



ATTO Technology, Inc.

ATTO ExpressPCI Utilities

Installation and Operation Manual

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ATTO ExpressPCI Utilities

ATTO ExpressPCI Utilities are a collection of applications, enhancements and utilities designed to enhance the performance of ExpressPCI SCSI and Fibre Channel host adapters.

ATTO ExpressPCI Utilities optimize performance for your specific applications with ATTO ExpressPCI SCSI or Fibre Channel host adapters. Tools for Macintosh® OS and OS X, Windows® and Sun Solaris™ operating systems are available.

Information about ExpressPCI Utilities is separated into chapters based on operating system. General product and additional contact information is in the appendices.

ATTO ExpressPCI Utilities for various operating systems

Function	Windows 2000/XP/Server 2003	Windows NT	Mac OS X	Mac OS	Solaris
SCSI NVRAM configuration	ExpressPCI Configuration Tool, SCSI Util or BIOS Utilities page 1, page 24	SCSI Util or BIOS Utilities page 24	ExpressPCI Configuration Tool page 1	Configuring ExpressPCI SCSI Adapters page 7	
FC NVRAM configuration	ExpressPCI Configuration Tool or BIOS Utilities page 1, page 24	BIOS Utilities page 24	ExpressPCI Configuration Tool page 1	Configuring ExpressPCI Fibre Channel Adapters page 11	Solaris Utilities page 43
Volume management	ATTO ExpressRAID*	ATTO ExpressRAID*	ATTO ExpressStripe for OS X*	ATTO ExpressRAID*	
Benchmarking	Bench 32 page 33	Bench 32 page 33	ATTO ExpressStripe for OS X*	ATTO Benchmark page 21	
Mode page configuration	Alamode page 32	Alamode page 32		Express Pro-Tools page 15	
FC-IP support	FC-IP Driver page 35	FC-IP Driver page 35			
SNIA FC API support	API Library page 38	API Library page 38			
FC LUN masking support	LUN Mask page 39	LUN Mask page 39			
Domain Validation	SCSI DV page 41				
*Available separately. Contact your ATTO representative or visit www.attotech.com					

Glossary

Fibre Channel is a serial communications technology designed to transfer large amounts of data among a variety of hardware systems over long distances. It is a key technology for applications that require shared, high bandwidth access to storage.

Fibre Channel provides a logical, point-to-point, serial channel for the transfer of data between a buffer at a source device and a buffer at a destination device. It moves buffer contents from one port to another, without regard to the format or meaning of the data so different upper level protocols are able to run over Fibre Channel hardware.

The Fibre Channel architecture is structured as a hierarchical set of protocol layers. Defined within these layers are rules for signal interfaces, serial encoding and decoding, error control, frame format and communications protocols.

ATTO Express PCI Fibre Channel host adapters carry SCSI protocol over Fibre Channel.

Glossary

Some terms used in the Fibre Channel industry are defined below. More information is available through the ATTO Technology website (www.attotech.com), the Fibre Channel Industry Association (www.fibrechannel.com), Cern (www.cern.ch), the Storage Area Networking Industry Association (www.snia.org), and the Fibre Channel Consortium (www.iol.unh.edu/consortiums, click on FC).

Term	Definition
ANSI	American National Standards Institute
arbitrate	process of selecting one L_Port from a collection of ports which ask for use of the arbitrated loop at the same time
arbitrated loop	a loop topology (FC-AL) in which two or more ports are interconnected, but only two ports can communicate at one time. Low-cost solution which may or may not use hubs and switches.
autonegotiation	hardware senses and automatically responds depending on configuration
BER	Bit Error Rate: a measure of transmission accuracy; the ratio of bits received in error to bits sent
bit	Smallest unit of data a computer can process: a single binary digit with a value of either 0 or 1
bus	a collection of unbroken signal lines used to transmit information from one part of a computer system to another. Taps on the lines connect devices to the bus.
Byte	an ordered set of 8 bits
channel	a point-to-point link which transports data from one point to another
CPU	Central Processing Unit: the portion of the computer that actually performs computations.
CRC	Cyclic Redundancy Check: an error-correcting code which calculates a numeric value for received and transmitted data. If no error has occurred during transmission, the CRC for both received and transmitted data should be the same.
destination address	a value in the frame header of each frame which identifies the port in the node where the frame is being sent
device driver	a program that allows a microprocessor to direct the operation of a peripheral device
DMA	Direct Memory Access: a way to move data from a storage device directly to RAM without using the CPU's resources
DMA bus master	Allows a peripheral to control the flow of data to and from system memory by block as opposed to allowing the processor to control the data by bytes (PIO or programmed I/O)

Term	Definition
fabric	A Fibre Channel switch or two or more Fibre Channel switches interconnected to physically transmit data between any two N_Ports on the switch or switches.
FC	Fibre Channel
F_port	A port in the Fibre Channel fabric where a N_port may attach
FL_port	A port in the Fibre Channel fabric where a NL_port may attach in an arbitrated loop
frame	an indivisible unit for transfer of information in Fibre Channel
frame header	the first field in the frame containing the address and other control information about the frame.
full duplex	a communication protocol which allows transmission in both directions at the same time
half duplex	a communication protocol which allows transmission in both directions, but only one direction at a time
host	a processor, usually a CPU and memory, which communicates with devices over an interface
initiator device	A component which originates a command
L_port	a port in an arbitrated loop, either a NL_port or a FL_port
LED	Light-emitting diode: a type of diode that emits light when current passes through it. Visible LEDs are used as indicator lights on all sorts of electronic devices.
LUN	Logical Unit Number: an identifier for a logical unit (0-7)
multi-mode fiber	an optical fiber which can carry several beams of light at once.
N_port	a port attached to a node used with point to point or fabric configurations
NL_port	a port attached to a node in Fibre Channel arbitrated loop or fabric loop configuration
originator	an initiating device; a component which originates a command
parity checking	A method which verifies the accuracy of data transmitted over the SCSI bus by adding one bit in the transfer to make the sum of all the bits either odd or even (for odd or even parity). An error message occurs if the sum is not correct.
PCI	Peripheral Component Interconnect. Allows peripherals to be connected directly to computer memory, bypassing the slower ISA and EISA busses.
point-to-point	a topology where two ports communicate
port	an access point in a device: see N_port, NL_port, etc.
port address	also port number. The address, assigned by the PCI bus, through which commands are sent to a host adapter board.
port number	see port address
receiver	the ultimate destination of data transmission; a terminal device
scatter/gather	a device driver feature which allows the host adapter to modify a transfer data pointer so that a single host adapter can access many segments of memory, minimizing interrupts and transfer overhead.
SCSI	Small Computer Systems Interface: a processor-independent standard for system-level interface between a computer and intelligent devices including hard disks, floppy disks, CD-ROM, printers, scanners, etc.
single-mode fiber	an optical fiber with a small core which supports one wavelength (ray of light). The core radius is nearly equal to the wavelength of the source.
topology	logical layout of the parts of a computer system or network and their interconnections
transceiver	a transmitter/receiver module
transfer rate	the rate at which bytes or bits are transferred, as in megabytes or gigabits per second.

1 ExpressPCI Configuration Utility

The ATTO ExpressPCI Configuration Tool is a utility for Windows XP/2000 and Mac OS X that helps you customize the NVRAM settings of your ExpressPCI host adapter to maximize the performance of your storage connection and update firmware and drivers.

While the factory settings on your ExpressPCI host adapter should provide excellent performance for a wide range of applications, some specialized applications may benefit from modification of the adapter NVRAM settings to tune the adapter for a specific performance range. The ExpressPCI Configuration Tool helps you tune your host adapter.

In addition to tuning ExpressPCI host adapters, this utility may also be used to verify the drivers and flash files currently in use and update the flash as necessary.

Installation

- 1 Using the documentation provided with your SCSI or Fibre Channel ExpressPCI host adapter, install the adapter in your system and connect it to your storage system using proper cables and termination. The most recent documentation for ATTO products can be downloaded directly from the ATTO Technology web site www.attotech.com
- 2 Download the ExpressPCI Configuration Tool from the ATTO web site www.attotech.com, or copy the installation file from the CD-ROM that came with your host adapter (specific models only).
- 3 Double-click the installer icon.
- 4 Follow the on screen instructions to properly install the utility.
- 5 You are now ready to use the configuration application. Double-click the application icon to run the program.
- 6 If the application did not install properly, or you have other questions, contact ATTO Technical Support for additional assistance.

Quick Start

NOTE ATTO ExpressPCI host adapters are designed to operate properly using the factory settings. Entering invalid or incorrect settings when using an NVRAM configuration utility such as ExpressPCI Configuration Tool may cause your host adapter to function incorrectly. ATTO strongly recommends backing up system data when installing or changing hardware configurations.

- 1 **Locate the application icon in the folder you created during installation.**
- 2 **Double-click the icon to start the application. You are presented with the main screen with three windows: Device window, Configuration Options window and status.**

The **Device window** provides a list of all devices currently connected to the system. Expanding the device tree reveals additional detail on devices connected there. Collapsing the branch will hide device information. Information and options for a device highlighted in the device window is presented in the Configuration Options window. The **Configuration Options window** has three tabs: Basic Info, Flash and NVRAM Config. The Basic Info and Flash tabs are available for all busses and devices (including those not attached by an ATTO host adapter) discovered by the utility. The NVRAM Config tab is only available when a specific channel is selected in the device window for an ATTO ExpressPCI host adapter. The **Basic Info tab**, provides basic information about the device currently highlighted in the device window. This is an informational screen and does not provide an interface for changes. The **Flash tab** provides information about the current revision of flash loaded on a highlighted host adapter. Use the *browse* button at the bottom of this tab to search for new flash files on your system (i.e. *FlashBundle_220U.2200*). Once the desired file is located, simply click on the *update* button to automatically update your host adapter.

Highlighting a specific channel on an ATTO ExpressPCI host adapter (typically the lowest level on the device tree) brings up the *NVRAM Config* tab which helps you to tune your adapter settings for optimum performance in specific applications. Use caution when making changes to NVRAM settings and only make changes to those you are familiar with. Once you have made the desired changes, simply click the *Commit* button to activate the changes (these take effect after rebooting your system). The *Defaults* button restores the adapter to factory default settings. Click the commit button to accept these settings. The *Restore* button reverts to the NVRAM settings saved the last time the commit button was used. Click the commit button to accept these settings.

Detailed information on NVRAM settings available for configuration including available options, default options and setting descriptions is available in this manual:

- ❖ Max OS X SCSI Chapter 2.3
- ❖ Mac OS X FC Chapter 2.4
- ❖ Windows SCSI Chapter 3.1
- ❖ Windows FC Chapter 3.2

Troubleshooting

You may see an error message informing you about an unexpected event or incorrect information discovered by the application. Using the help text presented with the error message, correct the issue before proceeding.

The following conditions cause a warning or error message to be posted in the *Status* area of the configuration utility. These messages will be shown in red.

Feature bounds checking

When the commit button is clicked, each NVRAM feature must be validated before being sent to the card. If any one of these features is deemed inappropriate based on the implemented checks, further NVRAM feature validation checks are stopped and the message is displayed. For example, if you enter the value 1000 in the Fibre Channel NVRAM feature *Execution*

Throttle and click the commit button, this message is displayed:

Execution Throttle is greater than the maximum allowable value of 255. No NVRAM configuration changes have been made to your card.

An error occurred loading NVRAM data.

The first time a channel is highlighted, the application tries to read NVRAM from the card. If the size of the NVRAM buffer does not match the expected size, or if the NVRAM buffer couldn't be retrieved at all, this message is displayed:

Warning: NVRAM could not be read, defaults returned.

NVRAM is corrupt and the driver returns to the defaults. The defaults are presented via the graphical user interface and you are informed that the values shown are defaults. These defaults must be committed in order to correct NVRAM.

An error occurred updating the NVRAM.

The driver cannot put the new settings on the card; no changes are made to the card.

This is not a flash file, or it is corrupt.

Only ATTO created flash files may be selected using the flash file dialog box. If another file type (i.e., a text file) is selected, the file is not an ATTO created flash file and is therefore incompatible with the flash mechanism. Or, this message is displayed if the ATTO created flash file is corrupt.

This HBA is not compatible with the selected flash file.

ATTO flash files are created based on the type of card to be flashed. Certain ATTO flash files are only compatible with certain ATTO cards. When a flash file is selected, the flash file is inspected to determine if the file is compatible with the card.

A valid file was not selected.

Occurs when you click the *Cancel* button on the flash file selection dialog.

An error occurred reading from the flash file, File may be corrupt.

Occurs when you selects a compatible flash file but the contents are corrupt.

An error occurred updating the flash.

You tried to flash a card when the firmware was not able to accept a flash or the card was prepared for firmware updating but the machine must be rebooted for the changes to take effect.

2 ATTO ExpressPro-Tools for Macintosh

This is an all in one utility which includes a host adapter configuration utility, a benchmarking application and storage management tools for SCSI and Fibre Channel configurations. All functions are accessible from a single main utility window.

ATTO ExpressPro-Tools supports Macintosh OS 8.6-9.x to create and format partitions, modify mode pages, and provide benchmark information.

Installing ExpressPro-Tools

ATTO ExpressPro-Tools should be installed on your hard drive.

