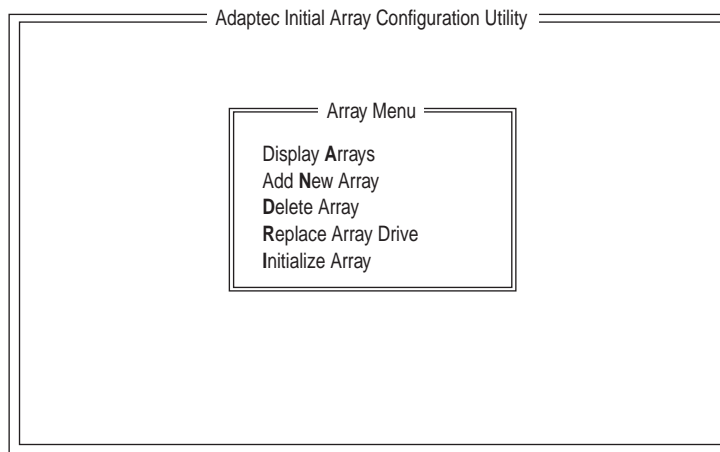
Figure 6-15. Initial Array Configuration Utility Main Menu

3   When the main menu appears, select **Add <u>N</u>ew Array**. The Select Array Menu appears.

To select Initial Array Configuration Utility menu options, type the *hot key*—the letter in the option that appears in a dif-

ferent color. You can also press the ↑ and ↓ keys until the option is highlighted and then press **Enter**. If you have a monochrome monitor and the highlight bar is not visible, press **Ctrl-B** to change to monochrome mode.

4   Press **Enter** to define Array #1 (assuming that you have not yet defined any other arrays).

The Select Array Type menu appears on the left of the screen, as shown in Figure 6-16.

```
┌─────────── Adaptec Initial Array Configuration Utility ───────────┐
│                                                                   │
│   ┌─ Select Array Type ─┐        ┌─ Select Array ─┐               │
│   │  RAID0              │        │   Array #1     │               │
│   │  Mirrored          │        │   Array #2     │               │
│   │  RAID5             │        │   Array #3     │               │
│   │                    │        │   Array #4     │               │
│   └────────────────────┘        └────────────────┘               │
│                                                                   │
│      ┌────────────────────────┐                                  │
│      │  Up/Dn: MoveUp/Down     │                                  │
│      │  Enter: Select Array    │                                  │
│      │  Esc:   Previous Menu   │                                  │
│      └────────────────────────┘                                  │
│                                                                   │
└───────────────────────────────────────────────────────────────────┘
```
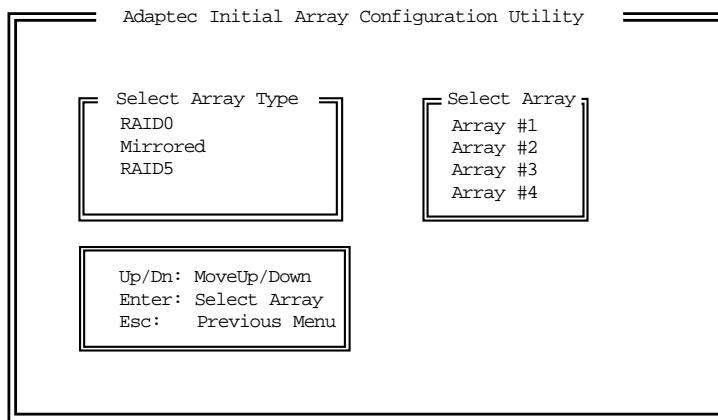
Figure 6-16. Selecting an Array and an Array Type

5   Select an array type for the new array. (See Chapter 2, *Array Basics*, for an explanation of the various RAID levels and array types.)

If you select **RAID 5** or **RAID 0**, a screen appears asking you if you want to make the array convertible between RAID 5 and RAID 0. Read the onscreen explanation and select **y** or **n**.

6   When a prompt appears asking how many drives the array will contain, type the number of drives (excluding spares) and press **Enter**.

The screen lists the number of drives available for assignment on all the channels of this adapter. It also lists the maximum and minimum number of drives allowed for each kind of array.

> **Note:** A *spare* is a disk drive associated with an array that will be used automatically as a replacement if one of the active drives in the array fails.

7 When the next screen appears, as shown in Figure 6-17, press **Tab** to highlight a channel. When the drives on the highlighted channel appear in the **SCSI IDs on Channel** menu, select the drives for the array. (Press the ↑ and ↓ keys until the drive name is highlighted, then press **Ins** or **Enter**.) The names of selected drives appear to the right, in the Adaptec Array # box.

```
┌══════════════ Adaptec Initial Array Configuration Utility ══════════════┐
│                                                                         │
│   ┌═ AHA-3980 ═┐   ┌═══ SCSI IDs on Channel ═══┐   ┌═══ Array #1 ═══┐   │
│   │   Bus #1   │   │ #0  QUANTUM  LPS34   335MB │   │                │   │
│   │ Channel A  │   │ #1  CONNER   CFA540  537MB │   │ Type=Mirrored  │   │
│   │ Channel B  │   │ #2  CONNER   CFA540  537MB │   │  Drive Channel ID │ │
│   │            │   │ #3  CONNER   CFA540  537MB │   │                │   │
│   └────────────┘   └────────────────────────────┘   └────────────────┘   │
│                                                                         │
│       ┌───────────────────────────────────┐                             │
│       │ Tab = Select channel              │                             │
│       │ Up/Dn Arrow = Select drive        │                             │
│       │ Ins = Install drive               │                             │
│       │ Del = Deselect drive              │                             │
│       └───────────────────────────────────┘                             │
└─────────────────────────────────────────────────────────────────────────┘
```
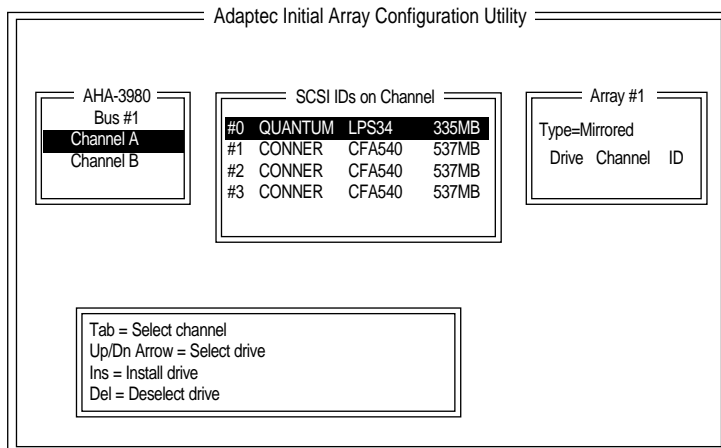
Figure 6-17. Selecting Drives for an Array

To select drives on a different host adapter channel, press **Tab** to select another channel and then select the drives from the **SCSI IDs on Channel** menu. To deselect the drive you most recently added, press **Del**.

When you have selected the number of drives you specified in step 6, the next screen appears automatically.

8 If the array is mirrored or RAID 5 *and* there are still one or more unassigned drives, a prompt appears asking whether you want to define spare drives for the array.

> **Note:** A spare must have at least the capacity of the smallest drive in the array.

If you do not want a spare: Type n and continue with step 9.

To select a spare: Follow these steps:

a At the prompt, type y.

b If more than one drive is available, a second prompt appears, asking how many spares the array will have. Type 1 or 2 and press **Enter**.

c To select each spare, follow the directions in step 7.

9 When the Select Format Mode menu appears, select **Initialize Array to <u>Z</u>ero**, the recommended mode.

Select **<u>L</u>ow-Level Format** only if the drives were previously formatted on another system or if you think they may have surface defects. Low-level formatting can take a long time for large disk drives. (See *Initializing an Array* on page 6-16 for more information.)

> **Caution:** If the drives contain data, all the data will be lost when you initialize or format the array.

10 When the menu of block sizes appears, select a block size. (This menu does not appear if the array is a mirrored array with only two drives). The recommended size is 16 KBytes.

11 Confirm that you want to format the array by typing y at the prompt. You will see percentage complete information on the screen as the array is formatted.

> **Note:** You cannot cancel an **Initialize Array to <u>Z</u>ero** or low-level format once it has started.

12 When you see the message Initialization of Array #*N* is complete, press any key to return to the Main Menu.

13   Press **Esc** and, with the newly-created diskette still in the drive, reboot the computer when you see the prompt.

Formatting and Partitioning the Array or Drive

Follow these steps regardless of whether you are creating a boot drive or a boot array.

1   Insert the diskette onto which you copied the Initial Array Configuration Utility into the A drive of the computer with the AHA-398x adapter. Then reboot the computer. (This has already been done if you just created an array.)

2   When the DOS prompt appears, type a:fdisk and press **Enter**. The FDISK Options menu appears. Above the list of options is the message Current fixed disk drive: 1.

3   If you are sure the disk drive noted in the message is the one you want to partition, continue with the next step. Otherwise, select **Change current fixed disk drive** (this option does not appear if *fdisk* found only one drive); from the list of drives that appears, select the drive you want to partition.

4   Select **Create DOS partition or Logical DOS Drive**.

5   Select **Create Primary Partition**.

6   When prompted whether you want the maximum partition size, type n (no).

7   When prompted, enter a partition size of about 20 MBytes. This will allow sufficient space for all DOS files, leaving the rest of the array (or disk) for a NetWare partition.

8   Press **Esc** until the FDISK Options menu reappears.

9   Select **Set active partition**, then follow any prompts that appear.

10   When finished, exit *fdisk* by pressing **Esc**. (Be sure the diskette is still in the drive.) The system reboots.

11   Type a:format c: /s and press **Enter**. This formats the array (or disk) and makes it bootable.

12   When the formatting operation is complete, remove the diskette from the drive and reboot the system. It will now boot from the hard drive or array.

At this point you have installed enough DOS to enable you to install NetWare. If you want to *fully* install DOS, complete these steps:

1 Remove the copied Initial Array Configuration Utility diskette from the drive and insert Disk 1 of the licensed copy of DOS.

2 Reboot the computer.

3 Proceed with the DOS Setup program. Ignore the message about DOS already being installed. When you are finished, the full version of DOS will be installed on the DOS partition you created earlier.

Copying Drivers

The AHA-398x includes a diskette with drivers for NetWare 3.11, 3.12, and 4.xx. DOS CD-ROM drivers are included so you can install NetWare from a CD-ROM drive. Follow these steps to copy the drivers to your hard disk drive or array:

1 Insert the AHA-3980/3985 Drivers and RAID Utilities diskette in the *A* drive.

2 At the DOS prompt, type a:install, and press **Enter**.

3 When the Adaptec Array Driver Copy Utility menu appears, as shown in Figure 6-18, select one of the NetWare options, depending on which version of NetWare you are installing on the computer.
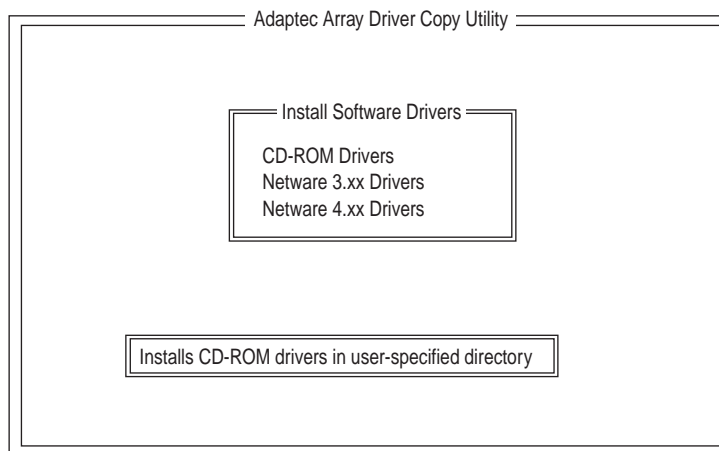
```
═══════ Adaptec Array Driver Copy Utility ═══════

            ══════ Install Software Drivers ══════

            CD-ROM Drivers
            Netware 3.xx Drivers
            Netware 4.xx Drivers


        ┌─────────────────────────────────────────────┐
        │ Installs CD-ROM drivers in user-specified directory │
        └─────────────────────────────────────────────┘
```

Figure 6-18. The Install Software Drivers Menu

4   When you are prompted, press **Enter** to accept the suggested default directory where the NetWare drivers will be copied. This will be either *\server.312* or *\nwserver*.

5   If a CD-ROM drive is connected to the AHA-398x and you will use it to install NetWare from a CD disc, return to the Main Menu and select **CD-ROM drivers**. Otherwise, skip to step 7.

6   When you are prompted, press **Enter** to accept the suggested default directory (*\scsi*) where the CD-ROM drivers will be copied. (See Chapter 14, *Using a CD-ROM Drive*, to learn more about using a CD-ROM drive under DOS and Windows.)

7   When the drivers have been copied, press **Esc** to exit from the Adaptec Array Driver Copy Utility.

8   Copy the *config.sys* and *autoexec.bat* files from the *\dos* directory of the AHA-3980∕3985 Drivers and RAID Utilities diskette to the root directory of your new boot array or boot drive.

   If the drive already has *config.sys* and *autoexec.bat* files, you can manually add the lines for the CD-ROM drivers. See the *3980dos.txt* file on the AHA-3980∕3985 Drivers and RAID Utilities diskette.

9   Remove the AHA-3980∕3985 Drivers and RAID Utilities diskette from the disk drive and reboot the computer.

Installing NetWare on a New Server

NetWare 3.11

Version 3.11 of NetWare is installed from floppy disks. Refer to the NetWare documentation for instructions on installing this version of NetWare.

NetWare 3.12

1   Use SCSI*Select* to determine the number of the PCI bus where the AHA-398x is installed:

   a   Boot the computer and press **Ctrl-A** when you see

   Press <Ctrl><A> for SCSI*Select* (TM) Utility!

b Look at the first screen that appears. The screen lists the PCI bus number and channels for each AHA-398x. The PCI bus number precedes each channel letter. The entry **01:A** (Channel A on PCI bus 1), for example, indicates the AHA-398x is on PCI bus 1.

c When finished, press **Esc** to exit SCSI*Select*.

2 Insert the NetWare 3.12 installation disc in the computer's CD-ROM drive.

3 Change to the directory that contains the NetWare file *install.bat*. The directory is similar to *d:\netware.40\english* (assuming you are installing from a CD-ROM drive designated drive *D*).

4 Type install and press **Enter**. A note to Ethernet users appears.

5 Press any key to continue.

6 Select **Install new NetWare 3.12**.

7 Select **Retain current disk partitions**.

8 Follow the instructions in the NetWare documentation to complete the installation. The installation program prompts you to enter a server name, an IPX number, and a destination directory for the server boot files. After the installation program copies the server boot files to that directory, you are further prompted to choose the country code, the file name format, and commands for the *startup.ncf* and *autoexec.ncf* files.

During installation, you can press **F1** to obtain onscreen help. If you need additional help, refer to the NetWare documentation.

9 Add the following lines to the *startup.ncf* file, located in the directory containing *server.exe* (the lines can be anywhere in the file):

```
load aha3980 bus_num=x
load ardrvr
```

where *x* is the PCI bus number you determined in step 1. When *aha3980.dsk* loads, it automatically loads *aspitran.dsk*; therefore, you need not include a separate load line for *aspitran.dsk*. For *startup.ncf* to properly execute, *aspitran.dsk* must be in the same directory as *aha3980.dsk*.

> **Note:** The NetWare Create Startup option does not work correctly with PCI devices. If you use it, you will find four load aha3980 lines that need to be deleted.

10 If, during the NetWare installation, you did not modify the *autoexec.bat* file to include the path for *server.exe*, change to the directory containing *server.exe*. Usually, the directory is *c:\server.312*.

11 At the DOS prompt, type server and press **Enter**. The server loads.

12 At the server prompt (:), type load install and press **Enter**. Create the NetWare partition, the *sys* volume, and other volumes, following the instructions in the NetWare documentation.

NetWare 4.xx

1 Determine the number of the PCI bus where the AHA-3980/ 3985 resides. To do so, you can use SCSI*Select*:

  a Boot the computer and press **Ctrl**-**A** when you see

    Press <Ctrl><A> for SCSI*Select* (TM) Utility!

  b Look at the first screen that appears. The screen lists the PCI bus number and channels for each AHA-398x. The PCI bus number precedes each channel letter. The entry **01:A** (Channel A on PCI bus 1), for example, indicates the AHA-398x is on PCI bus 1.

  c When finished, press **Esc** to exit SCSI*Select*.

2 Insert the NetWare installation disc in the computer's CD-ROM drive.

3 Change to the root directory of the installation disk containing the NetWare installation batch file (*d:\install.bat*, assuming you are installing from a CD-ROM drive designated as drive *D*).

4 Type install and press **Enter**.

5 Follow the instructions in the NetWare documentation to continue the installation on a single machine. During installation, you can press **F1** to obtain online help.