- 1 Insert the ATTO ExpressPro-Tools CD.
- 2 Double click on the ExpressPro-Tools disk icon.
- 3 Double click the ATTO ExpressPro-Tools *Installer*.
- 4 Drag the ATTO ExpressPro-Tools icon to the drive where you want ExpressPro-Tools installed. This will install ATTO ExpressPro-Tools into the ATTO folder on the hard drive specified.

- 5 The installer will ask if you would like to install the ExpressPro-Tools Extension to support removable drives or non-zero LUNs. If you do not need this option, choose No.

- 6 Click Quit.

Accessing ExpressPro-Tools

After ExpressPro-Tools has been installed on your hard drive,

- 1 Double click on the drive ATTO ExpressPro-Tools was installed to.
- 2 Double click on the ATTO folder.
- 3 Double click the application icon.
- 4 Enter your name and company.
- 5 The application will start.

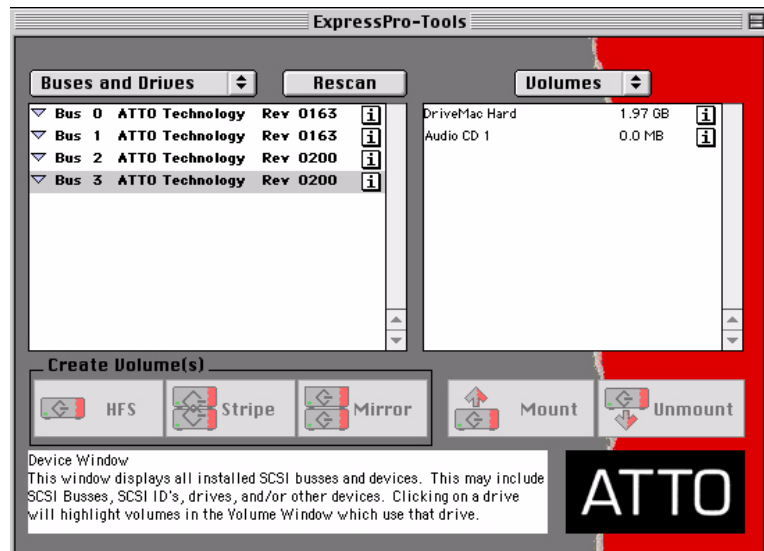
Exhibit 2.0-1 ExpressPro-Tools main screen display for the Macintosh OS.

Device window: displays busses, IDs and devices information depending on the setting chosen in the device window pull-down. Clicking on a drive will highlight the corresponding volume.

Information button: accesses additional information

Volume window: displays all Macintosh OS volumes on all busses. Click on a volume in the volume window to highlight the associated drives in the device window.

Balloon help, information: changes depending on what is highlighted or chosen above. Includes choices and explanations.



2.1 Navigating

ATTO ExpressPro-Tools provides an easy way to get information and make changes to your host adapter by offering choices, information and entry points into more complex information and actions via a series of screens. A choice may lead to another screen or another choice. Greyed areas cannot be accessed until activated by either choice or the needs of the system.

Main window

The main ExpressPro-Tools screen offers choices, information and entry into more complex information and actions via the device window and the volume window. A choice may lead to another screen or another choice. Greyed areas cannot be accessed until activated by either choice or the needs of the system.

Choices allow you to change host adapter configurations, get information about attached storage, run benchmarks, mount and unmount storage, and create and manage partitions and standard volumes.

Device window

On the left side of the ExpressPro-Tools main window is the device window. This window displays busses, IDs and devices. The amount of information shown depends on the setting chosen in the device window menu. Next to each item is

an information button. Clicking on a device in the device window highlights the associated volumes in the volume window.

The information displayed in the device window is divided into three categories: bus IDs, device IDs and logical unit numbers (LUNs).

Volume window

The volume window, on the right hand side of the main window, displays all Macintosh OS volumes on all SCSI and Fibre Channel busses. Clicking on a volume in the volume window highlights the associated drives in the device window. Next to each item is an information button.

The information displayed includes the volume name and size. An asterisk in front of a volume name denotes an unmounted volume. Clicking on the volume or the information button displays volume type, volume status and partition information.

2.2 Device & Volume Window Menus

The ATTO ExpressPro-Tools device window displays busses, IDs and devices. The volume window displays information about the available volumes.

The amount of information shown in the device and volume windows depends on the settings. An information button next to any item in either window provides more information about that item. Clicking on a device in the device window highlights the associated volumes in the volume window, and vice versa. Other choices may be presented after clicking on certain items in either window.

The device window menu, above the device window, presents three options.

- ❖ **Busses and Drives:** Displays all SCSI and Fibre Channel busses and the hard drives attached to them. Other devices which ExpressPro-Tools does not affect, such as CD-ROM drives, tape drives and scanners, are not shown in the device window.

- ❖ **Busses and Devices:** Displays all SCSI and Fibre Channel busses and the devices attached to them. This setting is useful for determining what devices are attached to your computer and what IDs are available for additional devices.

- ❖ **Busses and All IDs:** Displays all SCSI and Fibre Channel busses and all IDs, whether the device is at that ID or not. This option is most useful when configuring individual IDs using the ExpressPCI Configuration Options (refer to Chapter 2.3 for more information).

Note: You may configure individual SCSI IDs on a SCSI bus, but any change made to a Fibre Channel bus is changed for all the devices on that bus.

SCSI bus information

SCSI bus information is displayed in bold type.

Clicking on the triangle to the left displays or hides a SCSI ID and the devices attached to it. The information displayed includes the bus number,

device manufacturer and the version number if available. Double click on a device or click on its information button to reveal more information about that device, including the device version, width and transfer speed.

SCSI device ID information

- ❖ SCSI address of the device, where X is the bus number, Y is the SCSI ID number and Z is the Logical Unit Number.
- ❖ Type of device at the address
- ❖ Device manufacturer
- ❖ Amount of drive space available to create new volumes. A completely initialized drive appears as having 0.0 MB free.
- ❖ Double click on a SCSI ID or click on its information button for more information on the device ID, including drive vendor, model number, capacity and partition information. If the ID is on an ATTO bus, additional parameters are accessible (refer to Chapter 2.3).

Fibre Channel device ID information

Clicking on a Fibre Channel device ID will provide the following information:

- ❖ SCSI address of the device, where X is the bus number, Y is the ID number and Z is the Logical Unit Number. The SCSI address shown is translated from the FC_AL address.
- ❖ Type of device at that address
- ❖ Manufacturer of the device
- ❖ Amount of space available on the drive for creating new volumes: a completely initialized drive is shown as having 0.0 MB free.
- ❖ Double click on a device or click on its information button to reveal more information, including the drive vendor, model number, capacity and partition

information. Fibre Channel IDs on an ATTO bus may only be changed in a uniform fashion. (Refer to Chapter 2.4 for more information).

Scanning busses

A drive which is not powered up may not be seen by ExpressPro-Tools at start-up. If you believe other drives are on a bus but are not visible in the

ExpressPro-Tools device window, the busses can be rescanned. Rescanning the bus checks every ID of every bus for devices. Any devices found are displayed in the device window.

To re-scan the bus, select the *Rescan Bus* option from the utilities menu or the button in the main window.

2.3 Configuring ExpressPCI SCSI Adapters

ExpressPro-Tools may be used to configure ATTO ExpressPCI adapters, however, entering invalid values may cause your ExpressPCI adapter to function incorrectly. You may only configure SCSI busses labeled ATTO Technology. To access the configuration options for the ATTO ExpressPCI host adapter, double-click the appropriate bus or click the information button next to it.

WARNING You do not need to change options for ATTO ExpressPCI host adapters in ATTO ExpressPro-Tools. Entering invalid values may cause your ExpressPCI adapter to function incorrectly. Back up system data when changing or installing hardware.

Access the utilities you wish to use by clicking on drives or devices in the device window or by clicking the information button next to the device or drive.

Safeguard buttons

Safeguard buttons save your work or revert settings to previously saved versions. You must select a safeguard button if you make changes to the ExpressPCI adapter configuration.

Defaults: Reverts the current ExpressPCI adapter configuration options to default settings.

Cancel: Cancels edits and returns to the ExpressPro-Tools main window.

OK: Accepts edits and returns to ExpressPro-Tools main window. Changes made are saved to the Flash ROM of your ExpressPCI adapter when quitting ExpressPro-Tools. Restart computer for changes to take effect.

Configuration utilities

ExpressPro-Tools graphically displays all SCSI Manager 4.3 compatible busses found on your computer. While using the ATTO ExpressPro-Tools, you are able to view information on all busses and devices attached to your computer.

You may change a variety of settings for the SCSI bus by accessing the Channel menu. SCSI busses are identified on the ExpressPro-Tools device window in bold type. You may only configure SCSI busses labeled *ATTO Technology*.

To access the configuration options for the ExpressPCI adapter, double-click the SCSI bus or click the information button next to it.

Adapter configurations

Do not configure these features unless you have a thorough understanding of how they function or are advised to change them by an ATTO Technology Technical Support representative.

Controller ID

Choices: 0-15

Default: 7

ExpressPCI adapters are set to SCSI ID 7 because ID 7 has the highest priority on the bus.

WARNING Do not change this setting unless advised by an ATTO Technical Support representative. Multiple devices on the same SCSI bus with the same controller ID may cause data corruption or may cause your system to stop responding.

Termination

Choices: Automatic, High (Ultra320)

Choices: Automatic, High, None (Ultra 3, Ultra/WIDE)

Default: Automatic

ExpressPCI differential cards do not use this option. This setting can be used with the ExpressPCI-PSC to override its automatic termination setting. If you are using both internal and external SCSI busses, you must enable termination. Refer to the chart below to determine the proper setting for your device configuration.

Wide Devices refer to 16-bit Ultra/Wide SCSI or 16-bit Fast/Wide SCSI.

Narrow Devices refer to 8-bit Fast UltraSCSI, 8-bit Fast SCSI-2, or 8-bit SCSI-1.

Exhibit 2.3-1 Termination Selection Chart

Internal Connection	External Connection	Termination Selection
Narrow Device	Wide Device	High
Wide Device	Narrow Device	High
Narrow Device	Narrow Device	High

If you use a combination of Wide and Narrow devices, the Wide devices must be connected first

followed by the Narrow devices. This rule applies to both internal and external channels. For more information, check your devices' documentation.

Enable Wide IDs (8 - 15)

Choices: Enabled, Disabled

Default: Enabled

Allows you to access Wide devices that may reside at these ID locations without affecting Wide data transfer capability. This option is included for compatibility with some older, 8-bit SCSI devices and is not available for Ultra 320 adapters.

Video Tuner (Ultra3, Ultra/WIDE)

Choices: Enable, Disable

Default: Disabled

If you are not using a Radius capture board, keep at the default (disabled) setting. Enable may increase capture and playback performance for Radius users.

Selection Timeout

Choices: 1 ms - 1 sec

Default: 250 ms

Sets the amount of time a device has to respond to being selected. You can lower this value to speed boot process. If the value is lower than the recommended 250 milliseconds, it may be too fast and some devices may not have enough time to respond.

Pre-4.3 SCSI Manager (Ultra3, Ultra/WIDE)

Choices: Enabled, Disabled

Default: Enabled

Allows support for pre-4.3 SCSI manager devices such as older scanners and CD-ROMs. This setting does not apply to the ExpressPCI Ultra 320 host adapter because it is not compatible with pre-4.3 SCSI manager devices

Fall Back Sync Rate

Choices: 1.8/3.6 MB/sec. - 20/40 MB/sec.

Default: 20 (Ultra/Narrow), 40 (Ultra/Wide)

Sets the maximum synchronous transfer rate on the SCSI bus to account for the cabling and device restrictions of Single-Ended UltraSCSI. You may set the SCSI bus transfer rate to Fast/Wide SCSI transfer rates to eliminate the cabling and device limitations of UltraSCSI.

Quick Arbitrate & Select (Ultra320 only)

Choices: Disabled, Enabled

Default: Enabled

If enabled, Ultra320 QAS functionality is available. This feature improves performance by reducing the time required to process commands. QAS can only be enabled if all target settings are set to Sync DT-IU

Reconfigure device IDs

You can configure a variety of settings for each individual SCSI ID found on the ATTO SCSI bus. To access all SCSI IDs, whether devices are attached or not, use the device window menu to select busses and all SCSI IDs.

Identify the SCSI ID you want to adjust under the appropriate ATTO SCSI bus and double click on that device or click its information button.

SCSI ID configuration options

WARNING Do not configure features unless you have a thorough understanding of how they function or are advised to change them by an ATTO Technical Support representative.

Synchronous Transfers

Choices: Enabled, Disabled

Default: Enabled

Allows synchronous communication with devices. Synchronous communication is generally faster than asynchronous, but some devices may not function efficiently in synchronous mode. Toggle this switch to *Disabled* to initiate asynchronous data transfers.

Wide Transfers

Choices: Enabled, Disabled

Default: Enabled

Ultra3 Choice: Wide (default)

The ExpressPCI adapter tries to transfer SCSI data in a Wide mode to all devices when enabled. It may be disabled for older, Narrow devices that do not respond properly to Wide transfer negotiation.

Allow Disconnect

Choices: Enable, Disable

Default: Enabled

Controls whether the ExpressPCI adapter allows the device to use the SCSI disconnect/reconnect mechanism. Allowing SCSI disconnects increases performance in systems with a software-based

array. Allowing disconnect can increase the SCSI bus overhead time, and decrease performance.