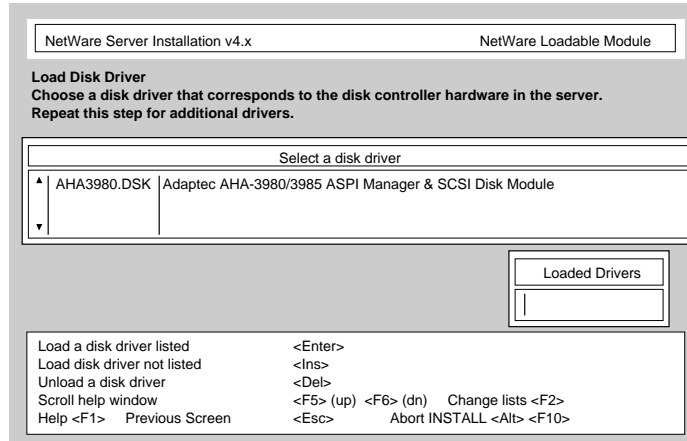When a screen similar to the one in Figure 6-19 appears, continue with the next step.

```
┌─────────────────────────────────────────────────────────────────────┐
│  NetWare Server Installation v4.x              NetWare Loadable Module │
└─────────────────────────────────────────────────────────────────────┘
 Load Disk Driver
 Choose a disk driver that corresponds to the disk controller hardware in the server.
 Repeat this step for additional drivers.

 ┌─────────────────────────────────────────────────────────────────────┐
 │                        Select a disk driver                           │
 │ ▲ AHA3980.DSK │ Adaptec AHA-3980/3985 ASPI Manager & SCSI Disk Module │
 │                                                                       │
 │ ▼                                                                     │
 └─────────────────────────────────────────────────────────────────────┘

                                                   ┌──────────────────┐
                                                   │  Loaded Drivers  │
                                                   ├──────────────────┤
                                                   │                  │
                                                   └──────────────────┘

 Load a disk driver listed          <Enter>
 Load disk driver not listed        <Ins>
 Unload a disk driver               <Del>
 Scroll help window                 <F5> (up)  <F6> (dn)   Change lists <F2>
 Help <F1>    Previous Screen       <Esc>        Abort INSTALL <Alt> <F10>
```

Figure 6-19. Selecting AHA3980.DSK

6 Press **Insert** to load a disk driver not installed.

7 Press **F3,** type c:\nwserver, and press **Enter**. A list of drivers appears.

8 Highlight *aha3980.dsk* and press **Enter**. Repeat this for each adapter that is installed.

The installation program copies the necessary files to the directory containing the *server.exe* file.

> **Note:** *Do not* select ASPITRAN.DSK; that is done automatically.

9 Choose **Yes** to select an additional disk driver.

10 Highlight *ardrvr.dsk* and press **Enter**.

If you wish to install other adapter drivers, specify them here. (If all adapters are the same model, you must load the same driver again for each adapter.)

11 Continue the installation using the instructions for your network card.

After you finish specifying the drivers, a summary screen shows the drivers that the installation program will load.

12 The installation program attempts to load *aha3980.dsk* but cannot, because no PCI bus number has been specified yet. You must add command line parameters to *aha3980.dsk* to specify the bus number. The *ardrvr.dsk* does not require any changes.

To add command line parameters, follow these steps:

a Press **F3**.

b Edit the command line information for *c:\aha3980.dsk* and add the following command:

> load aha3980 bus_num=*x*

where *x* is the PCI bus number you determined in step 1.

If you are installing additional AHA-398x RAID adapters, be sure to enter different bus numbers for each RAID adapter.

> **Note:** Press <**Alt**>+<**Esc**> to switch between the console screen and the installation program screen. The console screen displays a message indicating whether the driver loaded successfully. If an error message appears, see Appendix B, *Software Error Messages*.

13 Continue loading each driver you specified earlier.

14 Continue with the NetWare installation by following the procedures in the NetWare documentation. When prompted, select **Retain current disk partitions**.

15 When the installation program finishes, use an ASCII text editor to edit the *startup.ncf* file as follows:

a Delete duplicate load lines for *aha3980.dsk* until there is only one load line for each AHA-398x. If necessary, insert one load line for each AHA-398x using the format shown in step 12b. (You can add the lines anywhere in the file.)

b Check to make sure there is a load line for *ardrvr*. Your *startup.ncf* should now load *aha3980.dsk* for every installed AHA-398x adapter, followed by a single *ardrvr* load line.

> **Note:** The *aha3980.dsk* driver supports the NetWare tape backup utility, *sbackup.nlm*. Use *aha3980.dsk*, not the *adaptec.nlm* driver provided by NetWare, when running this utility. Adaptec's *aha3980.dsk* driver takes advantage of ASPI features bypassed by *adaptec.nlm*.

Other Initial Array Configuration Utility Options

Creating an Array with the Initial Array Configuration Utility, which begins on page 6-3, describes how to use the Initial Array Configuration Utility to create an array that you can use for a boot device. Normally, this is the only task for which you will use this utility. Then you can create and manage other arrays with the Administrator Utility after you install NetWare.

This section describes the other Initial Array Configuration Utility menu options, in case you need to use them.

Displaying Array Information

Follow these steps to display information about an array that has already been defined on your system:

1 Select **Display <u>A</u>rrays** from the Main Menu.

2 When the Array Menu appears, move the highlight to the array you want to view and press **Enter**.

3 View the information that appears on the screen. A sample screen is shown in Figure 6-20.

```
══════ Adaptec Initial Array Configuration Utility ══════
┌─────────────────────────────────────────────────────────┐
│ ┌────────── Configuration for Array #1 ──────────┐        │
│ │                                                │        │
│ │ Type = RAID5   Drives = 4   Boot Array = Yes   Array Size (MB) = 8158 │
│ │ Array Status = Initialized    Data Block Size (KB) =16 │
│ │ Member      SCSI ID     Channel     Status     Capacity │
│ │    0           1           A          UP        2040 MB │
│ │    1           3           A          UP        2040 MB │
│ │    2           4           B          UP        2040 MB │
│ │    3           5           B          UP        2040 MB │
│ └────────────────────────────────────────────────┘        │
│                                                           │
│                                  ┌─────────────────────┐  │
│                                  │ Press any key to continue │ │
│                                  └─────────────────────┘  │
└─────────────────────────────────────────────────────────┘
```
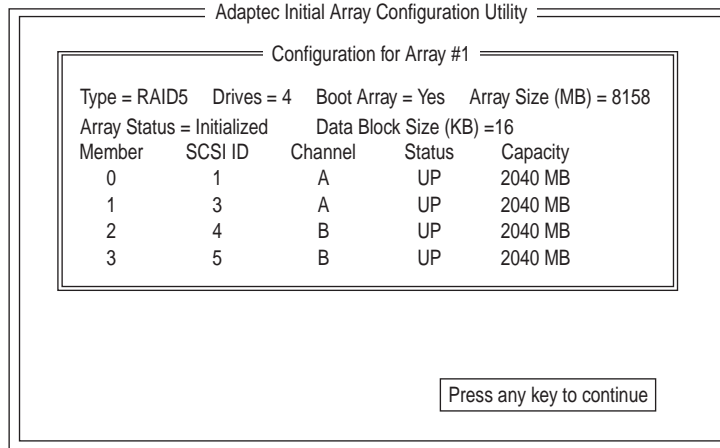
Figure 6-20. Sample Array Configuration Screen

4 Press any key to return to the Main Menu.

Deleting an Array

> ⚠ **Caution:** Before you delete an array, back up any data you want to keep. When you delete the array, all array data is lost!

To delete an array, follow these steps:

1 From the Main Menu, select **Delete an Array**.

2 When the menu of arrays appears, select the array you want to delete. A prompt asks you to confirm the deletion.

3 Type y to delete the array, or n to cancel the operation.

4 Restart the system.

The drives that were formerly part of the array can now be used as standard NetWare drives, or they can be redefined as part of another array.

6-15

Replacing an Array Drive

Follow these steps to replace a down drive in an array:

1 From the Main Menu, select **<u>R</u>eplace Array Drive**.

2 When the menu of arrays appears, select the array that has the drive you want to replace.

3 When the next screen appears, press **Tab** to highlight the channel of the drive you want to replace. When the drives on the highlighted channel appear in the **SCSI IDs on Channel** menu, select the drive you want to replace.

> **Note:** You cannot replace the drive if it is currently up, since this would not make sense. You should only attempt to replace a drive if it is down.

4 When the menu of channels appears, press **Tab** to select the channel that has the new drive you want to add to the array.

5 Select the drive on this channel that you want to add to the array.

6 When the message Member of Array #N replaced appears, press any key to return to the Main Menu.

Initializing an Array

When you add a new array, you are automatically prompted to initialize (format) it. If necessary, you can also select the **<u>I</u>nitialize Array** option separately from the Main Menu, perhaps to reinitialize an array that has become corrupted.

Here is some additional information on the two initialization methods:

- **Initialize Array to Zero:** (Recommended method) Fills the array with zeroes. This option is faster than a low-level format, but it does not verify the integrity of the disks. You can abort an initialization while it is underway; however, you must later complete the initialization.

■ **Low-level Format:** Performs a low-level SCSI format. This writes a consistent pattern to the disks and checks the disks for defects. Then it fills the array with zeroes. Low-level formatting can take a long time (the speed varies by drive model), and you cannot abort it once it has started.

Follow these steps to initialize an array:

1 Select **Initialize Array** from the Array Menu.

2 When the Select Array menu appears, select the array you want to initialize.

> **Note:** You are not allowed to initialize the array if one or more of the array drives is missing or down.

3 When the Select Format Mode menu appears, select **Initialize Array to Zero** or **Low-Level Format**.

> **Caution:** Formatting or initializing an array erases all data on the array and cannot be canceled once it has started. If the array contains data you want to keep, be sure to back it up first!

4 When the menu of block sizes appears, select a block size. (This menu does not appear if the array is a mirrored array with only two drives).

The allowable block sizes are 8, 16 (the default), 32, or 64 KBytes. The default size gives the best overall performance. If you will perform mostly sequential access on the array, you may achieve better performance if you use larger stripe sizes and larger NetWare volume block sizes.

5 When prompted, confirm that you want to format the array by typing y (yes). The initialization process begins.

6 When you see the message Initialization of Array #N is complete, press any key to return to the Array Menu.

❑

▾▾▾▾ Part 3

Managing Arrays

AHA-3980/3980W/3985/3985W User's Guide
Stock Number: 510810-00, Rev. D   Page: Part 3-xix
Print Spec Number: 493479-00
Current Date: 3/1/99   ECN Date: 3/19/96

Understanding the Administrator Utility

You use the Administrator utility to create and manage arrays while running NetWare. The Administrator utility lets you

- Create up to four arrays per server
- Monitor array performance
- Perform array tasks, such as verifying array integrity, testing spare disks, and re-creating data on replacement disks
- Change array configuration and delete arrays

This chapter explains how to start and exit the Administrator Utility and summarizes the options on the Main and System menus. Following chapters provide detailed instructions for using all options.

Note: Before you start the Administrator utility, make sure the *aha3980.dsk* driver is installed. See *Installing NetWare on a New Server* on page 6-9 for more information.

Starting the Administrator Utility

To start the Administrator utility, follow these steps:

1   If the server is not running, start it.

2   At the server prompt, enter one of the following commands:

a   Enter load c:aruadmin if this is the first time you have run the Administrator Utility.

If no previously defined arrays are detected, the utility starts in setup mode. If one or more arrays have already been defined and if *arumon* is not in *autoexec.ncf*, *arumon* is added to the *autoexec.ncf* file and the utility suite is automatically copied over from the *server.exe* directory.

b   Enter load aruadmin if this is *not* the first time you have run the Administrator Utility.

Exiting the Administrator Utility

To exit the Administrator utility, follow these steps:

1   Press **Esc** until the following prompt appears:

Do you want to exit the Administrator? (y|n)

2   Type y. You return to the server prompt.

The Main and System Menus

The Administrator utility has two primary menus: the Main Menu, shown in Figure 7-21, and the System Menu, shown in Figure 7-22. If your system has only one array, the Main Menu appears when you start the Administrator utility. If your system has multiple arrays, the System Menu appears when you start the utility.

```
═══════════════ Main Menu For Array #1 ═══════════════

Display Array Status         Scheduler Functions
Verify Functions             Reactivate Off-line Array
Reconstruct Functions        Reactivate Spare
Format/Initialize Array      Hardware Functions
Convert RAID Level           Install Utility Suite
Change Array Configuration
```
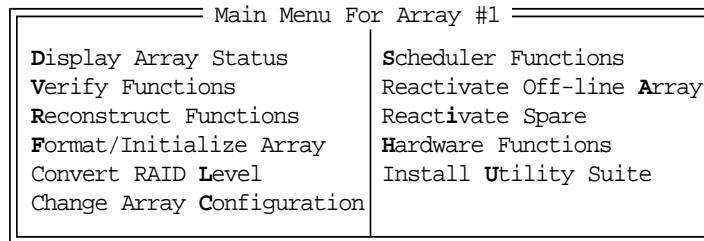
Figure 7-21. Administrator Utility Main Menu

```
═══════ System Menu ═══════

  Select Target Array
  Display Array Status
  Change Array Configuration
  Install Utility Suite
```
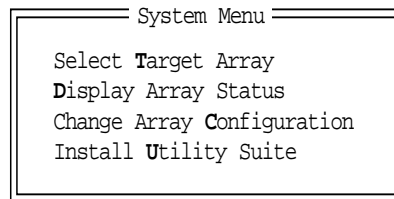
Figure 7-22. Administrator Utility System Menu

Main Menu

The Main Menu lists the tasks you can perform for an individual array:

- **Display Array Status:** Display information on the array and on disks included in the array. For details, see *Obtaining Array Information* on page 8-1.

- **Verify Functions:** Verify the data on the array (RAID 5 and mirrored arrays only). For details, see *Verifying Arrays* on page 9-1.

- **Reconstruct Functions:** Re-create data on a replacement disk. For details, see *Reconstructing Data on a Replacement Disk* on page 9-4.

- **Format/Initialize Array:** Format or initialize an array for a specified RAID level. For details, see Chapter 11, *Initializing Arrays*.

- **Convert RAID Level:** Switch between RAID 0 CVT and RAID 5 CVT formats. For information on why you might do this, see *RAID 0 CVT and RAID 5 CVT* on page 2-3. For instructions, see *Converting between RAID 0 CVT and RAID 5 CVT* on page 10-7.

- **Change Array Configuration:** Add an array (see *Adding an Array* on page 10-1). Change an existing array (see *Modifying an Array* on page 10-5). Delete an array (see *Deleting Arrays and Deinstalling NLMs* on page 10-10). Delete a spare (see *Deleting a Spare Disk* on page 10-7). Change who receives broadcast messages (see *Determining Who Receives Messages* on page 8-5). Change the frequency at which messages repeat (see *Setting the Repeat Interval for Error Messages* on page 8-7). Install the Adaptec array utilities (see *Installing the Array Utilities in the sys:system Directory* on page 10-11).

- **Scheduler Functions:** Schedule the Reconstruct, Verify, and Spare Test functions to run automatically at a specified time or regular interval. For details, see *Scheduling Tasks* on page 9-7.

- **Reactivate Off-line Array:** Restore to service an array that is off-line. For details, see *Reactivating an Off-line Array* on page 9-7.

- **Reactivate Spare:** This menu option is grayed out and is not selectable.

- **Hardware Functions:** Perform the following hardware-related tasks: Display the array that uses a specific drive; blink the drive light for a drive (helps you find a specific drive); and suspend activity on the host adapter channels used in an array (for drive boxes that require you to suspend SCSI bus activity before removing a drive). For details, see *Using the Hardware Functions* on page 9-9.

- **Install Utility Suite**: Install the Adaptec array utilities in the NetWare *sys:system* directory from the netware directory on C: (see *Installing the Array Utilities in the sys:system Directory* on page 10-11). This option is also available from the Change Array Configuration Menu. The array utilities are normally installed automatically.

System Menu

If a server has more than one array, the System Menu appears when you start the Administrator utility. If you select **Select Target Array**, the first option, a list of array names appears in a separate menu. If you select an array name, the Main Menu for that array appears, as shown in Figure 7-21. You select options in the Main Menu to perform tasks related to that array.

The System Menu also has the Display Array Status and Change Array Configuration options. Change Array Configuration has the same function as the Change Array Configuration option in the Main Menu. Display Array Status allows you to view the status of all arrays on the system, not just a selected array.

The entries in the Array Status window are color-coded to indicate the status of the array. Green means the array is operational, red means the array is off-line, and yellow means one of the array drives is down.

Selecting Menu Options

Option names in most menus include a *hot key*—a light blue character in color monitors, and a gray character in monochrome monitors. To select one of these options, just type the hot key. In the Main Menu in Figure 7-21, for example, the Display Array Status option has the hot key D; to select this option, type d. In this document, hot keys are indicated by an underlined character in the option name.

You can also select a menu option by pressing the ↑ and ↓ keys to highlight the option and then pressing **Enter**. If an option does not have a hot key, use this method to select it.

> **Note:** If you have a monochrome monitor and the highlight bar is not visible, press **Ctrl-B** to change to monochrome mode.

Grayed Menu Options

Grayed menu options are not selectable, usually because they do not apply to the chosen array. If an array has no failed drives, for example, the Reconstruct Functions option on the Main Menu is grayed, because no drives need to be reconstructed. Similarly, the Convert RAID Level option is always grayed for a mirrored array, because you cannot convert a mirrored array to another format.

Getting Help

You can display Help windows for most menus by pressing **F1**. As you highlight menu options, the Help windows automatically change to provide information about the highlighted option. To clear the Help windows, press **F1** again.

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Monitoring Array Performance

The Administrator utility monitors the performance of the arrays and compiles statistics—for example, number of reads and writes and number of bad sectors reassigned—and lets you view this information at the server console. If you have the Adaptec CI/O software, you can also view the statistics at a remote workstation.

The Administrator utility also monitors arrays for problems, such as failed drives. If it detects a problem, it issues an alert. Use the Administrator utility to determine who receives the alerts and how often the alerts repeat onscreen. If the Adaptec CI/O software is installed at a remote workstation, the alerts appear there also.

Obtaining Array Information

You can display the following types of information for any array on a server:

- An overview of the logical array characteristics (see Figure 8-23)

- An overview of physical array characteristics and any utilities running on the array (see Figure 8-24)

- Performance statistics for an array and its drives

- A list of all NetWare volumes on the selected array

```
================ Overview for Array #1 ================

Array Model = AHA-3980 Two Channel RAID on PCI Bus #1
Creation date = Tue Oct 4 11:11:57 1994
Array Type = Mirrored
Array Physical Capacity = 515MB
State = Fault-tolerant
Drives = 2
Spare Drive Count = 1
Date of last Verify is Fri Jan 27 18:14.
Date of last reconstruction is NEVER.
Error message repeat interval is 15 minutes.
```

Figure 8-23. Overview Screen

```
============== Configuration for Array #1 ==============

Array Type = Mirrored    Drives = 2    Utility Running = Verify
Utility is 90% complete                Priority = 0

Member  SCSI ID  Channel  Status  Capacity    Side      Mirror
0         1        A       UP       515MB    Primary      #1
1         3        A       UP       515MB    Secondary    #0
Spare0    6        B       UP       515MB
```

Figure 8-24. Configuration Screen

Displaying Overview Information

To display the overview information for the array and the drives, follow these steps:

1 Start the Administrator utility. If the system has more than one array, the System Menu appears; otherwise, the Main Menu appears.

2 From either menu, select **Display Array Status**. The Status Menu appears.

3 Select one of the following options:

   Display Array Overview: To view array information such as that shown in Figure 8-23.

   Display Array Drive Status: To view drive information such as that shown in Figure 8-24.

4 If in step 2 you selected from the System Menu, you can view information on the next array by pressing any key. Repeat this step to scroll through information screens for each array.

5 At the last information screen, press any key to return to the Status Menu.

6 Press **Esc** to return to the System Menu or Main Menu.

Displaying Performance Statistics

To display the performance statistics for an array or the disks in an array, follow these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select **Select Target Array**. Then select the array for which you want the statistics. The Main Menu for that array appears.

2 From the Main Menu, select **Display Array Status**. The Status Menu appears.

3 Select **Display Statistics**. The Statistics Menu for that array appears.

4 Select one of the following options:

Temporary Array Statistics: To display for the entire array the number of read requests and write requests.

Temporary Drive Statistics: To display for each drive the number of reads, the number of writes, and the total sectors read from and written to.

Permanent Drive Statistics: To display for each drive the errors that were corrected, successful retries, and reassigned blocks.

5 When finished viewing the screen of statistics, press **Esc** to display a pop-up menu and then select **Quit**.

> **Note:** Totals are reset to zero when an array is formatted or when you reset the totals to zero (see *Resetting the Temporary Statistics to Zero* on page 8-4).

Displaying Volume Information

To display volume information for an array, follow these steps:

1   If the system has only one array, skip to step 2. Otherwise, from the System Menu select **Select Target Array**. Then select the array for which you want the information. The Main Menu for that array appears.

2   From the Main Menu, select **Display Array Status**. The Status Menu appears.

3   Select **Display Volume(s) on Array**. The list of volumes for that array appears.

4   When you have finished viewing the volume information, press **Esc** to display a pop-up menu and then select **Quit**.

Changing the Data Sampling Rate

To develop the performance statistics, the arrays and drives are sampled once per second. If this slows the driver performance when you use other programs, you can increase the sampling rate through either of the following methods:

■   Display the Statistics Menu for the array (see steps 1 through 3 in *Displaying Performance Statistics* on page 8-3), and select **Set Sampling Rate**. At the prompt that appears, type the new sampling interval (in seconds) and press **Enter**.

■   At any screen displaying the statistics, press **Esc**. From the pop-up menu, select **Change Sampling Rate**. At the prompt, type the new sampling interval (in seconds) and press **Enter**.

Resetting the Temporary Statistics to Zero

The totals for the statistics are reset to zero when you format an array. You can rezero the temporary statistics at any other time through either of the following procedures:

■   Display the Statistics Menu for the array (see steps 1 through 3 in *Displaying Performance Statistics* on page 8-3), and select **Reset Temporary Statistics**.

■   At any screen displaying statistics, press **Esc**. From the pop-up menu, select **Reset Statistical Data**. When prompted to confirm, type y to reset the statistics. Like the first method, this method

rezeros all temporary statistics (not just those displayed onscreen).

Saving the Statistics in the Log File

You can save the current statistics in the *aru.log* file (for information on this file, see *The Log File* on page 8-8). To do so, use either of the following procedures:

■ Display the Statistics Menu for the array (see steps 1 through 3 in *Displaying Performance Statistics* on page 8-3), and select **Log Current Data Values**.

■ At any screen displaying statistics, press **Esc**. From the pop-up menu, select **Log Current Data Values**. Like the first method, this saves all current values (not just those displayed onscreen).

Each time you save the statistics, they are appended to the *aru.log* file. They do not overwrite previously saved statistics.

Determining Who Receives Messages

The Administrator utility broadcasts messages when it detects a problem (for example, a failed drive) or when you change the message repeat interval. The following table lists the broadcast messages.

Broadcast Messages

Message Text	Meaning
Array #*n* went off-line.	The array is not responding. Verify that all drives in the array have power and that all cables are properly connected. If the array still does not respond, drive(s) in the array may have failed.
Spare drive #*m* of *n* failed Ready test.	The spare did not respond to the signal sent during the Spare Testing operation (see *Testing Spare Disks* on page 9-4). Verify that the drive has power and that all cables are properly connected. If the drive still does not respond, it may have failed.
Message repeat interval changed from *n* to *m* minute(s).	A user has changed the interval at which error messages repeat onscreen (see *Setting the Repeat Interval for Error Messages* on page 8-7).

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Broadcast Messages *(Continued)*

Message Text	Meaning
Drive #*n* of Adaptec disk array #*n* went DOWN.	The drive is not responding. Verify that the drive has power and that all cables are properly connected. If the drive still does not respond, it may have failed.
Adaptec disk array monitor has lost contact with the array driver.	The array monitor cannot find the array driver. This message appears if you unloaded the array driver, but not the array monitor. If you receive this message when the array driver is loaded, the array driver is not responding to the monitor. Restart the server and try again. If the driver still does not respond, call Adaptec Technical Support at the number listed on page ii.
Spare for array #*n* not activated - STARTUP.NCF not accessible.	The utility tried to modify the array load line in the *startup.ncf* file to reflect the changed status of the spare, but could not find the *startup.ncf* file. This means DOS is not resident in memory. Restart the server and do *not* remove DOS; then restart the Administrator utility and try the procedure again.

Messages can be broadcast to everyone on the server connection list, to selected persons on the connection list, or to no one. To choose who will receive messages, follow these steps:

1 From the System Menu or the Main Menu, select **Change Array** **C**onfiguration.

2 Select **Change** **B**roadcast **Mode**. The Broadcast Modes Menu appears. At the bottom of the screen, a status message indicates the current broadcast mode.

3 Select one of these options:

Do **n**ot broadcast any messages: To have messages appear only at the server console.

Broadcast all messages to **e**veryone on connection list: To have messages appear at the workstations of everyone on the server connection list.

Broadcast only to specified **l**ocations: To choose the workstations where the messages appear.

4 If you choose **Broadcast only to specified locations**, the Administrator utility creates a file named *arubcast.lst* in the *sys:system* directory. A message noting this appears onscreen. Press any key to clear the message, then edit the *arubcast.lst* file to enter the workstations where messages will appear. Each line in the file can have one name, which must be typed exactly as it appears in the server connection list. To specify connections named Ron, Gary, Eileen, Jim, Margaret, and Gerhard, for example, the file appears as

>   Ron
>   Gary
>   Eileen
>   Jim
>   Margaret
>   Gerhard

The number of lines in the *arubcast.lst* file is unlimited.

> **Note:** The locations you select (everyone, no one, or specified locations) apply to all arrays, even if you selected a specific array from the System Menu.

Setting the Repeat Interval for Error Messages

Error messages repeat onscreen every 15 minutes by default. Several beeps call your attention to the message. To change the interval at which the messages repeat, follow these steps:

1 From the System Menu or the Main Menu, select **Change Array Configuration**.

2 Select **Change Message Repeat Cycle**. A prompt appears, indicating the current repeat interval and prompting you to enter the new one.

3 Type the new repeat interval (in minutes) and press **Enter**. To specify no repeats, enter 0.

This changes the interval for all error messages on all arrays, even if you selected a specific array from the System Menu. You cannot select different intervals for different error messages or for different arrays.

The Log File

The *aru.log* file provides an audit trail of events and error messages. It is stored in the *sys:system* directory. If you receive an error message or have a problem with the arrays, check the log file to determine the sequence of events that led to the problem. This will help you troubleshoot the problem. You should periodically back up the log file and then delete it.

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Managing Arrays

Use the Administrator utility to verify array data, test spare disks, reconstruct data on replacement disks, and reactivating off-line arrays. The Administrator Utility's Scheduler function lets you schedule most of these tasks to run automatically at a specified time or interval.

Verifying Arrays

Use the Administrator utility to verify the consistency of data on mirrored and RAID 5 arrays. If a mirrored or RAID 5 array becomes inconsistent, you lose data if a drive in the array fails. We recommend that you verify arrays after you set them up and at least weekly thereafter. Verification works as follows:

- **Mirrored arrays:** Data on the primary drive in a pair is compared block by block with the data on the secondary drive. If data blocks do not match, the data block on the primary drive is copied to the secondary drive.

- **RAID 5 arrays:** The parity data is compared with the data blocks it represents. If an inconsistency is detected, the parity is updated to be consistent with the data blocks.

> **Note:** You cannot verify an array that contains a disk that is down.

Verification runs in the background, so you can continue your work while verification is under way.

Assigning a Priority

You assign verifications a priority on the server. The priority, which can be 0 through 9, determines the proportion of verification I/O operations relative to other system I/O operations. At priority 1, 1 of 10 system I/O operations will be verification I/O operations; at priority 2, 2 of 10; at priority 3, 3 of 10; and so on. At priority 0, the lowest priority, verification I/O operations occur only when the system is free.

Verifying an Array Immediately

To verify an array immediately, follow these steps:

1   If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array you want to verify. The Main Menu for that array appears.

2   From the Main Menu, select **Verify Functions**. The Verify Menu for that array appears.

3   Select **Start Verify**. At the bottom of the screen, the prompt Enter background priority (0-9) appears.

4   Indicate the priority by typing a number from 0 through 9 (0 assigns it the lowest priority; 9, the highest).

Verification begins, and the Configuration screen for the array appears (see Figure 9-25). In that screen, the Utility Running field indicates that the verification is under way. A message on the second line indicates the percentage of verification that is complete.

> **Note:** If you exit this screen, you can redisplay it by selecting **Display Array Status** from the System or Main Menu, and then selecting **Display Array Drive Status**.

The Verify utility also tracks verifications, displaying a status bar that indicates the percentage completed. To display the status bar, press **Alt**-**Esc** until the status bar appears. You can display the status bar even if you exit the Administrator utility.

```
═══════════ Configuration for Array #1 ═══════════
Array Type = Mirrored     Drives = 2    Utility Running = Verify
Utility is 90% complete                 Priority = 0

Member  SCSI ID  Channel  Status  Capacity    Side     Mirror
  0        1        A       UP      515MB     Primary     #1
  1        3        A       UP      515MB     Secondary   #0
  Spare0   6        B       UP      515MB
```

Figure 9-25. Configuration Screen, Showing Percentage of Verification Completed

While Verify runs, the logical block addresses (LBAs) of any repaired data blocks appear onscreen. If no bad blocks were repaired, no message appears. Information on repaired blocks is also recorded in the *aru.log* file (see *The Log File* on page 8-8).

> **Note:** By default, the Administrator utility corrects parity data automatically. To disable automatic correction, change the Auto-Correct flag in the *aru.ini* file from y to n. See *Glossary of RAID Software* on page C-1 for details.

Verifying an Array at a Scheduled Time

Use the Scheduler to automate verifications and ensure they are done at regular intervals. For details, see *Scheduling Tasks* on page 9-7.

Canceling a Verification

You can cancel a verification while it is under way, using either of the following procedures:

- From the Verify Menu, select **Abort Verify**.

- At the status bar screen, press **Esc**. From the menu that appears, select **Abort**.

An onscreen message confirms that the verification was aborted.

To cancel a scheduled verification, delete it from the schedule. For instructions, see *Deleting a Scheduled Task* on page 9-9.

Changing the Priority of a Verification in Progress

If a verification is slowing other server operations unacceptably, you can lower the priority of the verification on the server. You can also speed a verification by increasing its priority. Change the priority at either the Verify Menu or at the screen showing the Verify status bar:

- From the Verify Menu, select **Change** <u>**Priority**</u>. A prompt appears, indicating the current priority and asking for the new priority. Type a number from 0 through 9, where 0 is the lowest priority.

- From the Verify status bar screen, press **Esc**. From the menu that appears, select **Change** <u>**Priority**</u>. When prompted to select a new priority, type a number from 0 through 9, where 0 is the lowest priority.

Verification continues automatically, running at the new priority.

Testing Spare Disks

Routinely test any spare disks in an array—we recommend daily testing. In this quick test, the Administrator utility sends a signal to the spare and checks whether the disk responds. The test involves no physical testing of the disk surface.

To test spare disks, use the Scheduler. Instructions are in *Scheduling Tasks* on page 9-7.

> **Note:** If a test fails, the message Spare drive #*n* of *m* failed Ready test appears onscreen. Verify that the drive has power and that the cables are properly connected; then retry the test. If the test still fails, the drive may have failed.

Reconstructing Data on a Replacement Disk

If you replace a failed disk in a mirrored or RAID 5 array, use the Administrator utility to reconstruct the data on the replacement disk (you cannot reconstruct data in a RAID 0 array). RAID 5 data is reconstructed from the user and parity data on the good disks. RAID 1 data is copied from the other disk in the mirrored pair. Data is reconstructed in the background, allowing you to continue working.

> ⚠️ **Note:** If your drive enclosure requires that all host adapter activity stop while you replace a drive, use Hot Swap Pause. For details, see *Pausing Host Adapter Activity When Replacing Disks* on page 9-11.

Reconstructing the Data Immediately

You can reconstruct data immediately or schedule it to be reconstructed at a specified time. To reconstruct the data immediately, follow these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array containing the replacement disk. The Main Menu for that array appears.

2 From the Main Menu, select **Reconstruct Functions**. The Reconstruct Menu for that array appears. Menu options that do not apply to that array type are gray, indicating you cannot select them. If the array is mirrored, for example, you can select only Re-mirror Single Drive or Re-mirror all DOWN Drives.

3 Select the option you want. A new screen appears, displaying the current drive statistics for that array. At the bottom of the screen, a prompt asks you to assign a priority to the operation.

4 Indicate the priority by typing a number from 0 through 9, where 0 indicates the lowest priority. Another prompt appears, asking you to confirm you want to continue.

5 Type y to continue, or n to cancel the operation.

As reconstruction begins, the Configuration screen for the array appears (this is similar to the screen in Figure 9-25). A message on the second line indicates the percentage of reconstruction completed.

> ⚠️ **Note:** If you exit this screen, you can redisplay it by selecting **Display Array Status** from the System or Main Menu, and then selecting **Display Array Drive Status**.

The Reconstruct utility also tracks reconstructions, displaying a status bar that indicates the percentage completed. To display the status bar, press **Alt**-**Esc** until the status bar appears.

Reconstructing the Data at a Scheduled Time

Because reconstructing data may slow a system, you may want to schedule this operation for a time when system use is light. You can use the Scheduler to start reconstructing the data automatically at a specified time. For details, see *Scheduling Tasks* on page 9-7.

Canceling Reconstruction

You can cancel reconstruction while it is underway by using either of the following procedures:

- From the Reconstruct Menu, select **<u>A</u>bort Reconstruct**.

- At the Reconstruct status bar screen, press **Esc**. From the menu that appears, select **<u>A</u>bort**.

An onscreen message confirms that the operation was aborted.

To cancel a scheduled operation, delete it from the schedule. For instructions, see *Deleting a Scheduled Task* on page 9-9.