Enable LUNs (Ultra3, Ultra/WIDE)

Choices: Checked, Unchecked

Default: Checked

Allows the use of Logical Unit Numbers (LUNs) for this particular SCSI ID. Each allowable LUN has a check box (i.e. LUN 0 through 7). The default has a check in each LUN check box. You can prevent any or all LUNs from being detected by removing the appropriate check.

The ExpressPCI host adapter settings allow changes to be discarded and replaced with factory default settings by choosing *Reset to Defaults*.

Enable LUNs (Ultra320)

Choices: Disable ID, 0, 0-7, 0-63

Default: 0-7

Allows the use of Logical Unit Numbers (LUNs) for this particular SCSI ID. IDs may be disabled or set to recognize a group of LUNs. For example, selecting the 0-7 setting scans LUNs 0-7, while selecting the 0-63 setting scans LUNs 0-63.

Synch Offset

Choices: 0-16 for Ultra/Wide SCSI

0-62 for Ultra3 SCSI

0-127 for Ultra320

Default: 16 for Ultra/Wide SCSI

62 for Ultra3 SCSI

127 for Ultra320

Extensive testing by ATTO has determined this default value to offer the best performance

possible. **Do not** change this setting unless instructed by an ATTO Technical Support representative.

SCSI Parity Check

Choices: Enable, Disable

Default: Enabled

Initiates error parity checking of data transfers over the SCSI bus when enabled without degrading system performance. This option assists compatibility of devices not supporting SCSI parity.

Sync Rate

Choices: varies by adapter, see Exhibit 2.3-2

Default: varies by adapter, see Exhibit 2.3-2

If synchronous transfers are enabled, the sync rate sets the maximum rate at which the ExpressPCI host adapter will negotiate with each device attached to it. ATTO recommends setting the rate to the maximum value supported by the host adapter.

If excessive SCSI errors occur, you have long cables or there are many devices on the bus, you may want to reduce the SyncRate value. Slowing the transfer rate may increase the reliability of the SCSI bus.

Exhibit 2.3-2 All possible SyncRate settings for each host adapter. Default values are in bold italics.

	Sync DT IU	Sync DT	Sync ST WIDE	Sync ST Narrow	Async
320	<i>UL4D, UL4S</i>				
160	UL4D, UL4S	<i>UL3D, UL3S, UL4D, UL4S</i>			
80		UL3D, UL3S, UL4D, UL4S	<i>UL3D, UL3S, UL4D, UL4S</i>		
40		UL3D, UL3S, UL4D, UL4S	All	UL3D, UL3S, UL4D, UL4S	
20			All	All	
10			All	All	
5				All	
NA					All

Adjust other parameters

To access these options, go to the device window and double click on a device or drive.

Tag Command Queuing

Choices: Enable, Disable

Default: Enabled

A feature of SCSI-2 and SCSI-3 protocols, allows SCSI commands to be executed out of order by a supporting SCSI device to increase speed for large numbers of small I/Os. Some older devices do not support tagged commands; set this command to *disabled* for proper operation with these devices.

Non-ATTO LUNs

Choices: Enable, Disable

Default: Enabled

Allows non-zero LUNs attached to third party host adapters to mount on your desktop at boot time. If you create an ATTO volume (RAID or non-RAID) on LUN(s), then the ATTO driver will control those LUN(s).

This applies to both zero and non-zero LUNs. At boot time, the ATTO driver will not scan for non-zero LUNs unless the device is on an ATTO host

adapter. If the disk at LUN 0 has the *Non-ATTO LUNs Enabled*, then the ATTO driver will continue to scan LUNs at this ID.

Spindown before shutdown/restart

Choices: On, Off

Default: Off

Spins a drive down so it can be removed during shutdown.

Canister (Pseudo-Removable)

Treats hard drives like removable media to allow you to swap drives. The drive spins down when dragged to the trash. The drive will automatically remount when reinserted.

PCI Burst Rate (Ultra3, Ultra/WIDE)

Choices: 16 to 512 bytes

Default: 512 bytes

SCSI only: May be changed to intervals between 16 and 512 bytes. Lowering the PCI burst rate for a device slows the host adapter card. Do not change this rate unless you are told to do so by an application or technical support for your application. Lowering the PCI burst rate does help some applications.

2.4 Configuring ExpressPCI Fibre Channel Adapters

ExpressPro-Tools may be used to configure ATTO ExpressPCI adapters, however, entering invalid values may cause your ExpressPCI adapter to function incorrectly. You may only configure Fibre Channel busses labeled ATTO Technology. To access the configuration options for the ATTO ExpressPCI host adapter, double-click the appropriate bus or click the information button next to it.

Access ExpressPro-Tools utilities by clicking on the drives or devices you wish to modify in the device window or by clicking the information button next to the device or drive.

Safeguard buttons

Safeguard buttons save your work or revert settings to previously saved versions. You must select a Safeguard button if you make changes to the ExpressPCI adapter configuration.

Defaults: Reverts the current ExpressPCI adapter configuration options to default settings.

Cancel: Cancels edits and returns to the ExpressPro-Tools main window.

OK: Accepts edits and returns to ExpressPro-Tools main window. Changes made are saved to the Flash ROM of your ExpressPCI adapter when quitting ExpressPro-Tools. Restart computer for changes to take effect.

Configuration parameters

You may only configure Fibre Channel busses labeled *ATTO Technology*.

To access the configuration options for the ATTO ExpressPCI host adapter, double-click the appropriate Fibre Channel bus or click the information button next to it.

WARNING You do not need to change options for ATTO ExpressPCI host adapters in ATTO ExpressPro-Tools. Entering invalid values may cause your ExpressPCI adapter to function incorrectly. Back up system data when changing or installing hardware.

Hard Address

Values: 0-126 **Display Only**

Displays the loop ID for the host adapter.

Hard Address Enable

Choices: Enable, Disable

Default: Disabled

When a Fibre Channel loop is initialized, each device selects and configures itself to an available

ID. *Hard Address Enable* permits the host to select the value entered in the *Hard Address* field.

Maximum Frame Length

Choices: 512, 1024, 2048

Default: 1024

Changes the size of the packet of information being sent. Changing this setting to a larger value may not affect performance.

Maximum IOCBs Per Port

Choices: 1-512

Default: 256

Changes the number of concurrent I/Os or commands that remain outstanding in the buffer.

Maximum Simultaneous Commands Per Port

Choices: 1-255

Default: 16

Changes the maximum number of concurrent commands active at a port.

Retry Count

Choices: 0-255

Default: 8

Works in conjunction with Retry Delay to adjust the number of times the host adapter tries to access a device after a busy signal. If this number is exceeded, the command automatically aborts.

Retry Delay

Choices: 0-255

Default: 5

Adjusts the amount of time to wait before trying to access a device again after an initial attempt to access the device results in an error.

Node Name

Display Only

A display of the International Electrical and Electronics Engineers (IEEE) 64-bit value unique to each Fibre Channel device. The IEEE is a professional standards organization.

Enable LUNs

Choices: Enable, Disable

Default: Enabled

Enables/disables Logical Unit Numbers (LUNs)

for a particular ID. LUNs label multiple storage units that share the same ID. Disabling LUNs affects all target IDs connected to the host adapter.

Max LUNs per target (version 2.82 or later only)

Choices: 1-255

Default: 32

When LUNs are enabled using the Enable LUNs setting, allows you to limit the number of LUNs scanned per target which may help reduce system boot time when few LUNs are present.

Video Tuner

Choices: Enable, Disable

Default: Disabled

If you are not using a Radius capture board, keep at the default (disabled) setting. Enable may increase performance for Radius users.

Device Discovery

Choices: Node WWN, Port WWN

Default: Node WWN

Certain RAID controllers require discovery using port WWN for proper operation.

Inhibit Driver Loading

Choices: Enable, Disable

Default: Disabled

Enable delays loading volumes until later in the boot process to prevent memory problems associated with a large quantity of volumes.

Full Duplex

Choices: Enable, Disable

Default: Enabled

Allows simultaneous transfer of data in both directions (transmit and receive).

Reset Delay

Choices: 0-255

Default: 5

Sets the time delay between the reset and scanning of the bus. Increase this value if some devices are not recognized at startup.

Data Rate (ExpressPCI FC 3300/3305 only)

Choices: 1Gb/sec., 2GB/sec., Auto-Negotiate

Default: Auto-Negotiate

Selects between the 1-Gigabit and 2-Gigabit/sec. data transfer rates available with the ExpressPCI FC 3300 or 3305 host adapter.

Heartbeat (For EPCI FC64 only)

Enable only when using an ATTO ExpressPCI FC host adapter connected to Seagate Barracuda

drives. Resolves issues where commands could occasionally remain outstanding on the drives. Disable if the host adapter is connected to a Vixel Rapport 4000 switch also connected to Seagate Barracuda drives. The performance loss to the Barracuda drive is less severe than losing the switch connection to the Vixel Rapport 4000.

Connection mode options

Arbitrated Loop (AL): Connects to either an FC-AL Arbitrated Loop or a Fabric Loop Port (FL_Port) on a switch.

Point to Point (PTP): Connects to a direct Fabric connection, such as an F port on a switch.

AL Preferred Loop: Allows the card to determine what kind of connection to use, but tries to connect in loop mode first, then point-to-point mode.

PTP Preferred Point-to-Point: Allows the card to determine what kind of connection to use, but tries to connect in loop mode first, then point-to-point mode.

Class 2: Enables the card to communicate with Class 2 devices.

Arbitration Loop Fairness: Should be enabled. Arbitration loop fairness is an algorithm which ensures that all NL_Ports on an arbitrated loop will have equal access to the loop. Each L_Port has an arbitration priority assigned to it based on its AL_PA (arbitrated loop physical address). The access fairness algorithm creates an access window in which all L_Ports are given an opportunity to win access to the loop, regardless of assigned priority, to prevent a device with a high priority to dominate the loop.

Some loops may require certain NL_Ports to have more access to the loop than just one access per window. You may need to disable Loop Arbitration Fairness.

Some Fibre Channel devices cannot execute arbitration fairness algorithms. Change this setting if you have exhausted the obvious configuration issues and drivers do not load or performance is intermittent.

2.5 Controlling Volumes

Volumes are usable quantities of storage composed of one or more partitions residing on a physical drive. A standard volume creates a partition on a single drive. ATTO ExpressPro-Tools creates, mounts, unmounts and configures volumes in the Macintosh OS environment.

ExpressPro-Tools can be used to create new Macintosh OS volumes from drives (except ATA drives) on any SCSI Manager 4.3 compatible or Fibre Channel bus. Physical devices and busses are shown in the left hand device window. Macintosh OS Volumes are shown in the right hand volume window.

Create a standard volume

To create a new Macintosh OS standard volume:

- 1 Select one or more drives from the device window. Shift-click to select multiple drives.**
- 2 Select the Create Standard Volume option from the Utilities menu (or click the HFS button).**
- 3 Fill in a name for the volume. Names may be any combination of characters up to 27 characters long and use any character except the colon. Names may be changed once the volume is mounted on the desktop.**
- 4 Fill in the desired volume size (in megabytes).**
- 5 Check mode page setting as desired. See Chapter 2.6.**
- 6 Click OK.**
- 7 Repeat steps 1 through 6 for each volume you wish to create.**

Mounting a volume

Mounting a volume places its icon on the desktop. The volume can then be accessed for reading and writing data. Volumes initialized with ExpressPro-Tools have a diamond shaped ATTO icon.

To mount a volume, select it from the volume window by clicking on it, then select *Mount Volume* from the Utilities menu or click the Mount

button. Selecting a drive in the device window and clicking the mount button mounts all volumes created from that drive. Unmounted volumes are marked with an asterisk (*) before their names.

Unmounting a volume

Unmounting a volume removes its icon on the desktop, but does not erase or change data on the volume in any way. The volume cannot be accessed until it is mounted again.

To unmount a volume, select it from the volume window by clicking on it, then select *Unmount Volume* from the utilities menu or click the Unmount button. Selecting a drive in the device window and clicking the unmount button unmounts all volumes created from that drive. Unmounted volumes have an asterisk (*) before their names.

Removing a volume

Removing a volume erases all data and volume information. The disk space used by the volume becomes available space to create new volumes.

To remove a volume, highlight it in the volume window, then select *Remove Volume* from the utilities menu.

Initializing a volume

Initializing a volume removes all data and volume information from the volume and creates an empty volume of the same size with the same name. A volume is automatically initialized when it is created.

To re-initialize a volume, select the volume from the volume window and select *Initialize Volume* from the utilities menu.

Updating drivers across volumes

For optimum system performance, all drives on a system should use the same disk driver. The *install driver* option allows you to install the ExpressPro-Tools Driver on all drives without altering the volumes on the drive.

To install the ExpressPro-Tools driver, select the drive from the device window, then select *Install Driver* from the utilities menu.

CAUTION Back up all hard drives before installing a new driver to prevent loss of data if errors occur.

Optimize volumes with mode pages

Mode Pages are device-specific parameters stored on the hard drive. See Chapter 2.6 for more information on changing mode page settings.

2.6 General ExpressPro-Tools Functions

ATTO ExpressPro-Tools is designed to be simple to use. Auto detection, prompts, pull-down menus and other devices provide information and choices.

Auto detection

Upon startup ExpressPro-Tools searches drives for unallocated space and determines the ATTO driver version, if present. If you have unallocated space or are using an older version of the ATTO driver, ExpressPro-Tools prompts you to allocate the free space or update the ATTO driver.