Changing the Priority for Reconstructing Data

As with verifying data, you can change the priority assigned to reconstructing data while the operation is under way. Use one of the following methods:

- From the Reconstruct Menu, select **Change <u>P</u>riority**. A prompt appears, indicating the current priority and asking for the new priority. Type a number from 0 through 9, where 0 is the lowest priority.

- From the status bar screen, press **Esc**. From the menu that appears, select **Change <u>P</u>riority**. When prompted to select a new priority, type a number from 0 through 9, where 0 is the lowest priority.

The operation continues automatically, running at the new priority.

Reactivating an Off-line Array

An array goes off-line if the power fails or if someone removes a second disk when one has already been removed. To reactivate an off-line array, follow these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array you want to reactivate. The Main Menu for that array appears.

2 From the Main Menu, select **Reactivate Off-line <u>A</u>rray**. A prompt appears, asking you to confirm that you want to reactivate the array.

3 Type y to reactivate the array, or n to cancel the operation.

Scheduling Tasks

The Scheduler lets you schedule the following tasks:

- Verifying mirrored and RAID 5 arrays
- Testing spare disks
- Reconstructing data on a replacement disk

If you use the Scheduler to schedule verifications, all arrays are verified. To verify only one array, follow the procedure given in *Verifying Arrays* on page 9-1.

Scheduling a Task

Follow these steps to schedule a task:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array for which you want to schedule a task. The Main Menu for that array appears.

2 From the Main Menu, select **<u>S</u>cheduler Functions**. The Scheduler Menu appears.

3 Select **Schedule <u>V</u>erify**, **Schedule <u>R</u>econstruct**, or **Schedule Spare <u>T</u>esting**. A second Scheduler Menu appears.

4 Select one of these options:

Schedule Task to Run Once: To schedule the task for a single time.

Schedule Cyclic Task: To schedule the task to run at regular intervals.

Test Now (appears only if you selected Schedule Spare Testing): To test the spare immediately. If you select this option, you are finished—ignore the remaining steps.

5 If you select Schedule Cyclic Task, the Task Schedule Intervals Menu appears. Select one of these options: **Schedule Daily**, **Schedule Weekly**, or **Other**.

6 Depending on the options you selected, you are prompted for one or more of the following: day of week, time of day, and hourly interval when you want the task to run:

– *To enter a day of the week:* Type the first three letters of its name and press **Enter**. To enter Monday, for example, type mon and press **Enter**. You can use upper or lower case letters.

– *To enter a time of day:* Type the hour and minutes (for example, 01:30) and press **Enter**. Use a 24-hour clock, and use leading zeroes before single-digit numbers. For 2:05 a.m., for example, enter 02:05; for 2:05 p.m., enter 14:05.

– *To enter an interval:* Type the interval in hours—using a leading zero before single-digit numbers—and press **Enter**. To specify an interval of 8 hours, for example, enter 08.

7 If you are scheduling a verification, a new menu appears. Select **In Parallel** to have all arrays verified at the same time, or **Serially** to have the arrays verified in sequence.

> **Note:** Verifying arrays in parallel usually slows your system more than verifying them in series.

Changing the Schedule

To change the schedule for a task, follow the procedure given in *Scheduling a Task* (beginning on page 9-7), entering the information for the new schedule. The new schedule automatically replaces the old schedule for that task.

Deleting a Scheduled Task

You can delete a scheduled task by following these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array for which you want to schedule a task. The Main Menu for that array appears.

2 From the Main Menu, select **Scheduler Functions**. The Scheduler Menu appears.

3 Select **Unschedule Verify, Unschedule Reconstruct**, or **UnSchedule Spare Testing**.

Using the Hardware Functions

The Hardware Functions option provides tools for

- Identifying the array that uses a specific drive

- Identifying the location of a selected drive by blinking the light on the front panel of the drive

- Suspending host adapter activity while you replace drives in an array

Identifying the Allocation of Host Adapter Drives

You can quickly identify where each host adapter drive is used by selecting the Display Host Adapter Drives option. This option lets you display for every drive the following information:

- The array that contains the drive

- The ordinal number of the drive in the array

To display the information, follow these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select *any* array. The Main Menu appears.

2 From the Main Menu, select **H**ardware Functions.

3 Select **Display Host Adapter Drives.** A screen similar to that in Figure 9-26 appears**.**

```
                      Adaptec Disk Array Administrator

     ┌─ ADAPTEC AHA-3980 ─┐    ┌─ SCSI IDs on Channel ─┐
     │     Bus #1         │    │ #0 QUANTUM   LPS34   335MB │   ┌────────────────────┐
     │   Channel A        │    │ #1 CONNER    CFA540  537MB │   │ Array #1, Member #0 │
     │   Channel B        │    │ #2 CONNER    CFA540  537MB │   └────────────────────┘
     └────────────────────┘    │ #3 CONNER    CFA540  537MB │
                               └───────────────────────┘

     ┌──────────────────────────┐
     │ Tab = Select channel     │
     │ Up/Dn Arrow = Select drive│
     └──────────────────────────┘
```
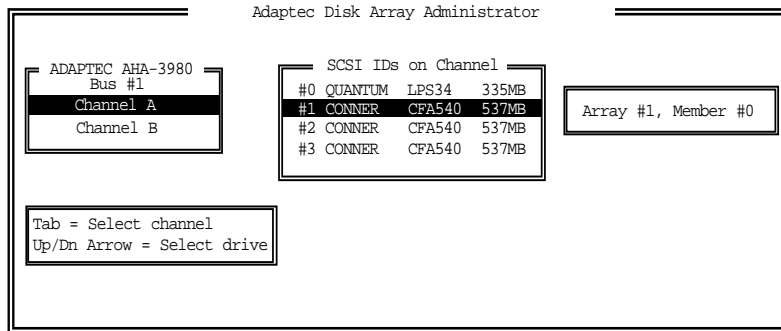
Figure 9-26. Displaying Information about Arrays and Drives

4 In the menu at the left of the screen, press the **Tab** key to highlight the host adapter channel whose drives you want to display. The drives for that channel appear to the right, in the SCSI IDs on Channel Menu.

5 Press the ↑ and ↓ keys to highlight the drive names. As you highlight each drive name, the array information for that drive appears in the window at the right of the screen.

Locating a Drive

If you are not sure which drive corresponds to drive information displayed onscreen, you can use the Blink Drive Lights option to locate the drive. Note the number of the array that contains the drive, then follow these steps to blink the drive light:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array that uses the drive. The Main Menu for that array appears.

2 From the Main Menu, select **H**ardware Functions.

3 Select **B**link Drive Lights. The Configuration screen for the selected array appears (see Figure 9-25 on page 9-3).

4 Use the ↑ and ↓ keys to select the drive you want to identify. The selected drive is denoted by an arrow to the left of the drive number (the first column on the screen).

5 To blink the drive light for the selected drive, press **Enter**. A blinking icon appears to the right of the drive number, and the drive light itself starts blinking.

6 To stop blinking the drive light, press **Enter** again.

Pausing Host Adapter Activity When Replacing Disks

Some drive enclosures allow you to remove and replace drives while SCSI bus activity continues; others do not. If your drive enclosure does not (check the documentation for the enclosure), use the Hot Swap Pause option before you remove or replace any drives in an array. Hot Swap Pause suspends activity on all SCSI buses (host adapter channels) used in the array, thereby assuring data integrity on the connected drives and arrays.

To use Hot Swap Pause, follow these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array containing the disk you are removing. The Main Menu for that array appears.

2 From the Main Menu, select **Hot Swap** **P̲ause**. A prompt appears, asking you to confirm you want to continue.

> **Note:** If you continue, activity to array drives and to non-array drives on the same SCSI bus will be paused.

3 To continue, type y. Otherwise, type n.

While SCSI bus activity is paused, the server beeps to remind you to replace the drive and resume activity. When you have replaced the drive, resume SCSI bus activity by pressing any key at the Administrator utility screen.

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Changing Array Configurations

This chapter explains how to

- Add up to four arrays to the server

- Modify an array by changing the RAID level, the drives in the array, or the number of spares

- Convert a RAID 0 CVT array to a RAID 5 CVT array and vice versa

- Delete one or more arrays from the server

Adding an Array

To add a new nonbootable array, follow these steps:

1 From the System Menu or the Main Menu, select **Change Array Configuration**.

2 Select **Add an Array**. The Selection List Menu appears. If you highlight an existing array, information on its configuration appears to the right of the Selection List Menu, as illustrated in Figure 10-27.

> **Note:** *Do not* use the Add an Array option to modify existing arrays. Instead, see *Modifying an Array* on page 10-5 for instructions.
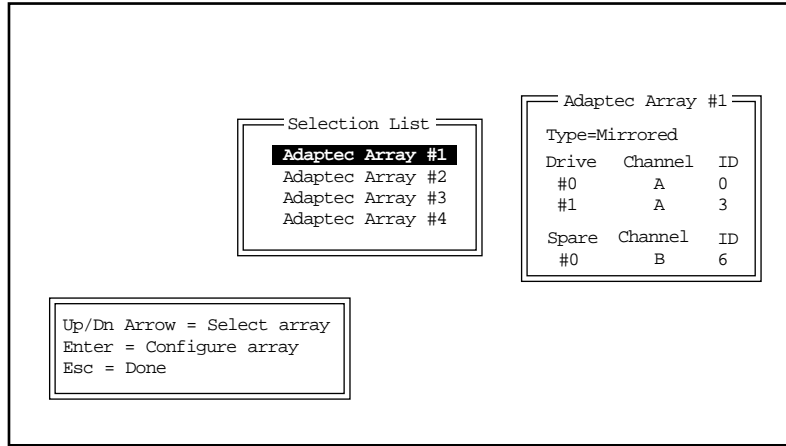
6   Type the number of drives (excluding spares) you want in the array, and press **Enter**. The utility scans the host adapter for drives, then displays a screen such as that shown in Figure 10-28.

```
┌─ ADAPTEC AHA-3980 ─┐    ┌── SCSI IDs on Channel ──┐    ┌─ Adaptec Array #1 ─┐
│       Bus #1       │    │ #0 QUANTUM  LPS34   335MB│   │ Type=Mirrored      │
│     Channel A      │    │ #1 CONNER   CFA540  537MB│   │ Drive Channel  ID  │
│     Channel B      │    │ #2 CONNER   CFA540  537MB│   │                    │
└────────────────────┘    │ #3 CONNER   CFA540  537MB│   │                    │
                          └──────────────────────────┘   └────────────────────┘

   ┌──────────────────────────┐
   │ Tab = Select channel     │
   │ Up/Dn Arrow = Select drive│
   │ Ins = Install drive      │
   │ Del = Undo               │
   └──────────────────────────┘
```
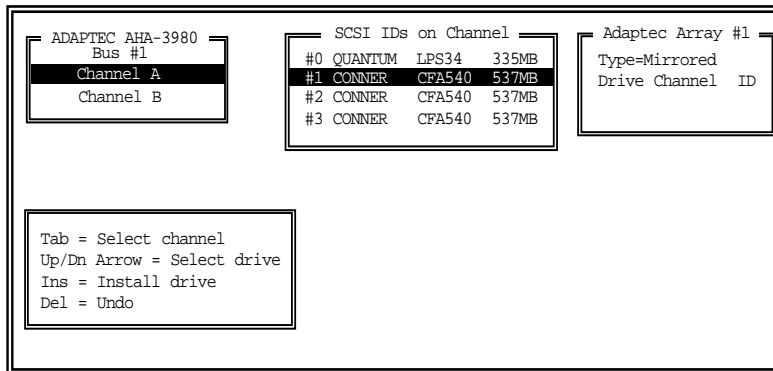
Figure 10-28. Selecting Drives for an Array

7   Press **Tab** to highlight a channel you want to use for the array. When the disks on the highlighted channel appear in the SCSI IDs on Channel Menu, select each disk for the array by pressing the ↑ and ↓ keys until the disk name is highlighted, and then pressing **Insert** or **Enter**. The names of selected disks appear to the right, in the Adaptec Array # box.

> ⚠ **Caution:** All data on the disks is lost when you initialize the array. *Do not* choose your boot disk to be included in an array. Also, *do not* choose disks that contain NetWare volumes you want to keep, such as the *sys* volume. A warning appears if the selected drive contains volume or partition information. Also, any mounted volumes on a drive must be dismounted before you can select the drive.

To select disks on a different host adapter channel, press **Tab** to select another channel and then select the disks from the SCSI IDs on Channel Menu. To deselect a disk, press the **Delete** key until the disk name no longer appears in the Adaptec Array # box. When you have selected the number of disks you specified in step **6**, the next screen appears automatically.

8 If the array is mirrored or RAID 5 *and* you have one or more disks left, a prompt appears, asking whether you want to choose a spare disk.

> **Note:** A spare must have at least the capacity of the smallest disk in the array.

If you do not want a spare: Type n and continue with step 9.

To select a spare: Follow these steps:

a At the prompt, type y.

b If more than one disk is available, a second prompt appears, asking how many spares the array will have. Type the number (1 or 2), and press **Enter**.

c To select each spare, follow the directions given in step 7. When you have selected the specified number of spares, the Selection List Menu reappears automatically.

9 To add another array, select the array from the Selection List Menu, then repeat steps 4 through 8.

10 When you have finished defining arrays and you are back at the Selection List Menu, press **Esc**.

11 When the next menu appears, select **Accept Configuration** to accept the arrays you have defined.

You can also select **Return to Setup** if you want to define more arrays or **Cancel Setup** to cancel the array definition(s).

12 Read the message that appears, then press any key to continue.

13 Read the confirmation message, and type y to confirm the array type.

14 Select a data block size for the array. The recommended size is 16 KBytes.

15 Select an initialization method—either **Initialize Array to Zero** (recommended) or **Low-Level Format**. Respond to the prompts to confirm that you want to initialize the array(s).

> **Note:** See Chapter 11, *Initializing Arrays*, for more information about selecting a data block size and an initialization method.

16   When initialization of the array is complete, press any key to continue.

The status line displays a percentage complete number while the array is being initialized.

Modifying an Array

You can modify an existing array by changing the RAID level, by changing the disks in the array, or by adding or changing a spare disk. If you change the disks or the RAID level, you must initialize the array after you configure it. If you only add or change a spare disk, you need not reinitialize the array.

Changing the RAID Level

To convert from RAID 0 CVT to RAID 5 CVT or from RAID 5 CVT to RAID 0 CVT, see *Converting between RAID 0 CVT and RAID 5 CVT* on page 10-7. You do not lose data if you convert between RAID 0 CVT and RAID 5 CVT.

To change an array to any other RAID level, first make sure the number of disks in the array is suitable for the new level (see *Number of Disks in an Array* on page 2-3). If it is, you can change the RAID level simply by reinitializing the array for that RAID level. For instructions, see Chapter 11, *Initializing Arrays*.

> **Caution:** Make sure your data is backed up before you reinitialize the array!

If the number of disks in the array is not suitable for the new RAID level, you must reselect disks for the array and then initialize the array. For instructions on selecting disks, see the next section, *Selecting Different Disks for the Array*. For initializing instructions, see Chapter 11, *Initializing Arrays.*

Selecting Different Disks for the Array

The procedure for changing the disks in an array is similar to that for adding a new array. The main difference is that you must restart the server after you change the disks in an existing array. With a new array, you do not need to restart the server.

Follow these steps to select different disks for an array:

1 From the System Menu or the Main Menu, select **Change Array Configuration**.

2 Select **Redefine Array**. The Selection List Menu appears, listing all possible arrays—defined or undefined. If you highlight an existing array, information on its configuration appears to the right of the Selection List Menu, as illustrated in Figure 10-27.

3 Select the array you want to change.

4 Follow steps 4 through 16 in *Adding an Array*, beginning on page 10-2.

5 Exit the Administrator Utility.

6 Restart the server.

7 Restart the Administrator Utility and view information about the array to make sure it now has the configuration you want.

Adding a Spare Disk

If you create a mirrored or RAID 5 array without spare disks (RAID 0 arrays never have spares), you can add up to two spare disks later. Spare disks are activated automatically if a disk in the array fails.

Follow these steps to add a spare disk to an array:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu, select the array to which you are adding spares. The Main Menu for that array appears.

2 From the Main Menu, select **Change Array Configuration**.

3 Select **Add Spare Drives**.

4 If you can add more than one spare, you are prompted to enter the number of spares you want to add. Type the number (1 or 2) and press **Enter**.

The Administrator Utility scans for drives on the host adapter used for that array, then displays the screen shown in Figure 10-28.

5 Press **Tab** to highlight the channel with the spare disk(s). The disks on the highlighted channel appear in the SCSI IDS on Channel Menu. Select each spare disk by pressing the ↑ and ↓ keys until the disk name is highlighted, and then pressing the **Insert** or **Enter** key. The names of selected disks appear to the right, in the Adaptec Array # box.

> **Note:** Remember, a spare must have at least the capacity of the smallest disk in the array.

6 Type y to confirm your choice or n to reject it.

7 When the confirmation message appears, press any key to return to the Configuration menu.

Deleting a Spare Disk

To delete a spare disk from an array, select the **Delete Spare** command from the Configuration menu. If the array has two spares, first select the spare you want to delete. A message appears to confirm the deletion of the spare disk.

You need not reinitialize the array when you delete a spare disk.

Converting between RAID 0 CVT and RAID 5 CVT

The RAID 0 CVT and RAID 5 CVT formats are similar to the RAID 0 and RAID 5 formats, but they allow you to convert a RAID 5 CVT array to a RAID 0 CVT array and back again without loss of data and without reinitializing the array. This feature is useful when you need to write a large quantity of data to a RAID 5 array—for example, if you are restoring data from tape to the array. If the array uses the RAID 5 CVT format, you can convert it to the RAID 0 CVT

format before you begin writing the data. With its high write performance, RAID 0 CVT allows you to transfer data more quickly. Once the data is transferred, you can convert back to the fault-tolerant RAID 5 CVT format.

Note: If you convert a RAID 5 CVT array with spares to a RAID 0 CVT array, the RAID 0 CVT array retains the spares, but they are not usable. When you convert the array back to a RAID 5 CVT array, the spares can again be used. Also, the disk space reserved for RAID 5 CVT parity information is not usable under RAID 0 CVT.

To convert between formats, follow these steps:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu select the array you want to convert. The Main Menu for that array appears.

2 From the Main Menu, select **Convert RAID Level**. The Convert Menu appears.

3 Select **Convert to RAID0 CVT** or **Convert to RAID5 CVT**. The Configuration Overview screen appears, showing the current configuration of the array. At the bottom of the screen, the prompt Enter background priority (0-9) appears.

4 Indicate the priority by typing a number from 0 through 9 (0 assigns it the lowest priority; 9, the highest). Another prompt appears, asking you to confirm you want to continue.

5 To continue, type y; otherwise, type n.

If you are converting from RAID 0 CVT to RAID 5 CVT, the Configuration screen for the array appears. A message on the second line indicates the percentage of the conversion that is complete. If you exit this screen, you can redisplay it by selecting **Display Array Status** from the System or Main Menu, and then selecting **Display Array Drive Status**.

The Convert utility also tracks RAID 0 to RAID 5 conversions, displaying a status bar that indicates the percentage completed. To display the status bar, press **Alt**-**Esc** until the status bar appears.

> **Note:** Status screens are not shown for conversions from RAID 5 CVT to RAID 0 CVT, because the conversions are instantaneous.

Canceling a Conversion

You can cancel a conversion of RAID 0 CVT to RAID 5 CVT while it is underway by using either of the following procedures:

- From the Convert Menu, select **<u>A</u>bort Convert**.

- At the status bar screen, press **Esc**. From the menu that appears, select **<u>A</u>bort**.

An onscreen message confirms that the conversion was aborted. The array remains a RAID 0 CVT array.

Changing the Priority of a Conversion in Progress

If a conversion is slowing other server operations unacceptably, you can lower the priority of the conversion on the server. You can speed a conversion by increasing its priority.

Change the priority at either the Convert Menu or at the screen showing the status bar:

- From the Convert Menu, select **Change <u>P</u>riority**. A prompt appears, indicating the current priority and asking for the new priority. Type a number from 0 through 9, where 0 is the lowest priority.

- From the status bar screen, press **Esc**. From the menu that appears, select **Change <u>P</u>riority**. When prompted to select a new priority, type a number from 0 through 9, where 0 is the lowest priority.

The conversion continues automatically, running at the new priority.

Deleting Arrays and Deinstalling NLMs

⚠ **Caution:** Back up data before you delete an array. When you delete the array, all array data will be lost!

Deleting an Array

Follow these steps to delete an array:

1 From the Main Menu or the System Menu, select **Change Array Configuration**. The System Configuration Menu appears.

2 Select **Delete an Array**. A menu of arrays appears, if more than one array is defined.

3 Select the array you want to delete. A prompt asks you to confirm that you want to delete the array.

4 Type y to delete the array, or n to cancel the operation.

5 Restart the server.

The disks that were formerly in the array can now be used as standard NetWare drives.

Deinstalling NLMs

This seldom-used option allows you to delete all references to NLMs (NetWare-loadable modules) from the NetWare *sys:system* directory. Follow these steps to use this option:

1 From the System menu (if you have multiple arrays) or the Main menu (if you have a single array), select **Change Array Configuration**.

2 Select **De-install Array NLMs**. A prompt asks you to confirm this operation.

3 Type y to remove the NLMs or n to cancel the operation.

4 Restart the server.

Installing the Array Utilities in the sys:system Directory

The array utilities must be installed in the NetWare *sys:system* directory. If *sys:system* exists when you create the initial arrays, the Administrator utility automatically installs the array utilities in *sys:system*. Otherwise, you must install the utilities later, after you create the *sys:system* directory. This may happen, for example, if you plan to place the *sys:system* directory on an array and so cannot create the directory until you define and initialize the arrays.

To install the array utilities in *sys:system*, follow these steps:

1   Create the *sys* volume, following the instructions in the NetWare documentation. The procedure for creating the volume on an array is the same as that for creating it on any disk.

2   Start the Administrator utility by entering

       load c:aruadmin

3   From the System Menu or the Main Menu, select **Install <u>U</u>tility Suite**.

The Administrator utility copies the array utilities to the *sys:system* directory.

❐

▼▼▼▼ **11**

Initializing Arrays

When you create or redefine an array, you are automatically prompted to *initialize* it. Initializing erases all existing data on the array and prepares it for high-level formatting. You cannot store data on the array until it is initialized.

Initialization is also available as a separate command in the Administrator Utility. If necessary, you can reinitialize an existing array. (This should seldom be necessary.)

Choosing the Initialization Method

There are two methods for initializing arrays: filling the array with zeros and low-level SCSI format followed by filling the array with zeros. The advantages and disadvantages of each method are as follows:

- **Initialize Array to Zero:** (Recommended method) Fills the array with zeroes. This option is faster than a low-level format but does not check the surface of the disks. You cannot abort an initialization once it has started.

- **Low-level Format:** Performs a low-level SCSI format. This writes a consistent pattern to the disks and checks them for defects. Then it fills the array with zeroes. Low-level formatting can take a long time (the time required varies by drive model), and you cannot abort it once it has started.

Choosing the Data Block Size

When initializing arrays other than RAID 1 arrays, you must choose the size of the data blocks that will be striped across the array. The allowable sizes are 8, 16 (the default), 32, and 64 KBytes. The default size gives the best overall performance with most arrays. If you will perform mostly sequential access on the array, you may achieve better performance if you use larger stripe sizes and larger NetWare volume block sizes.

> **Note:** You do not choose a data block size for RAID 1 arrays (mirrored arrays with only two disks), because they do not stripe data across disks.

Reinitializing an Array

Follow these steps to reinitialize an array that was previously defined. You are automatically prompted to initialize the array when you define a new array:

1 If the system has only one array, skip to step 2. Otherwise, from the System Menu choose **Select Target Array** and select the array you want to initialize. The Main Menu for that array appears.

2 From the Main Menu, select **Format/Initialize Array**. The Format Menu appears.

3 Select **RAID0**, **RAID5**, or **Mirrored**. (For a description of these RAID levels, see *Array Types* on page 2-1.) The Select Format Mode Menu appears.
If you select **RAID0** or **RAID5**, a screen appears asking you if you want to make the array convertible between RAID 5 and RAID 0. Read the onscreen explanation and select **y** or **n**.

> **Note:** If you selected a different RAID level when you defined the array, the level you select here supersedes that selection. This causes no problems with the array, as long as the number of drives you defined is suitable for the RAID level you select here. If the number is unsuitable, an onscreen message tells you.

4   Select **Initialize Array to Zero** or **Low-Level Format**.

> ⚠ **Caution:** Remember, initializing an array erases all
> data on the array disks. If the array disks contain data
> you want to keep, be sure to back them up before you
> initialize the array!

A menu of block sizes appears (this menu does not appear if
the array is a mirrored array with only two drives).

5   Select a block size. For recommended block sizes, see *Choosing
the Data Block Size* on page 11-2.

6   Type y (yes) in response to the prompts to confirm that you
want to initialize the array.

The Administrator utility begins initializing the array. The Configu-
ration screen for the array appears, as shown in Figure 11-29. The
Utility Running field indicates which initialization method is being
used. A number on the second line indicates the percentage of ini-
tialization that is complete.

```
═══════════════ Configuration for Array #1 ═══════════════
Array Type = Mirrored      Drives = 2    Utility Running = Initializing
Utility is 90% complete                  Priority = 0

Member  SCSI ID  Channel    Status      Capacity    Side      Mirror
 0         1        A      Initializing    515MB    Primary     #1
 1         3        A      Initializing    515MB    Secondary   #0
 Spare0    6        B           UP         515MB
```

Figure 11-29. Configuration Screen, Showing Percentage of Formatting Completed

> ☞ **Note:** If you exit the Configuration screen, you can redisplay it
> by selecting **Display Array Status** from the System or Main
> Menu, and then selecting **Display Array Drive Status**.

The Format utility also tracks formatting. For initialization, it displays a status bar indicating the percentage of initialization completed. For low-level formatting, it displays the elapsed formatting time. To display this information, press **Alt**-**Esc** until the Adaptec RAID Format Utility screen appears. You can display this screen even if you exit the Administrator utility.

Note: After you initialize an array, view the status screens for that array to verify the array configuration. See *Obtaining Array Information* on page 8-1 for instructions.

▼▼▼▼ **12**

Working from a Remote Workstation

Adaptec CI/O software lets you monitor SCSI subsystems, including arrays, from a remote workstation. You can also use Adaptec CI/O to access the Administrator utility from a remote workstation. The Adaptec CI/O documentation explains the capabilities of Adaptec CI/O and provides instructions for using it. This chapter summarizes the capabilities that pertain to arrays and explains how to set up Adaptec CI/O to work with the Administrator utility.

> **Note:** If you do not have Adaptec CI/O and would like information about this product, call Adaptec at the sales information number listed on page ii.

Standard Adaptec CI/O Features

Adaptec CI/O allows you to:

- View and create maps of SCSI subsystems, including arrays, as illustrated in Figure 12-30.

- View charts of system performance.

- Receive alarms notifying you of changes in device status. When an alarm occurs, an Alarm icon appears on the system map. The alarms are also stored both in an alarm log and in a database, which you can use to generate reports.
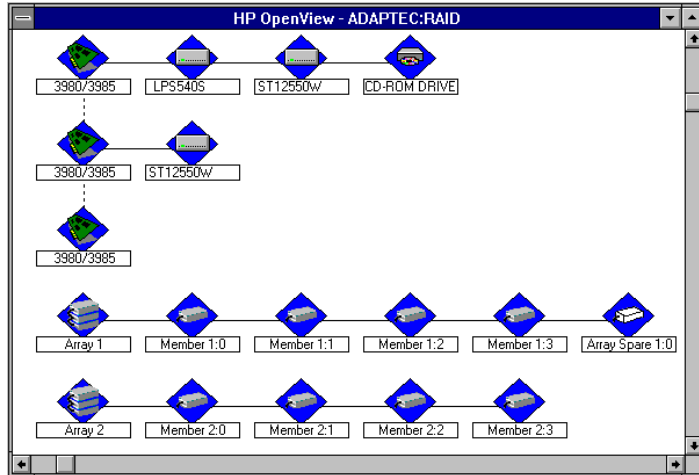
Figure 12-30. Viewing Array Information

■ Configure an alarm to trigger an action, such as starting a program or activating a remote paging device. (This function requires additional HP OpenView modules not included with CI/O.)

For more information on the capabilities of Adaptec CI/O, see the Adaptec CI/O documentation.

Adaptec CI/O Features When Working with the Administrator Utility

When enabled to work with the Administrator utility (see the next section), Adaptec CI/O gives you the following additional capabilities at client workstations:

■ You can remotely access the Administrator utility, allowing you to perform any Administrator utility function at the workstation.

■ You receive the following messages generated by the Administrator utility: Down Drive, Array is Critical (indicates the array will fail if another drive fails), Drive Up, Array Offline, Array Fault Tolerant, Reconstruct Failed, Using the Spare (indicates the spare has been activated), Spare Has Been Added.

- You can create an Adaptec CI/O submap that displays the following array information: RAID level, number of drives, and number of spares. For information on submaps, see the Adaptec CI/O documentation.

- You can use the SCSI I/O Monitor to display the array status (fault-tolerant, critical, or off-line) and the number and size of data reads and writes. For information on the SCSI I/O Monitor, see the Adaptec CI/O documentation.

Enabling a Remote Workstation to Receive Administrator Utility Data

To receive the Administrator utility data at a remote workstation, you must take the following steps:

1 At the remote workstation: Install Adaptec CI/O. See the Adaptec CI/O documentation for instructions.

> **Note:** Be sure to click on the **Install CI/O NLM** button as part of the CI/O installation process to add the workstation to the *traptarg.cfg* file.

2 At the server:

a Enter the following command in the *autoexec.ncf* file:

   load snmp   (insert this command just *before* the line containing load arumon)

b If the server includes Adaptec host adapters other than the AHA-3980 or AHA-3985, or if drives on a AHA-3980 or AHA-3985 are not included in an array, also add this line to the *autoexec.ncf* file:

   load cio   (insert this command just *after* the line containing load arumon)

c Start the Administrator utility.

12-3

Remotely Accessing the Administrator Utility

To access the Administrator utility from within Adaptec CI/O, follow these steps:

1 Click on the **Remote Console** button on the CI/O toolbar. This opens a Novell NetWare RConsole window, which lists the servers.

2 Select the name of the server where the Administrator utility is installed.

3 When prompted, enter your log-in name and password. You must have supervisory privileges.

4 When the RConsole prompt appears, enter the following command:

> load aruadmin

The Administrator utility starts. You can now use it, as described in Part 3 of this document.

Note: RConsole requires additional NLMs to be loaded on the remote server.

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▾▾▾▾ Part 4

Advanced Hardware Topics

Configuring the Adapter with SCSI*Select*

The AHA-398x RAID adapter has an onboard SCSI*Select* configuration utility, which allows you to change adapter settings without opening the computer or handling the adapter board. The factory default settings for the AHA-398x are correct for most computers; however, there may be cases in which you need to modify the settings. This chapter describes the default settings, explains when you should change them, and gives instructions for doing so.

SCSI*Select* also includes SCSI utilities to list the SCSI IDs of devices on the AHA-398x, format SCSI disk drives, and check them for defects. Instructions for using these utilities are included.

Default AHA-398x Settings

AHA-398x RAID adapters have the default settings shown in the following table. Some settings apply to the RAID adapter or channels; other settings apply individually to each device on the SCSI bus. The default settings are appropriate for most PCI-bus systems. For situations where you might want or need to change the settings, see the descriptions of each setting in the following sections.

Default AHA-398x Settings

Basic Channel Settings	Default Value
Host Adapter SCSI ID[1]	7
SCSI Parity Checking	Enabled
Host Adapter SCSI Termination[1]	Enabled
Individual Settings for Each SCSI Device	**Default Value**
Initiate Sync Negotiation	Yes
Maximum Sync Transfer Rate	10 MBytes/sec[2]
Enable Disconnection	Yes
Send Start Unit SCSI Command	No
Include in BIOS Scan	Yes
Initiate Wide Negotiation (AHA-3980W/3985W only)	Yes

[1] Each channel has its own setting. The default shown is for each channel.

[2] For AHA-3980W and AHA-3985W, the effective transfer rates are twice as fast as the settings shown in the SCSI*Select* screen because the adapters transfer 16 bits (2 bytes) per transfer.

Basic Channel Settings

Each channel has the default settings described here for SCSI ID, parity checking, and termination. For information on changing these settings, see *Changing the AHA-398x Settings* on page 13-7.

Host Adapter (Channel) SCSI ID

Each channel on the AHA-398x has the default SCSI ID of *7*, which gives the channel the highest priority on the SCSI bus (see *Setting SCSI IDs and Preparing a Boot Device* on page 5-15). We recommend that you leave this ID at 7.

If you plan to connect a second host adapter to the SCSI bus, make sure the second host adapter does not also have ID 7. If it does, change the ID of either the channel or the second host adapter to 6.

> **Note:** Devices on the same channel, including the channel itself, cannot share the same ID. The ID you assign the channel, therefore, must not be used by a device on that channel.

For more information on SCSI IDs, see *Setting SCSI IDs and Preparing a Boot Device* on page 5-15.

SCSI Parity Checking

SCSI parity checking is a procedure used to verify the accuracy of data transfer on the SCSI bus. By default, parity checking is enabled on all AHA-398x channels. Disable parity checking for a channel if any SCSI device on the channel does not support SCSI parity. Most currently available SCSI devices support SCSI parity. If you are not sure whether a device supports SCSI parity, read the documentation for the device.

Host Adapter SCSI Termination

The default termination setting for each channel is *enabled* (for a definition of termination, see *Terminating the SCSI Bus* on page 5-12). Disable termination for Channel A if you attach SCSI devices to *both* the internal and external connectors of Channel A. For more information on channel termination, see *Terminating Channel A* on page 5-14 and *Terminating Channels B and C* on page 5-13.

Individual Settings for Each SCSI Device

This section describes the settings that can be changed individually for each device on the SCSI channel. For instructions on changing the device settings, see *Changing the AHA-398x Settings* on page 13-7.