Auto Detection (default: enabled)

If Auto Detection is enabled upon startup, ATTO ExpressPro-Tools searches the drives for unallocated space and determines the version of any present ATTO driver.

- 1 ATTO ExpressPro-Tools automatically prompts you to allocate the free space or update the ATTO driver to the current version.**
- 2 You will be asked if you want to create a standard, single-drive volume. To use the recommendations provided by ATTO ExpressPro-Tools, select Create a Standard Volume and click OK. ATTO ExpressPro-Tools recommends settings for creating a new volume.**
- 3 If ATTO ExpressPro-Tools detects one or more drives with an older version of an ATTO driver, you will be asked if you want to update all drives to the latest version. Click Yes. If you want to avoid seeing this message each time you scan the bus, click Don't Display this Message Again.**
- 4 After restarting your computer, open the ATTO ExpressPro-Tools program.**
- 5 Pull down the options menu and select Enable Auto Detection or Disable Auto Detection. If Enable Auto Detection has a check mark in front of it, then auto detection is enabled.**
- 6 If auto detection does not locate any unallocated disk space or an older driver on disk, the main screen appears.**

Unallocated volume space

If ExpressPro-Tools detects a volume with available space, you are asked to create a standard, single-drive volume. To continue creating new volumes using the recommendations provided by ExpressPro-Tools, select *Create a Standard Volume* and click *OK*.

Updating the ATTO driver

If ExpressPro-Tools detects one or more drives with an older version of an ATTO driver, you are prompted to

update all drives. To update drives with the latest ATTO driver, click *Yes*. To leave the current driver on your drive, click *No*. To avoid seeing this message at each bus scan, click *Don't Display this Message Again*.

Ignoring auto detection

Auto Detection gives you opportunities to find and use any unused disk space, as well as determine which driver you are currently using. You may choose to ignore it.

To turn off ATTO ExpressPro-Tools Auto Detection, click *Don't Display this Message Again!* in the auto detection window and click *OK*. Auto Detection can also be disabled or enabled using the options menu in the main window. To enable or disable auto detection, pull down the options menu and select *Enable Auto Detection*. (If Enable Auto Detection has a check mark in front of it, then it is enabled).

If you would like to ignore Auto Detection, select *Nothing, Proceed to Main Window* and click *OK*. Returning to the main window allows other options to be selected.

If you want to ignore Update ATTO Drivers, select *Nothing, Proceed to Main Window* and click *No* for Update ATTO Drivers. Returning to the main window allows you to select other options.

Configure mode pages

Mode pages are device-specific parameters stored on the hard drive. These parameters control a variety of functions, including drive-cache management, error detection, and error recovery. ATTO has determined the best settings for these mode pages when working with digital video, prepress and digital audio.

To optimize a new volume for digital video or prepress

- 1 Select Configure Mode Pages**
- 2 Click Optimize for Digital Video or Optimize for Prepress.**
- 3 ExpressPro-Tools examines your drive and selects the optimum mode page settings for digital video capture and playback or prepress applications. If your application is not digital**

video or prepress, you can choose to set the drive's mode pages to their factory defaults or leave the mode pages as they are.

Mac OS extended volumes

Macintosh OS 8.1 added support for Macintosh OS extended volumes to use disk space more efficiently. ExpressPro-Tools supports standard Macintosh and Mac OS extended volumes.

Low-level format

Most hard drives are shipped from the vendor pre-formatted so low-level formatting is not necessary. However, if your drive is unformatted, or you suspect the drive contains bad sectors, you can format the drive by selecting *Low-Level Format*.

CAUTION Formatting a drive is time consuming and erases all data on that drive.

ExpressPro-Tools supports asynchronous formatting, allowing several drives to be formatted simultaneously, while still allowing you to run other

applications on your computer. It typically takes 20 to 30 minutes per gigabyte.

If you try to communicate with a drive being formatted, there will be a delay during which you will have no control of the system. Control will return after format is complete.

Erasing a drive

Erasing a drive removes all data and volume information from a disk drive, allowing you to create all new volumes on a drive. Erasing a drive affects all volumes on that drive. Clicking on a drive in the device window highlights volumes which use space on that drive.

To erase a drive

- 1 **Highlight the drive in the device window**
- 2 **Select Erase Disk from the Utilities menu. Erase Disk provides an optional Erase with Security Overwrite which writes a random pattern of data on the whole drive, making the data unrecoverable. Erase a Disk with Security Overwrite may take several hours for larger disk drives.**

2.7 FireWire Support

ATTO ExpressPro-Tools supports FireWire IEEE1394 Standard when using an Indigita SCSI Interface Module (SIM).

FireWire is a high-speed serial input/output technology used to connect peripherals to a computer. ATTO ExpressPro-Tools supports the IEEE (Institute of Electrical and Electronic Engineers) 1394 standard for FireWire when used with an Indigita SCSI Interface Module (SIM).

Please check our website, www.attotech.com/technology, for a list of supported FireWire drives and vendors, including the tested Indigita SIM and bridge products.

For specific technical information about IEEE 1394 FireWire, visit the Apple website, www.apple.com.

2.8 Error, Alert & Status Messages

Error, alert and status messages may come from ATTO ExpressPro-Tools, a device on the bus, the host or the host bus adapter.

Sense data messages

Sense data messages report information via a device on a bus in a numerical sense-data code. ExpressPro-Tools reports sense-data with a dialog box detailing the bus and ID of the reporting device.

Frequent sense-data messages include error or status messages. If you receive other sense-data messages, contact ATTO Technology or your storage vendor for more information.

Device appears not to be formatted. Try formatting the device.

No information can be read from the device at the indicated ID. The drive may be unformatted or may have become corrupt to the point that it requires reformatting. Before formatting the drive, try running a disk-repair utility, replacing the cable, verifying correct termination, turning the drive off and back on, and restarting your computer.

Device reset occurred.

Try rescanning the bus. The bus was reset recently so the information in the device window of ExpressPro-Tools may no longer be correct. Click the Rescan button to rescan the bus and verify which devices are attached.

Unit not ready.

Check the device, wait a few seconds, and then rescan the bus. Reasons the device may not have been able to respond to the ExpressPro-Tools commands: the cartridge was just inserted, the device was not fully powered up, or the device was being accessed by another user.

Medium not present.

Insert a cartridge into the drive before using.

Defect list error.

The device most likely needs to be formatted.

The defect list is a list of bad blocks on a disk drive. If this becomes corrupt, the drive needs to

be formatted for the drive to be reliable. Running a disk repair utility may help.

New media was inserted.

Rescan the bus to ensure update of complete information. A new cartridge has been inserted in a removable drive since the last time the device was polled by ExpressPro-Tools. Click the Rescan button to ensure that ExpressPro-Tools is using the correct device information.

No further information is available.

The reported sense-data is not a common error message. For more information, please record the sense-data values and contact your storage vendor or ATTO Technology Technical Support.

Other error messages

Some error messages are not based on sense-data reported by a device, but rather by other information gathered by ExpressPro-Tools. Usually these errors are based on error messages generated by the Macintosh OS.

Error Mounting Volume: Volume Name

ExpressPro-Tools was unable to mount the volume requested. Try rebooting your system with the shift key down to rule out a software conflict. If this doesn't help, try replacing the cable, verifying correct termination, turning the drive off and back on, and restarting your computer. If none of these things help, try reinstalling the driver using the *Install Driver* option, and restart.

Error Unmounting Volume: Volume Name

ExpressPro-Tools was unable to unmount the volume requested.

Can't unmount volume because it is in use.

ExpressPro-Tools was unable to unmount the requested volume. It is either in use by another user, or a file or application on that volume is currently open.

**Problem configuring Mode Pages for this drive!
Unconfigurable pages will be left unchanged.**

Some mode page settings of the selected drives did not match the expected settings. In order to prevent any damage or corruption, these unrecognized settings will not be changed. Please report the model of this drive to ATTO Technology Technical Support so that its mode page settings can be added to future versions of ExpressPro-Tools.

Can't install driver to disk! There is not enough room unless the disk is repartitioned.

You have attempted to use the Install Driver option to put the ExpressPro-Tools driver on a volume. Unfortunately, the driver partition created by the previous formatting software was not large enough for the ExpressPro-Tools driver. This volume must be erased and re-partitioned for the ExpressPro-Tools driver to be used.

Re-initializing the drive will erase all data on the disk.

Error writing driver to disk!

ExpressPro-Tools was unable to successfully write its driver to the volume selected. Replace the cable, verify correct termination, turn the drive off and back on, and restart your computer. If this does not help, re-initialize the disk.

WARNING Re-initializing the drive will erase all data on the disk.

Driver was installed to disk successfully! It will take control of the drive the next time you restart the system.

The Install Driver command was successfully completed. This drive will continue to use the old driver, if there is one, until the system is restarted. After restart, this drive uses the ExpressPro-Tools

driver, and is represented on the desktop by an ExpressPro-Tools icon.

Program aborting because the Macintosh OS SCSI Manager 4.3 cannot be accessed! In order to run the program, please ensure that your System Software is up to date, intact and includes SCSI Manager 4.3.

ExpressPro-Tools requires Apple's SCSI Manager 4.3 to operate. SCSI Manager 4.3 is built into every Power Macintosh and the Quadra 840AV. Other Macintosh compatible systems require SCSI Manager be loaded using the SCSI Manager 4.3 extension included with the operating system.

Drive's block size is 0! The drive may need to be low-level formatted.

Click the Rescan button. If this message reappears, the drive appears to be damaged or corrupted, and may need to be formatted. Before formatting the drive, try replacing the cable, verifying correct termination, turning the drive off and back on and restarting your computer.

Unrecoverable error accessing drive.

Click the Rescan button. If this message reappears, ExpressPro-Tools was unable to successfully communicate with the selected drive. Try replacing the cable, verifying correct termination, turning the drive off and back on, and restarting your computer.

Error formatting drive.

Click the Rescan button. If this message still comes up, ExpressPro-Tools was unable to format the selected drive. The drive may be defective. Try replacing the cable, verifying correct termination, turning the drive off and back on and restarting your computer.

2.9 ATTO Benchmark

ExpressPCI Utilities includes a utility for benchmarking drives to measure peak and sustained throughput for disk reads and disk writes.

The ATTO Benchmark utility is accessible through the ExpressPro-Tools main window (see page 3.) It measures peak and sustained throughput for disk reads and disk writes.

- 1 **Highlight a volume in the volume window.**
- 2 **Select Benchmark from the Utilities menu.**
- 3 **Modify test parameters.**
- 4 **Click Start.**

Additional volumes can be tested by selecting them from the menu in the lower left corner of the benchmark utility.

Test parameters

Your benchmark results may be tuned using the following parameters.

Max. Transfer Size

Choices: 32 KB, 128 KB, 512 KB, 2 Mb, 8 Mb
Default: 512 KB

The ExpressPCI Utilities Benchmark performs disk reads and writes of varying sizes on the volume tested. The Max. Transfer Size option determines the size of the transfers.

To test a drive for applications which transfer smaller blocks of data, select a smaller value, such as 32 Kilobytes. To test a drive for applications which transfer larger blocks of data, select a larger transfer size.

To run benchmark tests with a 2 megabyte maximum transfer size, allocate more memory to ExpressPCI Utilities: quit ExpressPCI Utilities, select its icon, select *Get Info* from the file menu, and change the preferred memory setting to a higher value.

Expected Peak

Choices: 10 MB/sec. to 400 MB/sec.
Default: 20 MB/sec.

Allows adjustment of the scale of the Transfer Rate axis on the benchmark graph, adjustable from 10 MB/sec. to 200 MB/sec. After a benchmark test is finished, the Transfer Rate axis

of the graph automatically adjusts to best fit the performance of the volume tested.

Sample Size

Choices: 1, 2, 4, 8
Default: 2

Adjusting the sample size changes the number of times each transfer is done during the benchmark test. The transfers are then averaged for the final result. A larger sample size provides more accurate results, but causes the benchmark test to take longer.

Read and Write Tests

Choices: Enabled, Disabled
Default: Enabled

By default, ExpressPCI Utilities performs both read and write tests on the drive being tested. These benchmarks are non-destructive, meaning they will not harm data on these volumes in any way. If, however, you wish to test only disk reads or writes, the read and write tests can be turned off by disabling the Reads and Writes boxes.

System Disk Cache

Choices: Enabled, Disabled
Default: Disabled

The System Disk Cache switch determines if the disk cache created by the Macintosh OS is used during the benchmark test. Turning off the disk cache provides a more accurate test of the disk and SCSI bus performance. Enabling the system disk cache provides a more accurate assessment of overall system I/O performance.

Volume Name

Selecting the volume allows you to benchmark several drives on the same graph so you can compare the results. Any Macintosh-compatible volume can be benchmarked.

Reading Benchmark results

Once the benchmark tests are completed, ExpressPCI Utilities graphically displays the test results and determines the peak and sustained values for the read and write tests performed.