Initiate Sync Negotiation

Synchronous negotiation is a SCSI feature that allows the SCSI channel and its attached SCSI devices to transfer data in synchronous mode, which is faster than asynchronous data transfer.

The Initiate Sync Negotiation setting determines whether the channel initiates synchronous negotiation with the SCSI device. At the default setting, *yes*, the channel initiates synchronous negotiation with the SCSI device. If you change the setting to *no,* the channel does not initiate synchronous negotiation; however, the channel always responds to synchronous negotiation if the SCSI device initiates it. If neither the channel nor the SCSI device negotiates for synchronous data transfers, data is transferred in asynchronous mode. Normally, you should leave the default setting, because most SCSI devices support synchronous negotiation and because synchronous data transfer is faster.

Some older SCSI-1 devices do not support synchronous negotiation. If you have such a device, your computer may operate erratically or hang if Initiate Sync Negotiation is enabled. If this happens, set Initiate Sync Negotiation to **no** for these devices.

Maximum Sync Transfer Rate

This setting determines the maximum synchronous data transfer rate that the channel supports. Allowable settings are 5.0, 6.7, 8.0, and 10.0 MBytes/sec. For AHA-3980/3985 adapters that transfer 8 bits (1 byte) per transfer, this means maximum transfer rates of 5.0, 6.7, 8.0, and 10.0 MBytes/sec. For AHA-3980W/3985W adapters that transfer 16 bits (2 bytes) per transfer, this means maximum transfer rates of 10.0, 13.4, 16.0, and 20.0 MBytes/sec.

Note: AHA-3980W/3985W transfer rates are actually twice as fast as the settings shown in the SCSI*Select* screen.

In most cases, you can use the default value of 10.0 MBytes/Sec. However, some older SCSI-1 devices only support the lowest data transfer rate. If you have one of these older devices, your computer may operate erratically or hang if you select a higher transfer rate.

If the channel is set *not* to negotiate for synchronous data transfer (that is, Initiate Sync Negotiation is set to *no*), then the value selected here is the maximum rate at which the channel accepts data from the device during negotiation. (This is standard SCSI protocol.)

Enable Disconnection

This setting determines whether the channel allows a SCSI device to disconnect from the SCSI bus (sometimes called Disconnect/ Reconnect). Enabling disconnection allows the channel to perform other operations on the SCSI bus while the SCSI device is temporarily disconnected.

When disconnection is allowed (default), the SCSI device may disconnect from the SCSI bus. The SCSI device may choose not to disconnect, however, even if permitted by the channel (this can usually be configured on the SCSI device). When disconnection is not allowed, the SCSI device cannot disconnect from the SCSI bus.

Leave Enable Disconnection at its default value if the channel connects to two or more SCSI devices. This optimizes SCSI bus performance. Disable disconnection if you connect an older SCSI device that does not support disconnection.

Send Start Unit Command

This setting determines whether the channel sends the Start Unit command to the SCSI device. Enabling this option can reduce the load on your computer's power supply by allowing SCSI devices to be turned on one-at-a-time when the computer boots. Otherwise, all SCSI devices turn on at the same time.

The default setting for Send Start Unit Command is *no* (disabled). Before you enable this option for a device, verify that the device supports the command. You may also need to change a switch or jumper setting on the device to enable it to respond to the command.

Include in BIOS Scan

This setting determines whether the AHA-398x BIOS scans a specific SCSI ID looking for a stand-alone disk device to control. If Include in BIOS Scan is set to *yes* for a SCSI ID the BIOS scans the ID, and the disk device at that ID then becomes accessible through Int 13; if the option is set to *no* the BIOS does *not* scan the SCSI ID. The Include in BIOS Scan setting has no effect on arrays; the AHA-398x BIOS always scans arrays regardless of which SCSI IDs are used by the disks in the array. The default setting for Include In BIOS Scan is *yes*.

Initiate Wide Negotiation (AHA-3980W/3985W only)

This setting determines whether the channel attempts 16-bit data transfer instead of 8-bit data transfer. The default setting is *yes*. When set to *yes*, the AHA-398x BIOS attempts 16-bit data transfer. When set to *no*, the BIOS uses 8-bit data transfer unless the SCSI device itself requests Wide negotiation. The effective data transfer rate is doubled when 16-bit data transfer is used. For example, a transfer rate of 10 MBytes/sec becomes 20 MBytes/sec.

Some 8-bit SCSI devices may have trouble handling Wide negotiation, which may result in erratic behavior or may cause your computer to hang. For these devices, set Wide Negotiation to **no**.

SCSI*Select* Basics

Use SCSI*Select* to

- Change the AHA-398x settings
- List the SCSI IDs of devices attached to the AHA-398x
- Format disk drives attached to the AHA-398x
- Check the disk drives for defects and reassign bad blocks

This section explains how to start SCSI*Select*, exit from it, and select menu options.

Starting SCSI*Select*

A banner similar to the one shown in Figure 13-31 appears when you turn on or reboot your computer. To start SCSI*Select*, press **Ctrl-A** when the BIOS banner appears on the screen.

> **Note:** The SCSI*Select* version number that appears on the BIOS banner and the SCSI*Select* screens reflects your version of SCSI*Select*. The version number may differ from that shown in the illustrations.

```
Adaptec AHA-3980/3985 BIOS v1.50
(c) 1995 Adaptec, Inc. All Rights Reserved


◄ ◄ ◄     Press <Ctrl> <A> for SCSISelect (TM) Utility!   ► ► ►

AIC-7870/Sequencer Diagnostics Passed

[List of SCSI Devices]
          .
          .
          .
BIOS Installed Successfully!
```
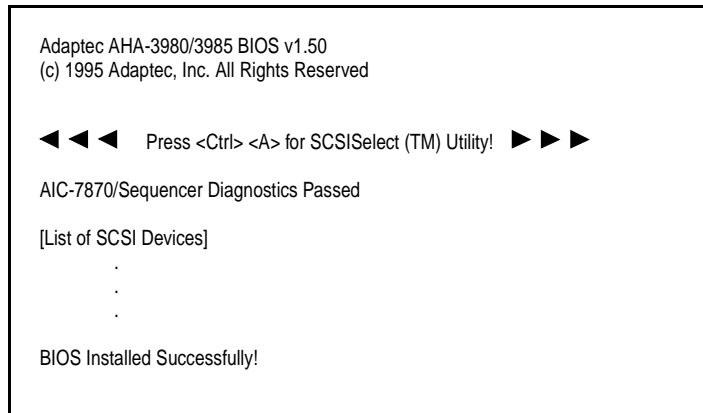
Figure 13-31. BIOS Banner

Using SCSI*Select* Menus

To select a SCSI*Select* menu option, move the cursor to the option with the ↑ and ↓ keys, then press **Enter**. In some cases, selecting an option displays another menu. You can return to the previous menu at any time by pressing **Esc**.

Exiting SCSI*Select*

To exit SCSI*Select*, press **Esc** until a message prompts you to exit. (If you changed any AHA-398x settings, you are prompted to save the changes before you exit.) Select **Yes** to exit, then press any key to reboot the computer. Any changes you made in SCSI*Select* take effect after the computer boots.

Changing the AHA-398x Settings

The factory default settings for the AHA-398x are correct for most computers. *Default AHA-398x Settings* on page 13-1 describes some cases in which you may need to change the settings. This section explains how the changes are made.

Each SCSI channel operates independently, so you must reconfigure the channels separately. Before you change a setting, check the recommended setting given in *Default AHA-398x Settings*, beginning on page 13-1.

To change the settings for the AHA-398x, a channel, or a SCSI device, follow these steps:

1 If you have not yet installed the AHA-398x and the SCSI devices, do so now (see Chapter 5, *Installing the AHA-398x and the SCSI Drives*).

2 Start SCSI*Select* (see *Starting SCSISelect* on page 13-6). The SCSI*Select* screen appears, listing the channels. As shown in Figure 13-32, the PCI bus number for the AHA-3980 ⁄ 3985 precedes the channel letter. Channel A on PCI bus 1, for example, is designated 01:A.

Note: Press **F5** to toggle the display between color and monochrome. (This feature may not work on all monitors.)

Adaptec AHA-3980/3985 ◄ SCSISelect(TM) ► Utility v1.16

You have more than one channel
in your system. Move the cursor to the
bus:channel of the one to be configured
and press <Enter>.

<F5> - Toggle color/monochrome

Bus:Channel
01:A
01:B

Arrow keys to move cursor, <Enter> to select option, <Esc> to exit (∗=default)
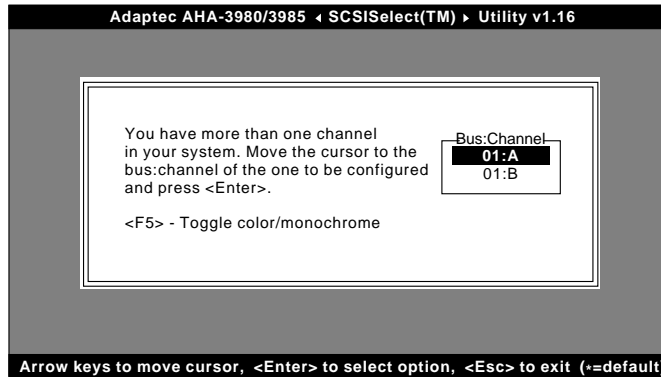
Figure 13-32. Selecting a SCSI Channel

3   Select the channel you want to configure. The Options menu
appears, as shown in Figure 13-33.

Adaptec AHA-3980/3985 ◄ SCSISelect(TM) ► Utility v1.16

AHA-3980/3985 at Bus:Channel 01:A

Would you like to configure the host adapter or run the
SCSI disk utilities? Select the option and press <Enter>.
Press <F5> to switch between color and monochrome modes.

Options
Configure/View Host Adapter Settings
SCSI Disk Utilities

Arrow keys to move cursor, <Enter> to select option, <Esc> to exit (∗=default)
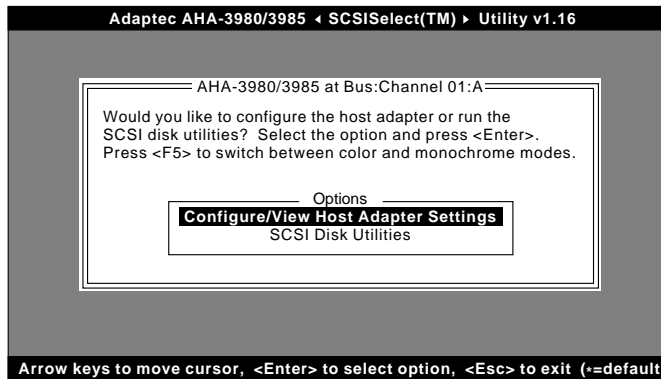
Figure 13-33. Options Menu

4 From the Options menu, select **Configure/View Host Adapter Settings**. The Configuration menu appears, as shown in Figure 13-34.
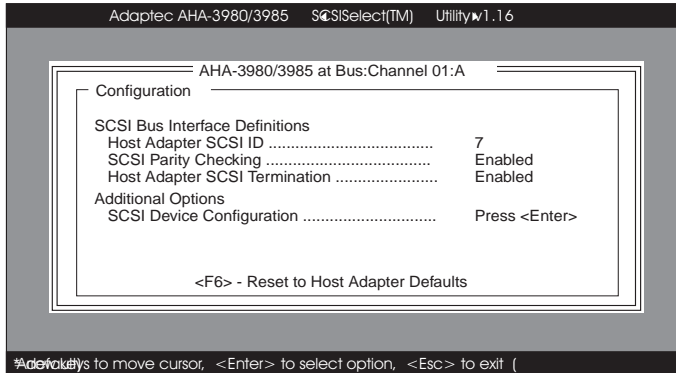
Figure 13-34. Configuration Menu

5 This step depends on which setting you want to change:

To change Host Adapter SCSI ID (the channel ID), SCSI Parity Checking, or Host Adapter SCSI Termination for the channel: Continue with step **6**.

To change the individual device settings: From the Configuration menu, select **SCSI Device Configuration**. The SCSI Device Configuration menu appears, as shown in Figure 13-35. The screen shows a column of information for each SCSI ID, even IDs that are not assigned to a device. Continue with step **6**.
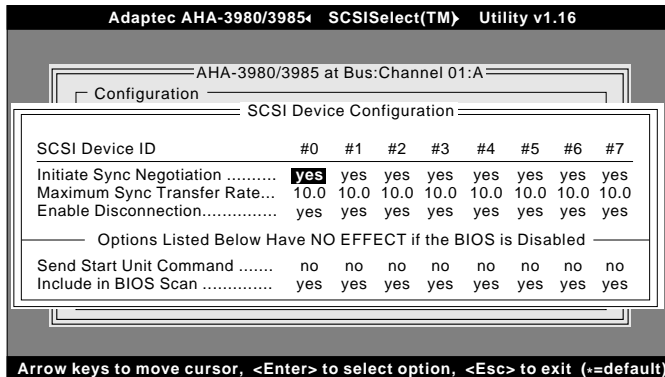
Figure 13-35. SCSI Device Configuration Menu

13-9

For AHA-3980W/3985W host adapters, this screen includes the Initiate Wide Negotiation option.

> **Note:** If you do not know the SCSI ID of a device you want to configure, press **Esc** until the Options menu appears, then select **SCSI Disk Utilities**. A list of SCSI devices and their SCSI IDs appears, as shown in Figure 13-36. Note the ID of the device you want to configure. Press **Esc** to redisplay the Options menu, then repeat steps 4 and 5.

```
   Adaptec AHA-3980/3985  ◄ SCSISelect(TM) ► Utility v1.16

            ═══ AHA-3980/3985 at Bus:Channel 01:A ═══
            ─── Select SCSI Disk and press <Enter> ───

     SCSI  ID # 0 :  No device
     SCSI  ID # 1 :  QUANTUM        LPS 540S
     SCSI  ID # 2 :  QUANTUM        MAVERICK 540S
     SCSI  ID # 3 :  MAXTOR         7345-SCSI
     SCSI  ID # 4 :  MAXTOR         7345-SCSI
     SCSI  ID # 5 :  WangDAT        Model 3200
     SCSI  ID # 6 :  Toshiba        CD-ROM SM-3501TA
     SCSI  ID # 7 :  AHA-3980/3985


 Arrow keys to move cursor,  <Enter> to select option,  <Esc> to exit  (∗=default)
```

Figure 13-36. Sample List of SCSI IDs

6 Select the setting you want to change. When the menu of allowable settings appears, select the new setting.

> **Note:** Default settings are marked with an asterisk (*) on all menus. Press **F6** to return all settings to the defaults.

7 To change other settings, press **Esc** if necessary to return to the Configuration menu; then repeat steps 5 through 7.

8 When you are finished changing the settings, press **Esc** until an onscreen message prompts you to save the changes. To save the changes, select **Yes**. To abandon the changes, select **No**.

9 Press **Esc** until an onscreen message prompts you to exit the utility, then select **Yes**.

10   Press any key to reboot the computer. The changes take effect after the computer reboots.

Listing SCSI IDs

With SCSI*Select*, you can list the SCSI IDs of devices attached to the AHA-398x. This lets you quickly verify that no devices on a channel have duplicate IDs.

To view the SCSI IDs, follow these steps:

1   Start SCSI*Select* (see *Starting SCSISelect* on page 13-6).

2   Select the channel that has the devices you want to list. The Options menu appears.

3   Select **SCSI Disk Utilities**. SCSI*Select* scans the SCSI bus and lists the SCSI IDs and associated devices on the SCSI bus (see Figure 13-36).

Figure 13-36 shows seven SCSI IDs. Fifteen SCSI IDs are listed for the AHA-3980W ⁄ 3985W adapters.

Formatting a SCSI Disk

A SCSI disk drive must be low-level formatted before you can use the operating system's partitioning and high-level formatting utilities, such as MS-DOS *fdisk* and *format*. Most SCSI drives have already been preformatted by the manufacturer. If a drive is not preformatted, you can use SCSI*Select*'s Format Disk option to low-level format it. The Format Disk option is compatible with most SCSI disk drives.

When you create an array with the Initial Array Configuration Utility or the Administrator Utility, you are automatically prompted to initialize (format) the drives used in the array. For more information, see *Creating an Array with the Initial Array Configuration Utility* on page 6-3 and *Adding an Array* on page 10-1.

⚠ **Caution:** A low-level format destroys all data on the drive or array. Be sure to back up your data before performing this operation. You *cannot* abort a low-level format once it starts.

To format a disk with SCSI*Select*, follow these steps:

1 Follow steps 1 through 3 in *Listing SCSI IDs* on page 13-11.

2 From the list of SCSI devices, select the device you want to format. A small menu appears.

3 Select **Format Disk**. A prompt appears, asking you to confirm that you want to format the disk.

4 Select **Yes** to start formatting the disk, or **No** to cancel formatting.

Verifying a Disk

The Verify Disk Media option scans the selected device's media for defects. If the utility finds bad blocks, it prompts you to reassign them so they are no longer used.

To verify a disk, follow these steps:

1 Follow steps 1 through 3 in *Listing SCSI IDs* on page 13-11.

2 From the list of SCSI devices, select the device you want to verify. A small menu appears.

3 Select **Verify Disk Media**.

4 If notified of bad blocks, select **Yes** to reassign the bad blocks or **No** to leave them as is.

You can press **Esc** at any time to abort the verification.

> **Note:** If the disk is part of an array, you can use the Administrator utility to verify all disks in the array. See *Verifying Arrays* on page 9-1 for instructions.

▾▾▾▾**14**

Using a CD-ROM Drive

You may need to install a CD-ROM drive on your computer so you can load software. For example, NetWare 3.12 and 4.xx are usually installed from a CD disc. The AHA-3980⁄3985 Drivers and RAID Utilities diskette included with your AHA-398x adapter contains the DOS and NetWare driver software you need in order to use a CD-ROM drive on your computer. With this software, the AHA-398x supports

- Up to 21 CD-ROM drives on one system
- Audio and data modes for all supported CD-ROM drives
- Generic data-only mode for nearly all CD-ROM drive models
- High Sierra and ISO-9660 CD formats

Using a CD-ROM Drive under DOS

To operate a CD-ROM on the AHA-3980⁄3985 under DOS, you need

- The ASPI manager, *aspi8dos.sys*
- The CD-ROM driver, *aspicd.sys*
- The Microsoft CD-ROM extensions, *mscdex.exe*

Note: You do not need *aspi8dos.sys* and *aspicd.sys* if the CD-ROM drive is connected to an adapter other than the AHA-398x. Instead, see the CD-ROM drive or adapter documentation for information on the required drivers.

The *aspi8dos.sys* and *aspicd.sys* files are copied to the *c:\scsi* direc-
tory when you select **Copy Drivers/CD-ROM Drivers** in the Array
Driver Copy Utility (see *Copying Drivers* on page 6-8). The
mscdex.exe file is included with MS-DOS 6 (see your MS-DOS doc-
umentation for details).

> **Note:** If you use MS-DOS 5 and do not have *mscdex.exe*, we
> recommend that you upgrade to MS-DOS 6 or above. You
> can also obtain *mscdex.exe* from Microsoft's online bulletin
> board or the CompuServe forum.

All you need to do is edit the *config.sys* file to include command
lines for *aspi8dos.sys* and *aspicd.sys*, and edit the *autoexec.bat* file
to include a command line for *mscdex.exe*. The following examples
illustrate the command line format and the command options
appropriate for most systems. (Sample copies of these files are
included on the AHA-3980∕3985 Drivers and RAID Utilities disk.)

Sample Command Lines for *config.sys* File:

    device=c:\scsi\aspi8dos.sys /d
    device=c:\scsi\aspicd.sys /d:aspicd0

Sample Command Line for *autoexec.bat* File:

    \dos\mscdex.exe /d:aspicd0 /M:12

    (This assigns the CD-ROM the next available drive letter,
    typically *D:* if there is only one DOS drive.)

The following tables describe the *aspi8dos* and *aspicd* command
line options. For a description of *mscdex* command line options, see
your Microsoft documentation. You can type command line options
in uppercase or lowercase letters. Leave a blank space between
options.

Command Line Options for *aspi8dos.sys*

Option	Example	Use
/ccbs*<count>*	/ccbs8	Specifies the maximum number of concurrent ASPI commands that can be supported. The valid range is 1 through 16. The default is 4. If you increase this value, the size of the ASPI manager also increases. Use this option only if you want to run an ASPI program that specifies a higher number of concurrent commands.
/d	/d	Displays information about the AHA-398x and attached SCSI devices when the computer boots.
/L	/L	Enables *aspi8dos* to recognize all eight possible LUNs associated with each SCSI ID. If the option is not used, *aspi8dos* can recognize only LUN 0 for each SCSI ID.
/m*n*	/m1	Causes aspi8dos to scan the PCI bus. The method used to scan the bus is determined by the value of *n*: /mb = scan PCI bus using PCI BIOS calls /m1 = scan PCI bus using Mechanism #1 /m2 = scan PCI bus using Mechanism #2 aspi8dos automatically scans the PCI bus for SCSI devices. It tries to determine which scanning method will work best for the given system configuration. Use the /mb, /m1, and /m2 options only if you want to override the aspi8dos internal scanning mechanism. Usually aspi8dos can determine which scanning method is optimal for your system. (PCI BIOS calls are described in the PCI BIOS spec; scanning mechanisms #1 and #2 are described in the PCI spec.
/norst	/norst	Prevents aspi8dos from resetting the SCSI bus when you boot your computer. By default, aspi8dos resets the SCSI bus when you boot the computer if the host adapter BIOS is not present. You can use /norst to prevent this from happening.
/pause	/pause	Pauses the system after loading *aspi8dos* at bootup, so you can read the message on the screen. After you read the message, press any key to resume booting.
/rst	/rst	Forces aspi8dos to reset the SCSI bus when you boot your computer. By default, aspi8dos does not reset the SCSI bus when you boot your computer if the host adapter BIOS is present.
/s*<slot number>*	/s1 /s3	Indicates the slot number(s) where you want aspi8dos to look for host adapters. Valid slot numbers = 1 to 15. If you do not use this option, aspi8dos scans all slots for host adapters, beginning at slot 1.

Command Line Options for *aspicd.sys*

Option	Example	Use
/d:*<name>*	/d:aspicd0	Required in the *config.sys* command line. Assigns a name to the CD-ROM drive so that *mscdex* can assign the CD-ROM a logical drive letter. The name must exactly match the CD-ROM drive name in the *mscdex* command line in *autoexec.bat*. Use any eight-character name.
/id={…}	/id=2+4 /id=3+5+1:4	Specifies CD-ROM drives controlled by *aspicd*. By default, *aspicd* controls all drives. In the first example, which is for a computer with one host adapter, *aspicd* controls the devices with SCSI IDs 2 and 4. In the second example, for a computer with two host adapters, *aspicd* controls the devices with SCSI IDs 3 and 5 on host adapter 0 and SCSI ID 4 on host adapter 1 (if you do not specify the host adapter number, *aspicd* assumes it is 0).
/L	/L	Enables *aspicd* to recognize all eight possible LUNs associated with each SCSI ID. If the option is not used, *aspicd* can recognize only LUN 0 for each SCSI ID. Add the /L option to the command line if you have a CD-ROM drive that can access multiple discs. If your computer system includes a Pioneer DRM-600 or DRM-604X multiple-disc CD-ROM drive, you do not need to add the **/L** option. The *aspicd* device driver automatically scans multiple LUNs if it detects one of these devices on the SCSI bus.
/norst	/norst	Prevents *aspicd* from issuing a SCSI Bus Reset message at system start-up. The default is to issue it. The Bus Reset message (supported by only Toshiba, Hitachi, and NEC drives) resets drives that are playing audio CDs when the computer reboots.
/pause	/pause	Makes your system pause after loading *aspicd* at bootup, so you can read the message on the screen. Press any key to resume booting.
/type:*<drive vendor>*	/type:sony	Allows *aspicd* to support audio play mode for CD-ROM drives that are compatible with a supported drive type but are not included on the list of supported drives. If you use the /type:*<drive vendor>* option, *aspicd* assumes that all CD-ROM drives on the SCSI bus are made by this vendor—you cannot combine different brands of CD-ROM drives on the bus. The valid entries for this option are chinon, denon, hitachi, lms, nec, panasonic, sony, texel, and toshiba.

Using a CD-ROM Drive under NetWare

To operate a CD-ROM on the AHA-398x under NetWare, you need *aspicd.dsk*. This driver is copied to your hard disk when you run the Array Driver Copy Utility and select **Copy Drivers/NetWare 3.xx [or 4.xx] Drivers** (see *Copying Drivers* on page 6-8).

Follow these steps to set up the CD-ROM drive under NetWare:

1   Edit the server *autoexec.ncf* file to include the following lines:

    load nwpa   (NetWare 4.01 and 4.02 only)
    load cdrom.nlm

2   Edit the server *startup.ncf* file to include the following line. Be sure to place it *after* the load lines for *all other* drivers:

    load *aspicd.dsk*

3   Start the server.

4   At the server prompt (:), type cd device list and press **Enter**. A list of CD-ROM drives appears.

5   Write down the device number and volume name of the CD-ROM.

6   At the server prompt, enter

    cd mount *<x> <name>*

where *<x>* is the device number and *<name>* is the volume name you wrote down in step 5.

> **Note:** The *aha3980.dsk* driver supports the NetWare tape backup utility, *sbackup.nlm*. Use *aha3980.dsk*, not the *adaptec.nlm* driver provided by NetWare, when running this utility. Adaptec's *aha3980.dsk* driver takes advantage of ASPI features that are bypassed by *adaptec.nlm*.

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Hardware Troubleshooting

This appendix explains how to diagnose and fix problems that may occur when you install an AHA-398x. If you do not find the solution to your problem here, check the *readme.txt* file on the AHA-3980/ 3985 Drivers and RAID Utilities disk, which accompanies the AHA-398x. That file contains information not available when this document was published. If you still need assistance after reading that file, call Adaptec Technical Support at the number on page ii.

Troubleshooting Checklist

AHA-398x RAID adapters have been tested for compatibility with a wide range of SCSI devices. Most problems that occur during installation result from errors in preparing and connecting devices on the SCSI bus.

Check these items first if a problem occurs during installation:

■ Does the AHA-398x BIOS banner appear when you boot your computer? The banner text is similar to this:

    Adaptec AHA-3980/3985 BIOS v1.50
    (c) 1995 Adaptec, Inc. All Rights Reserved.

If this does not appear, your motherboard BIOS may not support PCI-to-PCI bridges. Check the documentation for your motherboard or contact your vendor to determine whether the BIOS supports PCI-to-PCI bridges. If it does not, contact your vendor for information about upgrading your motherboard BIOS.

If your motherboard BIOS supports PCI-to-PCI bridges, you may have an IRQ conflict. The PCI bus is designed to automatically assign IRQ settings to the AHA-398x, but you may need to assign some of these values manually in the CMOS setup program. For details, see the *readme.txt* file on the AHA-3980/3985 Drivers and RAID Utilities disk.

■ Are the SCSI cables properly connected? Is pin-1 orientation maintained throughout the SCSI bus? (See *Connecting SCSI Devices* on page 5-5.)

■ Are the power cables properly connected? Connect internal SCSI devices to your computer's power supply. Connect the power cables of external SCSI devices to a grounded power outlet. Follow the instructions in the computer and SCSI device documentation.

■ Is the AHA-398x firmly seated and secured in a 5-volt PCI bus slot that is capable of bus mastering?

■ Is each SCSI device, including the channel, set to a unique SCSI ID? (See *Setting SCSI IDs and Preparing a Boot Device* on page 5-15.)

■ Is SCSI termination set correctly? (See *Terminating the SCSI Bus* on page 5-12.)

If your problem is still not resolved, continue with the next sections.

Startup Diagnostics

The AHA-398x includes the AIC-7870/Sequencer Diagnostics routine and the IRQ Diagnostics routine. Both routines run automatically when the system boots.

The AIC-7870/Sequencer Diagnostics routine tests the sequencers on the channels, the data flow, the memory, and the Exclusive OR function (for RAID 5 operations). When finished, one of the following messages appears:

■ AIC-7870/Sequencer Diagnostics passed: Indicates the tests were successful.

■ AIC-7870/Sequencer Error Code: [*error code text*]: Indicates that a test failed due to a defect in the adapter circuitry. You may need a new AHA-398x host adapter; call Adaptec or your reseller.

■ Did not find all channels: Indicates that the routine detected fewer than two channels or more than three channels. You may need a new AHA-398x host adapter; call Adaptec or your reseller.

■ Unknown Error in AIC-7870 Diagnostics: You may need a new AHA-398x host adapter; call Adaptec or your reseller.

■ Interrupt Test for SCSI device at [*bus number:device ID*] failed. Check interrupt assignment in system CMOS setup: Run the system CMOS Setup program and verify that the interrupt assignments are correct. If you are unable to fix the interrupt assignments, you may need a motherboard upgrade. Contact the system vendor.

■ Interrupt test for XOR device at [*bus number:device ID*] failed. Check INT B assignment in system CMOS Setup. If no reference to INT B, try assigning interrupts to every PCI slot: Run the system CMOS Setup program and follow the instructions in the message text. If this does not fix the problem, you may need a motherboard upgrade. Contact the system vendor.

BIOS Startup Messages

After you install your AHA-398x, the AHA-398x BIOS displays a message when you boot your computer. Normally, this message begins with the BIOS sign-on banner; continues with information for each detected SCSI device, and ends with the statement BIOS Installed Successfully!

Note: If none or only part of this message appears, see the *readme.txt* file on the AHA-3980/3985 Drivers and RAID Utilities disk for troubleshooting information.

If initialization fails, however, the AHA-398x BIOS displays a specific error message followed by a BIOS Installation Failure message. Here are the error messages and their meaning:

A drive larger than 1 gigabyte has been detected with 64 head / 32 sector partitioning. This drive is not compatible with the 255 head / 63 sector translation which has been enabled on this adapter. Data could be corrupted! Please check your system setup! Press any key to continue.

This message appears if the BIOS detects a large-capacity drive that has invalid partition information in the master boot record. Follow these steps to correct the problem:

1 Back up the data on the disk drive, if you want to save it.

2 Start SCSI*Select* and perform a SCSI low-level format on the disk drive (see *Formatting a SCSI Disk* on page 13-11).

3 Partition the drive again.

4 Restore data to the drive.

Device connected, but not ready.

This message appears if the channel receives no answer when it requests data from an installed SCSI device. The channel skips this device and moves on to the next device on the bus.

Follow these steps if you see this message when you request data from a SCSI drive:

1 Run SCSI*Select* and set Send Start Unit Command for this device to **yes** (see *Changing the AHA-398x Settings* on page 13-7).

2 Exit SCSI*Select* and request data from the drive again.

3 If the message still appears, follow the drive manufacturer's instructions to make sure the drive is set to spin up when the power is ON.

Host Adapter Configuration Error

The motherboard BIOS did not assign an IRQ to the AHA-398x. For troubleshooting information, see the *readme.txt* file on the AHA-3980/3985 Drivers and RAID Utilities disk.

New device(s) detected
> or

Drive missing from previous configuration
> or

Array member missing from previous configuration
> or

Drive configuration change
> or

Array configuration change

If you see any of these messages, followed by **Run ARUADMIN or ARCONFIG to update array configuration**, the BIOS has detected that you have made a change to the hardware configuration. Run the Administrator Utility or the Adaptec Initial Array Configuration Utility to update the configuration information.

Start unit request failed.

The BIOS was unable to send a Start Unit command to the device. Run SCSI*Select* and disable Send Start Unit Command for the device.

Time-out failure during SCSI Inquiry command!
> or

Time-out failure during SCSI Test Unit Ready command!
> or

Time-out failure during Start Unit command!

An unexpected time-out occurred. Check SCSI bus termination. Try disconnecting the SCSI peripheral cables from the channel and then starting the computer. If the computer successfully restarts, check SCSI bus termination and cable connections. One of the devices on the SCSI bus may be defective.

aha3980.dsk Error Messages

Any error that occurs while the NetWare driver *aha3980.dsk* is initializing prevents the driver from loading. If an error does occur, the driver first *beeps* the computer and then displays a numbered error message in this format:

ERR *xxx:message*

The *xxx* indicates the error code, and *message* describes the error. If you receive an error message when the AHA-398x driver initializes, check the following error descriptions to learn the probable problem and the remedy.

000   Failed ParseDriverParameters call
A call to NetWare 386's *ParseDriverParameters* routine has failed, probably because the command line contains an error.

001   Unable to reserve hardware, possible conflict
The driver failed in its attempt to reserve the AHA-398x adapter's hardware settings (that is, DMA and IRQ settings). Another card in your system may be causing a conflict with the AHA-398x.

002   NetWare rejected card - Failed AddDiskSystem call
The driver failed in its attempt to register the AHA-398x with NetWare 386. The file server may not have enough memory.

003   Invalid command line option entered -> option
An invalid option was entered on the command line. The Option field displays the invalid option that was entered.

004   Invalid command line, please enter correctly
The driver was unable to understand the command line options you entered. Be sure you have entered these options correctly.

200   No host adapter found for this driver to register
No AHA-398x was found in your computer. Be sure the AHA-398x is properly configured and properly seated in the slot.

202   Unable to read host adapter configuration
The driver failed to read the AHA-398x configuration data. Make sure your AHA-398x is properly inserted.

204   Invalid 'verbose' setting, use 'y'
You can only enter y or n for this option (e.g., verbose = y).

205   Invalid 'removable' setting, use 'off'
You can only enter off or on for this option (e.g., removable = off).

206   Invalid 'fixed_disk' setting, use 'off'
You can only enter off or on for this option (e.g., fixed_disk = off).

208   SCSI present but not enabled/configured for PCI.
The motherboard BIOS was unable to enable the AHA-398x, perhaps because the motherboard BIOS does not support PCI-to-PCI bridge technology. Contact your vendor for information on this and other possible causes. You may need to upgrade your motherboard BIOS.