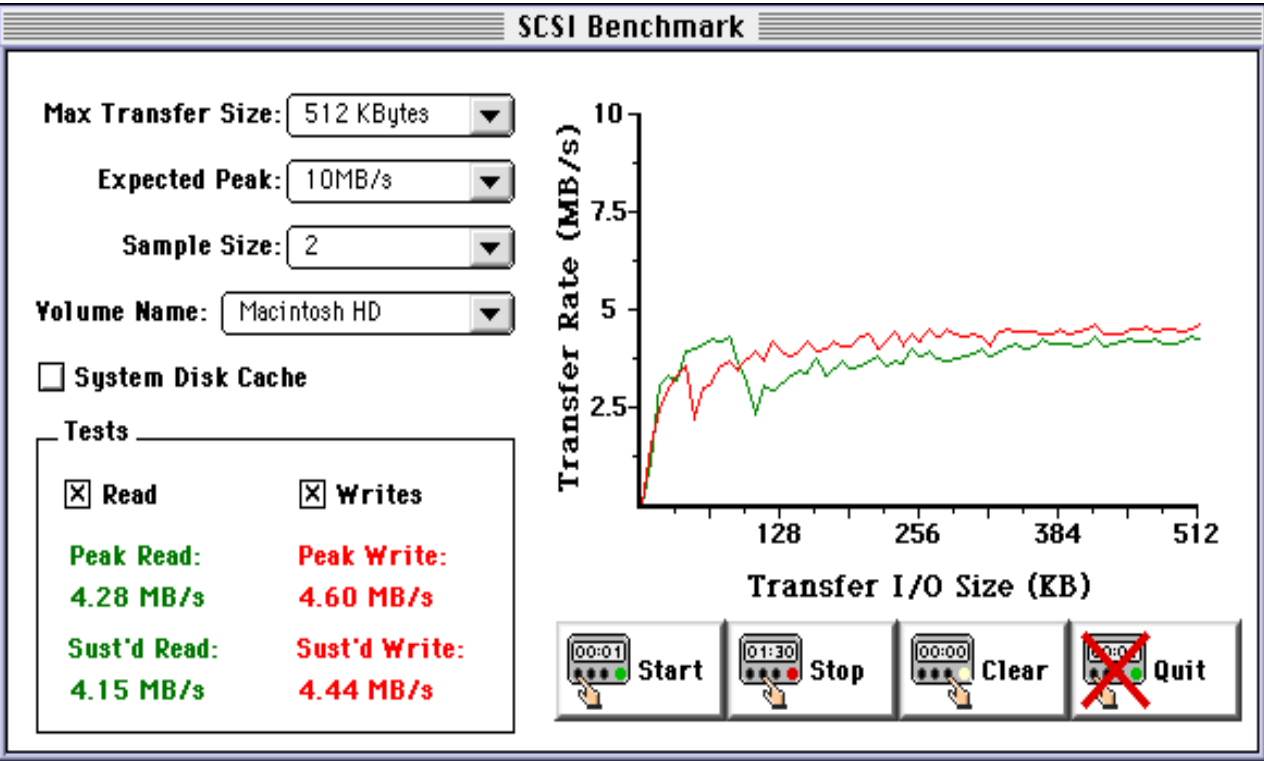
Read tests are shown in green and write tests in red.

The sustained read or write, shown as a relatively flat line on the graph, indicates the true performance of the drive.

A spike in the graph indicates a disk read or write to or from the system cache or the cache incorporated in the disk being tested. The top of this spike is normally the peak read or write value.

The peak value is also commonly referred to as the burst transfer rate.

When the system disk cache is turned on, the performance of a volume may appear to exceed the maximum performance of the bus because sometimes data is being transferred to or from the System Disk Cache (system RAM) rather than to or from the disk being tested.



3 ExpressPCI Utilities for Windows BIOS

ATTO ExpressPCI Utilities supports Windows® NT/2000/XP and Windows 95/98. Additional support is provided through the ATTO hardware BIOS driver (BOOTROM.sys for Ultra3, Ultra/WIDE and Fibre Channel adapters, BOOTROM2.sys for Ultra320 adapters).

Installing Windows Utilities

The ExpressPCI Utilities installation utility will automatically launch when the ATTO ExpressPCI CD-ROM is inserted.

- 1 The main installer screen presents four options. Click on the appropriate button.**

- Install SCSI Software (ExpressPCI PSC, PSCd, DC, UL3S, UL3D)
- Install SCSI Software (ExpressPCI UL4S, UL4D)
- Install Fibre Channel Software
- Exit.

- 2 Selecting any of the three Install ... options brings up another options window. Some options may be unavailable, depending on the type of installation. Click on the appropriate button to begin the desired task.**

- Create Standard Driver Installation Floppy
- Create Microsoft Certified Driver Installation Floppy
- Install ATTO Tools
- Install Adobe Acrobat
- Browse ATTO Manuals

- 3 Depending on your selection, you will be presented with additional on-screen instructions. Follow these instructions to complete the task. The appropriate utilities will be installed on your system.**
- 4 Click the Exit button when you are finished with the installation utility.**

Configuration Tools

ATTO provides a full suite of configuration tools and supplemental utilities to enhance the performance of the ExpressPCI host adapters.

- ❖ Host adapter NVRAM settings may be changed using the appropriate utility. Refer to the appropriate chapter in this manual for information on using these utilities.

During system boot, press **[CTRL-F]** to modify NVRAM settings on ExpressPCI Fibre Channel host adapters

During system boot, press **[CTRL-Z]** to modify NVRAM settings on ExpressPCI SCSI host adapters.

In Windows NT/2000/XP, run the *SCSI Util* application to modify NVRAM settings on ExpressPCI SCSI host adapters.

In Windows 2000/XP, run the ATTO ExpressPCI Configuration Tool to modify NVRAM settings on ExpressPCI Ultra 320 SCSI and Fibre Channel host adapters. This application does not work with ATTO Ultra3 and Ultra/WIDE host adapters.

- ❖ Monitoring system performance (*Bench32*), configuring mode pages (*Alamode*), validating SCSI connections (*SCSIDV*), masking Fibre Channel LUNs (*LUN Mask*) and other specialized functions are also supported by ExpressPCI host adapters. Refer to the appropriate chapter of this manual for information on these utilities.

3.1 Configuring ExpressPCI SCSI NVRAM Parameters

The default NVRAM settings will work for most applications, but your particular hardware configuration may require some changes. SCSI host adapter NVRAM settings may be changed using either of two utilities from ATTO Technology. During system boot, press [CTRL-Z] to modify NVRAM settings. In Windows NT/2000/XP, locate and run the 'SCSI Util' application. Both utilities provide similar functionality to customize NVRAM settings.

Using the CTRL-Z option

The primary purpose of the CTRL-Z utility is to provide an interface for modifying NVRAM parameters. However, it also provides a useful interface for getting information about your host adapter and updating the firmware in flash. These additional functions are discussed later in this chapter.

To modify NVRAM settings:

- 1 **During system boot, a text string will prompt you to type [CTRL-Z]. This will start the configuration utility and open the Main Menu.**
- 2 **From the main menu, select option 1 (Adapter Menu)**
- 3 **From the Adapter Menu, select option 2 (Configure Adapter Channels)**
- 4 **After making your changes, return to the Main Menu to save/discard your changes.**
- 5 **Exit the utility to complete system boot.**

Available parameters

Channel Number

Choices: Variable

Default: 0

Choices depend upon the number of ExpressPCI adapters installed in your computer chassis and the number of channels per adapter. For example, if only one single channel ExpressPCI adapter is installed, 0 is the only choice. If two dual channel ExpressPCI adapters are installed, choices are 0, 1, 2 and 3.

Firmware Version (Ultra320 only)

Display-only field that reports the version of firmware loaded in onboard flash.

I/O Address

Display-only field that cannot be modified.

Interrupt Level

Display-only field that cannot be modified.

Host Adapter BIOS

Choices: Enabled, Disabled, Scan Only

Default: Enabled

If *Enabled* is selected, the BIOS driver will remain resident, if disk drives, or a bootable CD, are detected during the bus scan.

Using the *Disabled* setting, the BIOS will start, reset the SCSI chip and issue a SCSI bus reset if enabled in the configuration settings. The user may strike [Ctrl Z] to invoke the configuration utility, but then the driver will be unloaded.

If *Scan Only* is selected, the BIOS driver will scan the SCSI bus and display the devices attached, and then unload itself after a brief delay.

SCSI Termination

Choices: Automatic, High

Default: Automatic

Use the table below to determine the correct termination selections:

Exhibit 3.1-1 Termination Selection Chart

Internal Connection	External Connection	Termination Selection
Narrow Device	Wide Device	High
Wide Device	Narrow Device	High
Narrow Device	Narrow Device	High

The Auto setting will turn the termination for the SCSI channel off if both connectors are used. If only one connector is used, Auto will set the channel's termination to Full.

Initiator ID

Choices: 0-15

Default: 7

The ExpressPCI SCSI adapter is normally set to SCSI ID 7 because ID 7 has the highest priority on the bus. The setting should remain at ID 7 unless you are instructed to change the setting by an ATTO Technical Support representative.

Reset Bus on Startup

Choices: Yes, No

Default: Yes

If enabled, the SCSI bus is reset upon adapter initialization. If disabled, the SCSI bus is still scanned for devices, but the bus itself is not reset.

Bus Reset Delay (sec.)

Choices: 0-255

Default: 3

Sets the time delay between the reset of the SCSI bus and the scanning of the SCSI bus. You may need to modify if devices require a longer time to respond following reset.

Selection Timeout

Choices: 25ms - 1 sec. (Ultra3, Ultra/WIDE)
1ms - 1 sec. (Ultra320)

Default: 250 ms

Allows you to set the amount of time a device has to respond to being selected; it can be lowered to speed up the boot process. If the value is lower than the recommended 250 ms, it may be too fast and some devices may not have enough time to respond.

PCI Bus Parity (Ultra3, Ultra/WIDE only)

Choices: Yes, No

Default: Yes

Controls the host adapter's ability to detect parity on the PCI bus.

PCI Burst Size (Ultra3, Ultra/WIDE only)

Choices: Disabled, 8 bytes, 16 bytes, 32 bytes, 64 bytes, 128 bytes, 256 bytes, 512 bytes

Default: 512 bytes

Sets the burst rate threshold for read and write operations when moving data across the PCI bus.

Quick Arbitrate & Select (Ultra320 only)

Choices: Disabled, Enabled

Default: Enabled

If enabled, Ultra320 QAS functionality is available. This feature improves performance by reducing the time required to process commands. QAS can only be enabled if all target settings are set to Sync DT-IU

Max Single-Ended Sync Rate

Choices: Variable by adapter type

Default: 20 (Narrow)/40 (Ultra/Wide)

Sets the maximum synchronous transfer rate on the SCSI bus to account for the cabling and device restrictions of Single-Ended UltraSCSI. You may set the SCSI bus transfer rate to Fast/Wide SCSI transfer rates to eliminate the cabling and device limitations of UltraSCSI.

SCSI device settings

Selecting SCSI Device Settings and pressing *Enter* brings up individual settings for each SCSI Target ID. The SCSI Target Parameter screen allows the user to set individual configuration parameters for each possible SCSI target for the current adapter. The adapter is selected from the Host Adapter settings screen before entering this screen.

The settings for *Disconnect*, *Sync*, *Wide* and *Tagged* only apply if the device connected to your ExpressPCI host adapter supports the respective feature as indicated by the data returned with the Inquiry command. That is, the boot or host operating system driver will only enable the feature if the device indicates that it supports the feature.

SCSI target settings

Enable Disconnect

Choices: Yes, No

Default: Yes

When enabled, the device will disconnect during SCSI command execution. Allowing SCSI disconnects increases performance in systems with multiple devices connected to the SCSI bus. If disconnect is disabled, SCSI bus overhead time will be increased and performance will decrease.

Enable Synchronous SCSI

Choices: Async, Sync ST, Sync DT, Sync DT-IU

Default: Variable by adapter type

Synchronous communication is generally faster than asynchronous but some devices may not function efficiently in synchronous mode. This option assists compatibility with older devices that do not support synchronous negotiation.

Enable Wide SCSI

Choices: Yes, No

Default: Yes

If enabled, the ExpressPCI adapter tries to transfer SCSI data in a Wide mode to all devices. This option assists compatibility with older, Narrow devices that do not respond to Wide transfer negotiation. If the synchronous SCSI parameter is set to Sync DT or Sync DT-IU, only WIDE negotiation is permitted.

Tagged Command Queuing

Choices: Yes, No

Default: Yes

Enabling this option allows more than one command to be sent to a LUN at a time.

Sync Offset

Choices: 1-16 for PSC, PSCd, DC

1 - 62 for UL3S, UL3D

1-127 for UL4S, UL4D

Default: 16 for PSC, PSCd, DC

62 for UL3S, UL3D

127 for UL4S, UL4D

Extensive testing by ATTO has determined this default value to offer the best performance possible. **DO NOT** change this setting unless instructed by an ATTO Technical Support representative.

Sync Rate

Choices: varies by adapter, see Exhibit 2.2-2

Default: varies by adapter, see Exhibit 2.2-2

If synchronous transfers are enabled, the sync rate sets the maximum rate at which the ExpressPCI host adapter will negotiate with each device attached to it. ATTO recommends setting the rate to the maximum value supported by the host adapter. If excessive SCSI errors occur, you have long cables or there are many devices on the bus, you may want to reduce the Sync Rate value. Slowing the transfer rate may increase the reliability of the SCSI bus.

Exhibit 3.1-2 The chart below lists all of the possible Sync Rate settings for each host adapter. Default values are in bold italics.