209   Out of range bus number setting, use 0 through 255
The PCI bus number is incorrect. It must be a number from 0 through 255. Use SCSI*Select* to determine the number of the PCI bus to which your AHA-398x is connected. To determine the PCI bus number, look on the first SCSI*Select* screen, which lists the PCI bus number and channels for each AHA-398x. The PCI bus number precedes the channel letters—for example, 01:A (Channel A on PCI bus 1) indicates the AHA-398x is connected to PCI bus 1.

Disk Drive Configuration Problems

This section describes situations that may occur if your computer has multiple disk drives, including combinations of standard disk drives[1] and SCSI disk drives.

Standard hard disk drives can be set to *installed* or *not installed* by the CMOS setup program supplied with the host computer. The setup program allows you to select the number of standard hard disks that are recognized by the computer, regardless of whether they are physically installed. SCSI drives are not controlled through the CMOS setup program.

If both SCSI and non-SCSI disk drives are installed, then the non-SCSI disk drive is *always* the boot device.

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[1] *Standard disk drive* means a disk drive attached to the computer through a standard ISA/EISA, non-SCSI disk controller—for example, an IDE drive.

Booting the Computer from a SCSI Drive

■ Be sure that both standard hard disks are mapped out of the computer by setting the CMOS setup to **No Drives Installed**.

■ Be sure that the SCSI boot drive is on Channel A and has the lowest SCSI ID on that channel. Also, verify that each device on the channel has a unique SCSI ID. You can use SCSI*Select* to determine the SCSI IDs of devices on the SCSI bus, as described in *Listing SCSI IDs* on page 13-11.

■ Be sure that parity checking is consistently enabled or disabled on all devices on the SCSI bus. See *SCSI Parity Checking* on page 13-3.

■ Verify that Include in BIOS Scan is enabled for that device in SCSI*Select*. See *Include in BIOS Scan* on page 13-5 and *Changing the AHA-398x Settings* on page 13-7.

■ Be sure to reboot the computer after changing any values on a channel, in a CMOS setup program, or on a SCSI device. This ensures that the new initial values are loaded.

■ Be sure that the SCSI bus is properly terminated. See *Terminating the SCSI Bus* on page 5-12.

■ Be sure that the intended boot disk has an active DOS partition and has been formatted.

■ Check cable connections and pin-1 orientation.

Using a Standard Drive as C and a SCSI Drive as D

■ Use the CMOS setup program to map the second standard hard disk (if one exists) out of the configuration.

■ Be sure that the SCSI drive to be used as drive *D* has been assigned SCSI ID 0 on Channel A. You can also use SCSI*Select* to determine the SCSI addresses of peripherals on the SCSI bus.

■ Be sure that SCSI parity checking is consistently enabled or disabled on all devices on the SCSI bus.

■ Verify that the channel and the SCSI devices are properly configured and installed.

■ Be sure to reboot the computer after changing any values on a channel, in a CMOS setup program, or on a SCSI device. This ensures that the new initial values are loaded.

■ Be sure that the SCSI bus is properly terminated.

■ Be sure that the disk is formatted and has a DOS partition.

■ Check cable connections and pin-1 orientation.

Using SCSI Drives as C and D

■ Make sure your computer's CMOS setup is set to **No Drives Installed**, as is required for SCSI host adapters.

■ Be sure that the SCSI drive to be used as drive *C* has been assigned SCSI ID 0 on Channel A. You can use SCSI*Select* to determine the SCSI IDs of devices on the SCSI bus, as described in *Listing SCSI IDs* on page 13-11.

■ Be sure the SCSI drive to be used as drive *D* has been assigned SCSI ID 1 on Channel A.

■ Verify that Include in BIOS Scan is enabled for that device in SCSI*Select*. See *Include in BIOS Scan* on page 13-5 and *Changing the AHA-398x Settings* on page 13-7.

■ Be sure to reboot the computer after changing any values on a channel, in a CMOS setup program, or on a SCSI device. This ensures that the new initial values are loaded.

■ Be sure that SCSI parity checking is consistently enabled or disabled on all devices on the SCSI bus.

■ Verify that the channel and the SCSI devices are properly configured and installed.

■ Be sure that the SCSI bus is properly terminated.

■ Be sure that the disk has a DOS partition and is formatted.

Computer Hangs, or Channel Cannot Always Find the Drives

■ Check SCSI parity for consistency and be sure SCSI termination is set correctly.

■ Check cable length and integrity. Check pin-1 orientation.

A-9

■ If the AHA-398x LED remains on when the computer hangs, the AHA-398x may be interfering with your computer's operation. It may be installed in a PCI slot that does not support bus mastering. See your computer documentation.

Other Problems and Solutions

The screen is difficult to read when I run SCSI*Select.*
Press **F5** to toggle the display between color and monochrome modes. This may make it easier for you to read the screen.

When I tried to use the format/verify utility on a disk device, I got an Unexpected SCSI Command Failure pop-up box with a lot of error information. What does this mean?
This probably means that the utility encountered a problem with the disk device or the media and therefore cannot run. The following information appears in the pop-up window:

■ SCSI Target ID of the device

■ SCSI CDB Sent (e.g., 2F 00 00 00 00 00 00 08 00 00)

■ Host Adapter Status (e.g., 11h - Selection Timeout)

■ Target Status (e.g., 00h - Good Status)

■ Sense Key (e.g., 06h - Unit Attention)

■ Additional Sense Code

■ Additional Sense Code Qualifier

You can probably determine from the Sense Key information both the cause of the problem and its solution. Here are some of the more common Sense Key values and their meanings:

■ 02h - Not ready
  The media is not ready to format. Be sure that media is inserted in the drive and that the media has spun up.

■ 03h - Medium error
  The disk media may be defective or physically damaged. Verify and format the media with SCSI*Select* (see *Formatting a SCSI Disk* on page 13-11).

■ 04h - Hardware error
  The disk drive may be defective. Read the hardware documentation and contact the manufacturer.

- 05h - Illegal request
  The Adaptec formatting utility does not support a low-level format of this device; however, the device may already be low-level formatted by the manufacturer. (This error rarely occurs.)

- 06h - Unit attention
  The removable media may be write-protected. Disable write protection and run the utility again.

The Additional Sense Code field provides more information about the error. The meaning of these codes may be listed in your hardware manual.

My computer locks up when I press Esc to exit SCSI*Select*.
If this happens, turn your computer OFF and then ON to reboot. Any settings you changed before you tried to exit the program were stored and are not lost.

One of the SCSI devices on my computer doesn't allow me to disable termination. How can I attach it to the SCSI bus?
You might be able to attach this device on the end of the SCSI bus so you do not need to disable termination on it. If this is not possible, contact the manufacturer about other possible solutions.

I connected my computer's LED cable to the host adapter. Now the light stays on all the time and my computer hangs.
The red LED on the AHA-398x normally lights when there is activity on the SCSI bus. If the light stays on when there is no activity on the bus, it may mean that the internal SCSI cables are installed in a reversed position. Turn OFF the computer and check the pin-1 orientation of the internal SCSI cable connectors. See *Connecting Internal SCSI Devices* on page 5-7.

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Software Error Messages

This appendix describes the error messages displayed by the Adaptec RAID software, explains the probable cause of the error, and suggests remedies. Messages are listed in alphabetical order.

A SCSI Inquiry command failed.
A SCSI Mode Select command to a drive in the disk array failed.
A SCSI Mode Sense command to a drive in the disk array failed.
During formatting, the formatting utility issues these SCSI commands to all drives. If you receive one of these messages, a drive did not respond to the command. Check the power and cable connections for the drives. If a drive still does not respond, it is probably bad. Replace it and try formatting again.

Adaptec array command *n* failed.
The array driver *ardrvr.dsk* may not be loaded. Load *ardrvr.dsk* and try again.

Adaptec thread creation failed.
This message indicates problems with the operating system. Contact Adaptec Technical Support.

An AUTOEXEC.NCF file must be created before running this utility.
The utility could not find the array monitoring utility, *arumon,* which must be loaded at all times (see *arumon.nlm* on page C-3). Add the following line to the end of the server's *autoexec.ncf* file:

    load arumon

Save the change and then restart the server. NetWare will now load *arumon* automatically whenever the server starts.

B-1

Attempt to obtain Adaptec driver version failed.
An array utility tried to obtain the version number of the Adaptec array driver (*ardrvr.dsk*) but was unable to do so—probably because the driver is not loaded. Load *ardrvr.dsk* and try again.

Before you can include this device, you must dismount all volumes on it.
You selected a disk with mounted volumes to be a spare or to be part of a new array. You must dismount all volumes on the disk before you do this.

Could not find an Adaptec array driver load line in STARTUP.NCF.
The *startup.ncf* file does not include a load line for an array. To create a load line, create an array.

Encountered a problem loading an NLM. Installation may be incomplete.
This message appears when the Administrator utility installs the array utilities in *sys:system* and a required file does not load. Recopy the files from the *c:\aha398x\netware* directory to the DOS directory containing the *server.exe* file; then use the Install Utility Suite option to re-install the utilities (see *Installing the Array Utilities in the sys:system Directory* on page 10-11).

Failed to open Adaptec drive definition file.
The utility could not read or find the file *arudrv.def*. Recopy the file from the AHA-3980∕3985 Drivers and RAID Utilities disk; then restart the Administrator utility.

Host adapter number in the STARTUP.NCF file is invalid.
An array load line in the *startup.ncf* file contains an invalid host adapter ID. Delete the load line from the *startup.ncf* file, then use the Administrator utility to create the array (see *Adding an Array* on page 10-1). The Administrator utility will automatically enter the correct IDs in the *startup.ncf* file.

Invalid Adaptec disk array model number of *n* for command *m*.
Call Adaptec Technical Support.

Invalid command error received from the Adaptec disk array driver.
This indicates a software problem. Call Adaptec Technical Support.

I/O error occurred on array #*n* during Convert. Conversion aborted.
I/O error occurred on array #*n* during Reconstruct. Reconstruct aborted.
I/O error occurred on array #*n* during Verify. Verification aborted.
The utility was unable to convert, reconstruct, or verify the array. Try the procedure again. If it still fails, call Adaptec Technical Support.

No current broadcast string found.
The *aru.ini* file does not include the necessary broadcast information. Determine whether the file exists or is corrupted. If the file does not exist, unload then reload *arumon*. This should create the file. If the file is corrupted, call Adaptec Technical Support.

No device error received from the Adaptec disk array driver.
The utility is not working properly. Call Adaptec Technical support.

Not enough drives to configure any RAID level.
You tried to create a new array, but there is only one drive left. For the minimum number of drives in each array type, see *Disk Requirements* on page 2-3.

Not enough memory to run this utility!
The system memory is already allocated to other utilities. Unload some of these utilities to free up memory, or install more memory.

The automatic loading of MCIM.DSK has timed out. Please ensure that it is in the same directory as SERVER.EXE.
If the *mcim.dsk* file is in the directory, it may be taking a long time to load. Load the file manually.

The drive is too small for reconstruction.
The reconstructed data cannot fit on the replacement drive. Use a larger capacity drive.

The Format command failed on drive #*n*.
This message can appear during formatting or drive reconstruction. Check the power and connections to the drive, then retry the procedure. If the message still appears, the drive is probably bad. Replace the drive and try the procedure again.

B-3

The Read Capacity command for drive #*n* failed.

During formatting, the formatting utility issues a SCSI Read command to all drives. If you receive this message, a drive did not respond to the command. Check the power and cable connections for the drives. If a drive still does not respond, it is probably bad. Replace it and try formatting again.

The SCSI Read Capacity command for spare #*n* failed.

You are formatting or reconstructing a disk that has failed or that cannot be found. Verify that the drive is turned on and check all connections. If this does not resolve the problem, replace the disk.

This Adaptec utility is incompatible with the Adaptec disk array driver.

You either updated the Adaptec array driver *ardrvr.dsk* without reinstalling (updating) the other Adaptec array files, or updated the utility NLMs without updating the driver. Copy the updated Adaptec RAID software from the diskette to the server directory that contains *server.exe*, then use the Install Utility Suite option to install the updated software (see *Installing the Array Utilities in the sys:system Directory* on page 10-11).

This NLM is not executable from the command line.

You cannot run this utility from the command line. You must use the Administrator Utility.

Unable to convert the array.

An I/O error occurred during the conversion. Check the power and cable connections for all array drives, then try the conversion again.

Unable to find a DOWN drive that responds to Test Unit Ready.

You are trying to reconstruct data on a drive that was down, but the drive is not responding. Either the drive is not installed or it is still down. Install or replace the drive and try again.

Unable to obtain Adaptec array state.

The utility tried to determine the status of the array, but was unable to do so—most likely because the *startup.ncf* file does not include a load line for the array. Reinstall the array, following the instructions in *Adding an Array* on page 10-1.

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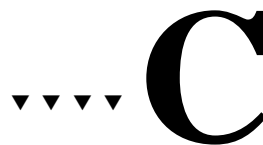
Glossary of RAID Software

Read this appendix for an overview of

- NetWare drivers used by the arrays
- NetWare loadable modules used with the arrays
- Other files associated with the Adaptec RAID software

NetWare Drivers

ardrvr.dsk
The array driver, which makes the array disks appear to the server as a single virtual disk and controls array operations. The driver uses the information you enter with the Initial Array Configuration utility and the Administrator utility (component disks, RAID level) to set up and operate the array.

mcim.dsk
The interface between *ardrvr.dsk* and the AHA-398x. This driver loads automatically when *ardrvr.dsk* loads.

NetWare Loadable Modules

aruadmin.nlm

The Administrator utility, which allows central control of all array tasks, including the following:

- Setting up nonbootable arrays

- Displaying the status and configuration of arrays

- Verifying mirrored and RAID 5 arrays

- Testing spare drives

- Reactivating an off-line array or spare

- Reconstructing data on replacement drives

- Converting a RAID 5 array to RAID 0, or vice versa

- Adding, redefining, or deleting an array

- Scheduling Verify, Reconstruct, and Spare Test operations

The Administrator utility gives the operator a tool for creating arrays. It also inserts the *arumon.nlm* load line in the *autoexec.ncf* file, ensuring the Array Monitor utility loads whenever the server starts.

The Administrator utility loads other utilities, such as *arucvt* (the Convert utility), as needed.

arucvt.nlm

The Convert utility, which runs the RAID conversion function for *aruadmin*. Depending on the operator's selection, *arucvt* converts RAID 0 CVT arrays to RAID 5 CVT arrays or vice versa.

arufmt.nlm

The Format utility, used to format the arrays for the RAID level specified by the operator. This utility is used for the formatting function in *aruadmin*.

arulib.nlm

The library of routines used by all array NLMs. This file loads automatically when the first array file (usually *arumon.nlm*) loads.

arumon.nlm

The Array Monitor utility, which performs the following functions:

- Monitors the array driver for error conditions and displays the error messages on the server console. The messages are also broadcast to any client locations selected by the operator.

- Automatically starts the Reconstruct utility (*arurec.nlm*) if a drive fails in an array that contains a spare.

- If a function is scheduled, loads the Scheduler utility (*arusched.nlm*) when the server starts.

The Array Monitor utility must be loaded at all times and only one instance may be loaded. When you set up the initial arrays on a server, the Administrator utility automatically inserts the load line for *arumon.nlm* in the *autoexec.ncf* file, ensuring the Array Monitor utility loads whenever the server starts.

arurec.nlm

The Reconstruct utility, which runs the data reconstruction function for *aruadmin* and *arusched*. In mirrored arrays, this utility remirrors one or all down drives. In RAID 5 arrays, the utility uses parity and user data on the good drives to reconstruct data on a down drive.

arusched.nlm

The Scheduler utility, which performs Verify, Reconstruct, and Spare Test operations scheduled by *aruadmin*. If an operation is scheduled, *arumon* loads the Scheduler utility when the server starts. The Scheduler utility sleeps until the scheduled time of the operation.

aruver.nlm

The Verify utility, which runs the array verification function for *aruadmin* and *arusched*. This utility verifies the consistency of data on mirrored and RAID 5 arrays.

Other Files

aru.ini

A text file that contains the following configuration information:

- Monitor type: Color or monochrome. The default is *C* (color).

- Persons who will receive broadcast messages: The default is *Everybody.*

- Scheduling information: The scheduled times for verifications, spare tests, or reconstruction of data on a replacement disk

- Auto-Correct flag for the Verify function: The default is *Y* (that is, Auto-Correct is on). For information on the Auto-Correct flag, see *Verifying Arrays* on page 9-1.

- Low-level format flag for the Reconstruct function: The default is *N* (that is, no low-level format is performed as part of the Reconstruct function).

If you accidentally delete the *aru.ini* file, you can re-create the file by restarting the server. When the Array Monitor utility loads, it automatically creates the *aru.ini* file (if it does not exist), setting the parameters to their default values. Use the Administrator utility to reschedule verifications or other tasks, and to select those who will receive broadcast messages. The information is automatically stored in the new *aru.ini* file.

aru.log

A data file, created the first time *arumon.nlm* loads, that contains error messages, start and completion times for functions, and note-worthy messages. All array modules write to this file.

aru.msg

The message file, a compressed ASCII file that contains all text displayed on screen.

arudrv.def

The drive definition file, which contains format information for drives of various manufacturers. This information is used by the Format utility (*arufmt.nlm*).

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