	Sync DT IU	Sync DT	Sync ST WIDE	Sync ST Narrow	Async
320	<i>UL4D, UL4S</i>				
160	<i>UL4D, UL4S</i>	<i>UL3D, UL3S, UL4D UL4S</i>			
80		<i>UL3D, UL3S, UL4D UL4S</i>	<i>UL3D, UL3S, UL4D UL4S</i>		
40		<i>UL3D, UL3S, UL4D, UL4S</i>	<i>All</i>	<i>UL3D, UL3S, UL4D, UL4S</i>	
20			<i>All</i>	<i>All</i>	
10			<i>All</i>	<i>All</i>	
5				<i>All</i>	
NA					<i>All</i>

Enable LUNs (Ultra3, Ultra/WIDE)

Choices: Checked, Unchecked

Default: Checked

Allows the use of Logical Unit Numbers (LUNs) for this particular SCSI ID. Each allowable LUN has a check box (i.e. LUN 0 through 7). The default has a check in each LUN check box. You can prevent any or all LUNs from being detected by removing the appropriate check.

The ExpressPCI host adapter settings allow changes to be discarded and replaced with factory default settings by choosing *Reset to Defaults*.

Enable LUNs (Ultra320)

Choices: Disable ID, 0, 0-7, 0-63

Default: 0-7

Allows the use of Logical Unit Numbers (LUNs) for this particular SCSI ID. IDs may be disabled or set to recognize a group of LUNs. For example, selecting the 0-7 setting scans LUNs 0-7, while selecting the 0-63 setting scans LUNs 0-63.

Selectable boot device

Allows users to select a SCSI disk drive or stripe group from which the system BIOS will load the operating system.

Changing the *Enable Selectable Boot* option from *No* to *Yes* will display candidate disk drives. Select the primary drive from any stripe set or any non-striped drive. If the selectable boot option is enabled, the BIOS driver will route any drive 80h I/O requests to the designated selectable boot drive, causing the Operating System (OS) to be loaded from this drive.

If a SCSI drive is selected as the Boot device *Enable Selectable Boot* value becomes *Yes*. To disable a SCSI boot device (start from IDE drive), press the spacebar to change the value to *No*. To choose another SCSI boot device, change the *Enable Selectable Boot* to *No* then press the spacebar again to see the candidate drives.

The assignment of drive letters by the OS is OS dependent. DOS and Windows 95 will assign drive letters to drives in the same order as their post

selectable-boot drive numbers, so drive C: will always be assigned to the boot drive. Windows NT uses its own algorithm to assign drive letters, usually following the same order as the original BIOS drive numbering.

Update flash ROM

You can update the flash ROM on your ExpressPCI host adapter using a floppy diskette. Before selecting this option, create a driver floppy using the ATTO installation utility described earlier in this chapter. After creating the floppy disk, choose the *Update Flash ROM* from the CTRL-Z Adapter Menu. The ExpressPCI host adapter flash will be updated automatically after you confirm that you want to proceed with the task.

Display device list

A display-only dialog box listing all devices detected in the SCSI bus scan. The operator can scroll the list to see all devices.

Reset defaults

Host adapter default settings can be automatically reset to the manufacturer's defaults from the CTRL-Z Main Menu. All setting will be reset using this method.

Format disk drives

More than one disk drive may be formatted at one time, as long as each supports the SCSI disconnect feature. Select drives to format by checking boxes for each drive.

Press the Enter key and a confirmation will appear. Confirm the selected drives to be formatted. During the formatting process, the check boxes turn into status fields, displaying either *Formatting* (blinking, red) or *Completed* for each drive. When the format is complete, a message box will inform you. When the message box is closed, the application returns to the main menu. If an error occurs during the formatting, an

error message will appear. Formatting will continue on all other drives.

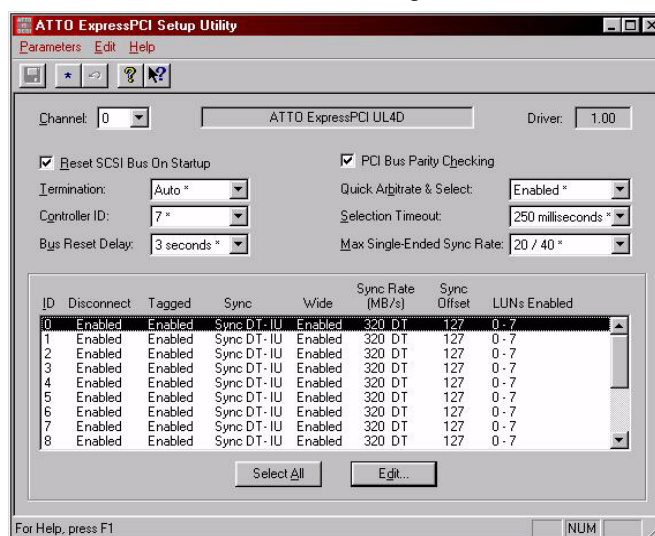
Using the SCSI Util Application

SCSI Util allows you to change the same NVRAM parameters as described for the CTRL-Z utility earlier in this chapter. The sole exception to this is that *SCSI Util* will not allow you to select a boot device, update flash ROM, display a device list, or format disk drives. Please use the CTRL-Z utility for these functions.

To modify NVRAM settings:

- 1 **Locate the SCSI Util application icon on your hard drive. Double-click the icon to start the application.**
- 2 **Make the desired changed to the IDs. Multiple IDs can be modified simultaneously using the buttons at the bottom of the Main Menu. Specific IDs may also be selected using the CTRL and SHIFT keys while left-clicking with the mouse.**

Additional information on using *SCSI Util* is



available by using the Help menu in the application.

- 3 **Save your changes and exit the application**

3.2 Configuring ExpressPCI FC Adapters

The ATTO ExpressPCI FC host adapter includes Fibre Channel utilities in the ROM which allow easy use and installation of the ExpressPCI FC adapter. However, because the ExpressPCI Fibre Channel utilities for the PC are built into the host adapter's ROM, they will only function with an ATTO ExpressPCI FC host adapter.

After installing your ATTO ExpressPCI FC host adapter you have several options for configuring NVRAM parameters:

- ❖ During system boot: an ATTO banner will appear. Hit [Ctrl F] to enter the ATTO ExpressPCI SCSI Utilities program.

If devices are connected, the ATTO ExpressPCI Utilities screen appears and the host adapter scans the bus for devices.

If no devices are detected, you will see *No Devices Found*: either you do not have any devices connected to your ExpressPCI host adapter, or the device is not responding.

If your device is not responding, refer to your device troubleshooting guide for suggestions.

The main menu screen shows the various utilities available:

1. Configure Adapter channels
2. Selectable boot device
3. Reset All Parameters
4. Display Device List
5. Format Disk Drives
6. Update Flash ROM
7. Save Parameters and Exit
8. Discard Parameters and Exit

Configure adapter channels

Provides information about the ExpressPCI FC host adapter and its configuration. Changes may be made by toggling among choices using keyboard arrow keys.

Adapter Number

Illustrates the host adapter you are configuring. Use the up and down arrow keys to toggle among host adapters.

I/O Address

Displays the PCI slot in which this host adapter is installed.

Interrupt Level

Display of the interrupt level assigned by the BIOS.

Adapter Node Name

Display of the IEEE (Institute of Electrical and Electronic Engineers) world wide name unique to each host adapter. The IEEE is a professional standards organization.

Host Adapter BIOS

Choices: Enabled, Scan Only, Disabled

Default: Enabled

Enables the BIOS at boot. If you wish to boot from an internal IDE drive and not from the ExpressPCI FC host adapter, select *Scan Only*.

Device Discovery

Choices: Node WWN, Port WWN

Default: Node WWN

Certain RAID controllers require discovery using port WWN for proper operation.

Enable LUNs

Choices: Yes, No

Default: Yes

Enables/disables Logical Unit Numbers (LUNs) for a particular ID. LUNs label multiple storage units that share the same ID. Disabling LUNs affects all target IDs connected to the host adapter. If you are connecting devices that do not support LUNs, select *No*.

Execution Throttle

Choices: 1-255

Default: 16

The maximum number of concurrent commands active for a port. Increasing this value may increase performance, but you may saturate a drive with commands, decreasing performance.

Frame Size

Choices: 512, 1024, 2048

Default: 2048

Changes the size of the packet of information being sent. Most Fibre Channel hard drives support frame sizes of 512. Changing this setting to a larger value may not affect performance.

IOCB Allocation Per Target**Choices:** 1-512**Default:** 256

Changes the number of concurrent I/Os or commands that remain outstanding in the buffer.

Loop Reset Delay (sec.)**Choices:** 0-255**Default:** 5

Adjusts the amount of time to wait before trying to access a device again after an initial attempt to access the device results in an error. Increase this value if some of your devices are not recognized by the system at startup.

Hard Address Enable**Choices:** Yes, No**Default:** No

When a Fibre Channel loop is initialized, each device selects and configures itself to an available ID. Hard Address Enable permits the host to select the value entered in the Hard Address field.

Connect Speed (ExpressPCI FC 3300, 3305, 3320)**Choices:** 1 Gb/sec., 2 Gb/sec., Auto**Default:** Auto

Selects between the 1-Gigabit and 2- Gigabit/sec. data-transfer rates or autonegotiates the rates of the ExpressPCI FC 3300 or 3305 host.

Heartbeat (For EPCI-FC64 only)

Enable only when using an ATTO ExpressPCI FC host adapter connected to Seagate Barracuda drives. Resolves issues where commands could occasionally remain outstanding on the drives. Disable if the host adapter is connected to a Vixel Rapport 4000 switch also connected to Seagate Barracuda drives. The performance loss to the Barracudas is less severe than losing the switch connection to the Vixel Rapport 4000.

Connection Mode options

Arbitrated Loop (AL): Connects to either an FC-AL Arbitrated Loop or a Fabric Loop Port (FL Port) on a switch.

Point-to-Point (PTP): Connects to a direct Fabric connection, such as an F port on a switch.

AL Preferred: Allows the card to determine what kind of connection to use, but tries to connect in Loop mode first, then Point to Point mode.

PTP Preferred: Allows the card to determine what kind of connection is to use, but tries to connect in Loop mode first, then point-to-point mode.

Class 2: Enables the card to communicate with other Class 2 devices.

Loop Arbitration Fairness: Should be enabled. Loop arbitration fairness is an algorithm that ensures that all NL_Ports on an arbitrated loop will have equal access to the loop. Each L_Port has an arbitration priority assigned to it based on its AL_PA (arbitrated loop physical address). The access fairness algorithm creates an access window in which all L_Ports are given an opportunity to win access to the loop, regardless of assigned priority. Without this, a device with a high priority may dominate the loop.

Some loops may require certain NL ports to have more access to the loop than just one access per window. You may need to disable Loop Arbitration Fairness.

Some Fibre Channel devices cannot execute arbitration fairness algorithms. If you have exhausted the obvious configuration issues and drivers do not load or performance is intermittent, change this setting.

Class 2 Options**Choices:** Disabled, ACK_1 Only, ACK_0 Capable**Default:** Disabled

Select the appropriate option if you choose to take advantage of Class 2 Fibre Channel class of service.

PCI Memory Write/Invalidate**Choices:** Enabled, Disabled**Default:** Disabled

Setting to disabled will override the host's BIOS setting and force memory write/invalidate to be disabled. It must be disabled for PCI Latency Timer to operate (see below).

PCI Latency Timer**Choices:** 8, 16, 24, 32, 40, 48, 56, 64, 80, 96, 112, 128, 160, 192, 224, 248**Default:** 248

Controls how long the host adapter maintains control of the PCI bus: setting it higher allows the host adapter to remain on the bus for a longer

time, improving performance. However, controlling the PCI bus for too long can starve other PCI devices such as video capture cards. If the default is chosen, the value will be assigned by the PC's BIOS. *MemoryWrite/Invalidate* must be disabled for the PCI Latency Timer to be acknowledged (see above).

Note: for Media 100 Finish, set the Latency timer to 32.

Selectable Boot device

You may boot from a device connected to the ATTO ExpressPCI FC.

Enable Selectable Boot

Choices: Yes, No

Default: No

Allows you to boot from a device connected to the host adapter. If you select yes, a screen listing the devices connected to the host adapter will appear. Select the device from which you wish to boot and hit Enter.

Current Boot Node Name

Display only

Shows the International Electrical and Electronics Engineers (IEEE) worldwide address assigned to the current boot device. The IEEE is a professional standards organization.

Current Boot LUN Number

Display only

Shows the LUN address assigned to the current boot device.

Display device list

The complete list of all devices connected to the ATTO ExpressPCI FC includes the device Channel Number, ID, LUN, Vendor, Product ID, Type and Group Name.

If you do not see any devices connected to the host adapter, refer to Chapter 2.8.

Format disk drives

The complete list of disk drives connected to the ATTO ExpressPCI FC includes the channel number, the ID, LUN, Vendor, Product ID, type and size of each drive.

If your drive is unformatted or you suspect that it contains bad sectors, you can low-level format the drive by selecting it in the window and clicking Enter.

CAUTION Low-level formatting is time-consuming and erases all data on a drive.

Save parameters and exit

Saves all changes you have made and exits ATTO ExpressPCI FC Utilities. The host will reboot.

Discard parameters and exit

Discards all changes you have made, defaulting back to previous settings, and exits ATTO ExpressPCI FC Utilities. The host will reboot.

3.3 Configuring Mode Pages: Alamode Utility

Alamode.exe is a Windows NT utility to help you optimize disk drive performance by configuring mode pages without requiring specific knowledge of mode page parameters.

A mode page or mode parameter page is a group of related settings or parameters that govern certain aspects of how a drive operates. Most drives come from the factory set for maximum compatibility to work safely and reliably with the widest range of hosts and systems.

However, these out-of-the-box settings may disable some high-performance features which your ATTO ExpressPCI host adapter could use. Depending on your requirements, mode pages can be configured to affect performance, computability, data integrity and other characteristics.

Alamode optimizes all mode pages at once. You do not have to select which pages to optimize or which parameters to optimize. Changing mode page settings is quite safe. However, if anything does go wrong, change the drive's mode pages back to Factory Defaults. No data will be lost.

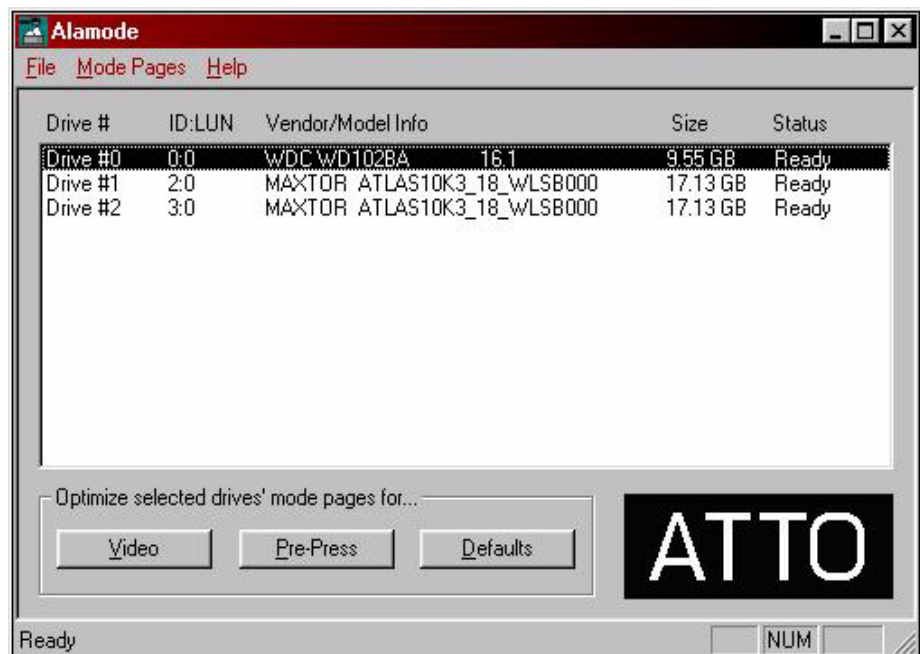
Exceptions

- ❖ You cannot optimize IDE drives because they don't have mode pages.

- ❖ You cannot optimize drives that are striped in a RAID group. You may optimize the drives before striping them, or break up the group into individual drives, optimize them, and then rebuild the group. The second method, however, will destroy any data on the existing RAID volume.
- ❖ If you plan on formatting the drive *and* setting its mode pages, set the mode pages first using Alamode.

Using Alamode

- 1 **Launch the application.**
- 2 **Select the drive you want to optimize.**
- 3 **Click the button corresponding to the type of application for which you want to optimize performance**
 - ❖ Digital Video
 - ❖ Pre-press
 - ❖ Default (return the drive to its factory default settings)
- 4 **You should shutdown and restart the system before continuing to use the drive. This ensures that the drive will actually behave according to the new settings.**



3.4 Windows Benchmarking: Bench32

ExpressPCI Utilities includes a utility for benchmarking drives to measure peak and sustained throughput for disk reads and disk writes.

To run ATTO Disk Benchmark

- 1 **Click on the Start button**
- 2 **Go to** Programs, ATTO ExpressPCI Utilities
- 3 **Double click on** Disk Benchmark

Additional information on using Bench32 is available by using the Help menu in the application.

Performing a benchmark test:

- 1 **Select the desired test options from the main window.**

Drive

Select the logical drive to benchmark. A test can be performed on any system drive.

Transfer Size

Select the range of transfer sizes used for reading and writing data to the test drive. Transfer speeds will be displayed for each size in the range. If the first size is greater than the second size, the test will not be performed for any transfer sizes.

Total Length

Select the total size of the data file to be created on the test drive. This file is deleted upon completion of testing.

Direct I/O

If this option is checked, file I/O on the test drive is performed with no system buffering or caching. Combine this option with Overlapped I/O for maximum asynchronous performance.

Radio Button Group

Three additional options are also available -- Overlapped I/O, I/O Comparison, and Neither.

Select *Overlapped I/O* to perform queued I/O. Upon selection, the Queue Depth option appears to select the maximum number of read or write commands that may be executed simultaneously.

Select *I/O Comparison* to compare the data read from the test file to the data written on a per block basis. You can select the data pattern for comparison in the Test Pattern dropdown box that appears.

Select *Run Continuously* to run the test continuously for a specified number of minutes. The test will stop before the specified time if any errors are detected.

Select *Neither* if you do not want to perform overlapped I/O or I/O comparisons.

Three additional fields are provided for informational purposes only:

Stripe Group

If the test drive is a stripe group, select its name. The names and quantities of drives in the stripe group will be printed to the Description box. Select *Clear* to clear the contents of the Description box.

Controlled by

Lists all ATTO host adapters on the system that may control the selected drive.

Description

Enter additional information about the test that can be saved or printed. Be sure to enter additional information after making a selection from the Stripe Group dropdown box, as this will erase the current description.

- 2 **When all selections are made, press the Start button in the main window. The benchmark test will now begin on the selected drive and the Test Results Display at the bottom of the window will be updated. The y-axis of the graph represents the transfer sizes in the selected range and the x-axis represents the transfer speeds in MB/sec. I/O speeds for each transfer size are also displayed textually to the right of the graph in KB/sec.**

- ❖ Pressing the *Stop* button will stop the test.
- ❖ When the test completes, the results can be saved or printed.
- ❖ If the I/O comparison option was selected and errors were not detected, the message *No errors detected* is displayed.
- ❖ If errors were detected, a dialog box will appear to display the errors in a table with the following four columns:

Transfer Size

Transfer size at which the error occurred.

Buffer Index

Index into the data block at which the error occurred.

Actual Value

The value read from the file.

Expected Value

The value written to the file.

Log to File

Logs the error table to a (*.log) file and closes the dialog. The file is given the same name as the test file and saved in the same directory. If the test was not previously saved, errors are logged to the generic file Bench32Error.log in the root of the test drive. If the log file already exists, the new errors are appended to the previously recorded errors. This is the only way to save detected errors. They are not saved in the test document file.

Performing multiple benchmark tests

The ATTO Disk Bench supports four command line parameters for uninterrupted testing:

testfile

Opens and executes the test named *testfile* with the extension .bmk or .tst (prior versions of Disk Bench).

textfile

Opens the text file named *textfile* with the extension .bmk or .tst (prior versions of Disk Bench). Each test in this list will be opened and executed in order. Stopping one test in the list will prevent further tests from being executed. Error logging is the same as the command line parameter testfile, but all errors generated from all tests in the list are logged to one file: *textfile.log*.

/p testfile

Same as *testfile*, only the test will be printed to the default system printer instead of being executed.

/p textfile

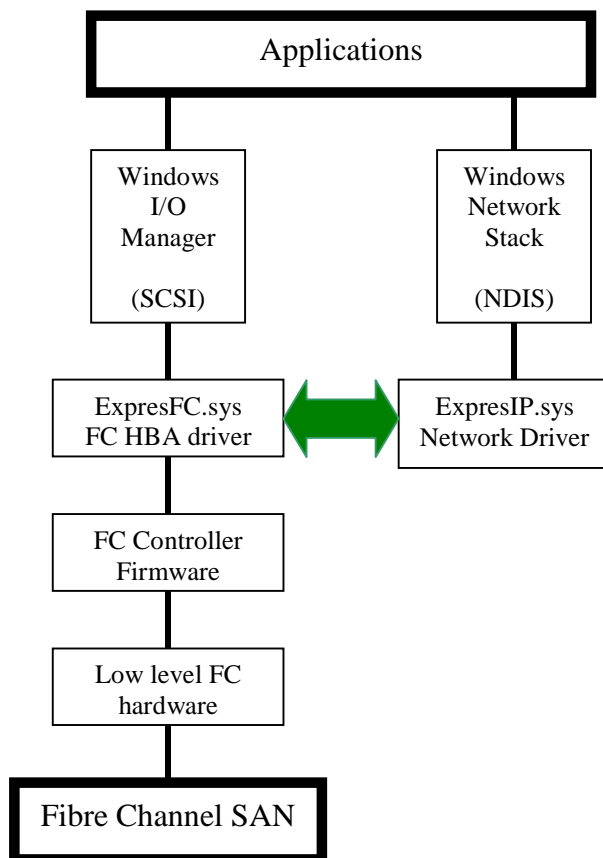
Same as *textfile*, only the tests in the list will be printed to the default system printer instead of being executed.

3.5 Fibre Channel Internet Protocol Driver

Fibre Channel, acting as a general transport layer, is capable of carrying several different upper level protocols (ULPs). While SCSI (SCSI-FCP) is the primary implementation of the technology, Internet Protocol (FC-IP) is becoming more popular.

ExpressPCI host adapters become FC-IP enabled when the ATTO IP driver, *expresip.sys*, is attached to the main ExpressFC driver, presenting itself as a network card to the operating system.

Practically speaking, ULPs and applications simply see the ExpressIP driver as controlling a standard Ethernet card. Behind the scenes, the ExpressIP driver actually routes IP commands over Fibre Channel using hooks created inside the FC driver to allow commands and data to be quickly passed back and forth.



Installation

For FC-IP to work properly, the following components must be installed:

- ❖ ATTO ExpressPCI FC host adapter
- ❖ ExpressIP driver
- ❖ IP-enabled firmware.

If you plan on using FC-IP on multiple adapters in the same system, you must install a separate ExpressIP instance for each adapter.

You should also specify the Node Name for each ExpressIP instance.

To install the ATTO ExpressIP driver in Windows NT:

- 1 **Log on as a system administrator.**
- 2 **Click *Start*, point to *Settings*, and then click *Control Panel*.**
- 3 **Double-click *SCSI Adapters* and highlight the appropriate ATTO ExpressPCI host adapter.**
- 4 **Click *Properties*. The *Device Status* should indicate that the device is working properly.**
- 5 **From the *Control Panel*, double-click *Network*, select the *Adapters* tab, click the *Add* button**
- 6 **When prompted, click the *Have Disk* button.**
- 7 **Insert the ATTO ExpressPCI FC installation disk into drive A.**
- 8 **Enter the path A:\IP, and press *Enter*. (If installing from a CD or downloaded driver package, use the *Browse* button to find the directory).**
- 9 **Press *Enter* (the only available option shown should be ATTO ExpressIP Adapter.)**
- 10 **The system will automatically install the driver and load the ExpressIP configuration utility. Refer to the *Configuring the ExpressIP Driver* section (below) for information on customizing the adapter settings.**
- 11 **Exit the ExpressIP utility if you want to accept the default settings.**
- 12 **Press the *OK* button in the *Network* window to complete the installation process.**
- 13 **Windows may prompt you for additional parameters; configure these as you would a standard Network adapter.**

- 14 You will be prompted to restart Windows. The new driver will load properly and be fully operational after system restart.**

You may choose to use the default values which are appropriate for most systems. However, systems which handle unusually large amounts of Fibre Channel IP traffic may benefit from modifying these values.

- 15 from the Control Panel double-click Network Adapters, select the Adapters tab, highlight the ExpresIP adapter, and click on the Properties button.**

Settings also may be modified directly in the registry key

(HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\ExpresIPn\Parameters).

In this string, n refers to the number of the ExpresIP interface. All values in the registry are stored as strings, not numbers.

To install the ATTO ExpressIP driver in Windows 2000:

- 1 Log on as a system administrator.**
- 2 Click *Start*, point to *Settings*, and then click *Control Panel*.**
- 3 Click *System*, click on the *Hardware* tab, and then click *Device Manager*.**
- 4 Double-click *SCSI Adapters* and highlight the appropriate ATTO ExpressPCI host adapter.**
- 5 Click *Properties*. The *Device Status* should indicate that the device is working properly.**
- 6 From the *Control Panel*, click *System*, click on the *Hardware* tab, double-click *Add/Remove Hardware*, click the *Next* button, and select the *Add/Troubleshoot* button.**
- 7 Click the *Next* button.**
- 8 Windows will automatically search for Plug and Play hardware. When this process is complete, select *Add a new device from the list of installed devices*.**
- 9 Click the *Next* button.**
- 10 Windows will prompt you to search for new hardware. Select *No, I want to select hardware from a list*, and click the *Next* button.**

- 11 Select Network adapters from the list of Hardware types.**
- 12 Click the *Next* button**
- 13 When prompted, click the *Have Disk* button.**
- 14 Insert the ATTO ExpressPCI FC installation disk into drive A.**
- 15 Enter the path A:\IP, and press *Enter*. (If installing from a CD or downloaded driver package, use the *Browse* button to find the directory).**
- 16 Press *Enter* (the only available option shown should be ATTO ExpressIP Adapter.)**
- 17 The system will automatically install the driver and load the ExpresIP configuration utility. Refer to the *Configuring the ExpresIP Driver* section (below) for information on customizing the adapter settings.**
- 18 Exit the ExpresIP utility if you want to accept the default settings.**
- 19 Press the *OK* button in the Network window to complete the installation process.**
- 20 Windows may prompt you for additional parameters; configure these as you would a standard Network adapter.**
- 21 You will be prompted to restart Windows. The new driver will load properly and be fully operational after system restart.**

You may choose to use the default values which are appropriate for most systems. However, systems which handle unusually large amounts of Fibre Channel IP traffic may benefit from modifying these values.

- 22 Access the Device Manager, open the ExpresIP properties adapter and select the Advanced tab.**

Configurable values

MTU Size (default 8192, min. 92, max 65280)

MTU (Maximum Transmission Unit) is the maximum size (in bytes) of a unit of IP data that can be transmitted per Sequence. If a packet is larger than the MTU size, Windows will break that packet into MTU-sized chunks before transmission. Larger sizes may make for higher speeds during large transfers.

Note: Every device on the SAN must use the same MTU size.

Buffer Count (default 32, min. 8, max 1024)

Each buffer contains a single IP Sequence (therefore, the size of each buffer is exactly the MTU size). If the chip runs out of buffers, it will drop incoming packets. If you expect large amounts of simultaneous FC-IP traffic, you may wish to increase this.

Note: If your system does not have a lot of memory and you set this value too high, the driver may not load.

Node Name (default empty)

This field allows you to enter the 16-character WWN of the adapter that this particular instance of the ExpresIP driver should connect to. Invalid values in this field will cause the driver not to load. Setting *Not Present* (or blank) causes the driver to attach to the first eligible ATTO FC HBA it finds. If you are using

multiple adapters in a system, it is a good idea to specify the Node Name of each ExpresIP instance.

Number of IP Control Blocks (default & minimum is 4x Buffer Count, max 8192)

This field specifies how many IP Control Blocks (IPCBs) are allocated by the driver. One IPCB is required for each packet transmitted or received. Systems that handle a lot of FC-IP traffic may need to increase this value to avoid dropping transmit packets; otherwise, just leave this value unspecified, and the driver will default to 4 times Buffer Count (which should be more than enough in most cases). Invalid values in this field will cause the driver to use the default. Note: setting this value too high can cause the driver not to load on systems without a lot of memory.

3.6 SNIA Fibre Channel Host Adapter API

API, or Application Programming Interface, is a set of commands used by an application directing the operating system to perform certain tasks. ATTO ExpressPCI host adapters use API Version 1.0 as defined by the Storage Network Industry Association (SNIA) Fibre Channel Work Group.

The Common HBA API Version 1.0, released in October 2000, is a vendor-neutral format for reporting information about host adapters to upper level software applications.

While uses for the API are almost limitless, it is commonly used in applications that require

- ❖ query information about adapter properties and port information
- ❖ query information attached storage resources
- ❖ event notification

ATTO ExpressPCI host adapters support the API on Windows NT and Windows 2000 systems.

The API has two major parts: the ATTO library and the registry key.

Registry entry is made in
KEY_LOCAL_MACHINE\Software\SNIA
and points to the location of the ATTO library.

ATTO vendor library is installed in the same location as the ExpressFC driver. A related component, the *common library*, is provided by the SAN-aware application provider.

3.7 FC LUN Masking Utility

ATTO ExpressPCI host adapter drivers allow you to select which devices and Logical Unit Numbers (LUNs) on a SAN are visible to the Windows® NT and Windows 2000 operating system.

Many devices, including RAID controllers and SCSI-to-Fibre Channel bridges, use LUNs to allow access to multiple drive units through a single World Wide Name (WWN). However, you may not want to allow all users connected to one device to have access to all devices. The ATTO LUN masking capability allows you, as the administrator, to select which LUNs each user will be able to access, allowing greater flexibility in configuring a Fibre Channel SAN.

Note: You must have Write Access to the registry key

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services

and all its sub-keys to save changes. Consult your system administrator if you cannot save changes.

Main screen

The main user screen allows you to monitor and manage all LUN masking functions.

The screen is divided into two sub-sections: Adapters and Devices.

Adapter List

Displays information about all the adapters detected or configured on this system. The first column displays the WWN of the adapter. If the adapter is installed, the second column will display the model of the adapter. If it is not installed, text will state *not installed*.

Clicking on an adapter in the adapter list will update the device list in the bottom window. Adapters can be added and configured using the *Add Adapter* button.

Adding a new adapter

You may wish to configure your adapter's LUN mask configuration before physically installing the adapter in the host system.

- 1 **Press the Add *Adapter* button**
- 2 **Enter the WWN of your adapter (found on the sticker along the upper edge of the card)**
- 3 **Add devices (see below).**

Device List

Displays information about all devices detected or configured for the adapter that is currently selected in the adapter list.

The first column displays the Node World Wide Name (WWN) of the device. The second column displays the current LUN mask configuration for this device. If no LUNs are masked, the word *none* will appear in this column. If the entire device is masked, the word *all* will appear in this column.

Adding a new device to an adapter

- 1 **Select the adapter in the Main Window adapter list.**
- 2 **Press the Add Device button at the bottom of the screen**
- 3 **A dialog box will ask for the Node Name (WWN) of the device to add. Enter the WWN.**
- 4 **Press OK.**
- 5 **The device will appear in that adapter's Device list on the bottom half of the main window. Save this change to the registry.**

Note: If you do not save the change, devices which do not have any LUNs masked may disappear from the device list if they are not detected as being physically connected to the adapter the next time you open the application.

Using the *Edit LUN Mask* Dialog box

- 1 **Double click the WWN of the device you wish to edit in the Devices list or select it and press the *Edit LUN Mask* button. If you do not see the device listed, you may need to add it.**

- 2 A dialog box will show 256 buttons, each representing a LUN on the device. Buttons that are depressed indicate LUNs that will be masked by the driver, meaning the devices will not be visible to the operating system. The *Mask All LUNs* button and *Clear LUN Mask* buttons provide shortcuts to select or deselect all the LUN buttons with a single keystroke.
- 3 When you have completed configuring the LUN mask for this device, click the **OK** button.
- 4 You may select a different device on the same adapter by selecting it from the *Node Name* drop down list at the top of the window.

Saving and applying your changes

- 1 Click the *Save Changes* button on the bottom of the windows. If you forget to save before closing the utility, you will be prompted to save your changes.
- 2 If you want the changes to take effect immediately, press the *Apply Changes* button before exiting but after saving. This will cause the driver to reread the registry

settings and alter its internal device database. You may need to run Windows Disk Administrator (Windows NT) or the Volume Manager (Windows 2000) to see devices that you have just un-masked. If Windows is unable to see devices or LUNs that you have just un-masked, you may need to reboot the system.

Config Menu

Save Saves all changes to system registry

Apply Applies configuration changes to driver

Revert Reloads configuration from registry

Exit Exits the LUN Masking utility

View Menu

Toolbar Shows or hides the toolbar

Status Bar Shows or hides the status bar

Help Menu

Help Topics An index to topics on which you can get help

About Displays the version number of this application

3.8 Performing Domain Validation Testing

Domain Validation tests the physical connection between host adapter and devices to ensure that the desired data transfer speeds can be achieved. Eliminating the guesswork of determining transfer rates, Domain Validation is a handy tool for configuring SCSI busses.

As SCSI performance has increased steadily over the past several years, it has become more important to verify that the connection between the host adapter and storage devices (i.e. cables, connectors, targets, etc.) is capable of handling the high-speed data transfers. Previously, users had to manually decrease transfer rates until data was transferred successfully by trial and error. Domain Validation (DV) eliminates the guesswork by verifying the connection, ensuring trouble-free data transfers. If speeds are determined not to be feasible, a slower speed is enforced.

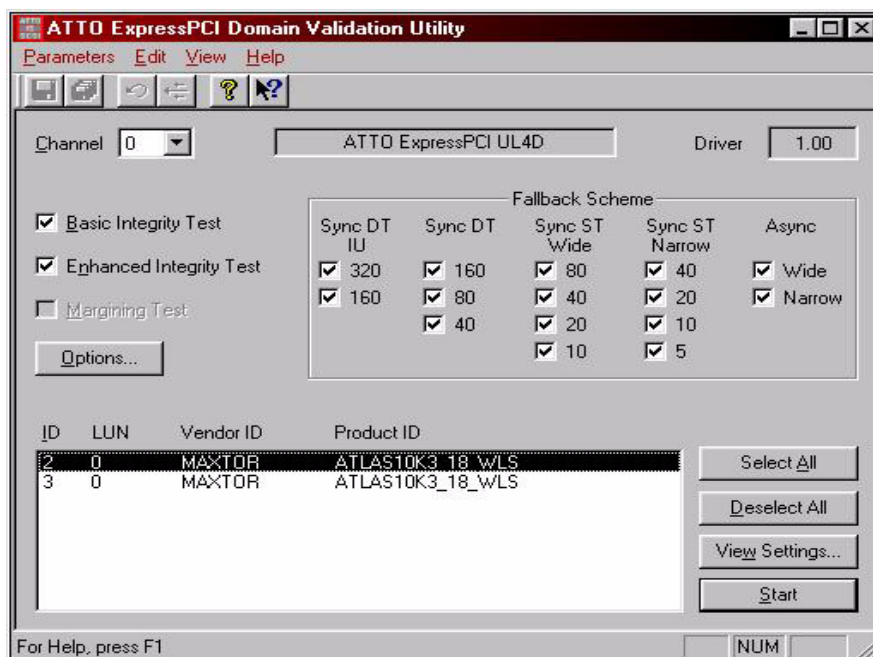
The ATTO *SCSIDV* utility performs Domain Validation on your storage connection. The three DV tests can be selected in the *SCSIDV* main screen.

Basic Integrity Test performs a simple integrity check to determine the fastest valid mode of operation between initiator and target, detecting most physical configuration problems such as path width errors, expander errors, gross cable errors, incorrect termination, or a damaged transceiver.

Enhanced Integrity Test performs a more advanced integrity check. A data pattern intended to stress the physical domain is written to and then read from memory on the device and compared with the original data pattern. If data compare errors are detected, fallback is attempted until a valid mode of operation is found. Problems detected by the Enhanced Integrity Test include cables with incorrect impedance, bad SCSI device spacing, poor termination, marginal transceivers, excessive crosstalk and excessive system noise.

Margining Test varies driver signal strength by +/- 20% and verifies the integrity of the subsystem using the same methods as the Enhanced Integrity Test. Failure indicates that the subsystem is close to failure because inferior components are significantly degrading SCSI bus signals and thus lowering the signal margins. This can result in sudden subsystem failure or intermittent integrity errors.

Specific instructions for using the *SCSIDV* utility are located under the Help tab in the application.



4 Solaris Utilities for ExpressPCI FC Adapters

ATTO ExpressPCI Fibre Channel Utilities for Sun Microsystems Solaris™ configure ATTO ExpressPCI FC host adapters for Sun Solaris configurations.

ATTO ExpressPCI Fibre Channel Utilities for Solaris only work with ATTO ExpressPCI FC host adapters.

The utilities are built into the ROM of the host adapter and will only show up if the card is installed.

- 1 **Download the file *protools.tar.Z* from the ATTO Technology website at www.attotech.com.**
- 2 **Copy the file *protools.tar.Z* into a temporary directory (i.e, /tmp)**
- 3 **Using the Unix utility, uncompress the file: *uncompress protools.tar.Z*. Once uncompressed, the file will no longer have the Z suffix.**
- 4 **Create a destination directory for the program files: *Mkdir/usr/local/atto*.**
- 5 **Make the new directory the default: *Cd/ usr/local/atto***
- 6 **Untar the program files with the following command: *tar xvf /tmp/protools.tar***

At the prompt enter: */usr/local/atto/protools*

If devices are connected, the ATTO ExpressPCI Utilities screen appears.

ATTO ExpressPCI FC scans the bus for devices. If no ATTO host adapter is attached during the boot process, the display will show:

```
ATTO ProTools for Solaris, © 2000 ATTO
Technology, Inc.
No Adapters Found!
#
```

Refer to the installation and troubleshooting information for the host adapter to resolve any issues before you proceed.

If you have more than one ATTO host adapter installed, you will be asked which model to work on:

ATTO ProTools – FC HBA Configuration

0 – FC – 66

1 – FC – SW

Select Enter to exit

Note: At any Select prompt, pressing Enter alone goes back to the previous list of options, eventually exiting the utility.

Type the number corresponding to the ATTO host adapter model and press *Enter*.

The utility will not ask you to select which card to modify the settings for:

ATTO ProTools – FCSW Configuration

Available hba (s):

0 – hba0

Select Enter to exit

Type the number corresponding to the ATTO host adapter to configure and press *Enter*.

Two options are now available: Configuration and Persistent Bindings.

ATTO ProTools – FCSW Configuration

1 – Configuration

2 – Persistent Bindings

Select Enter to exit:

Type the number of the corresponding action and press *Enter*.

Configuring the ATTO ExpressPCI host adapter

ATTO FC host adapters have several parameters that can be altered to configure the cards best to perform in a specific environment. The configuration portion of the utility provides a concise method for viewing and setting these

parameters. When the configuration option is selected, a list of parameters and their current values will be displayed:

ATTO ProTools – FCSW Configuration for hba0:

```
max – frame length=1024
max-iocb-allocation=256
execution – throttle=31
login – timeout=4
login – retry – count=10
enable – adapter – hard – loop –ID=0
enable – hard – loop ID=0
enable – 64 bit – addressing=0
enable – LIP – reset=0
enable – LIP – full – login=1
enable – target – reset=0
reset – delay=5
port – down - retry – count=30
link – down – error=1
loop – down – timeout=60
connection – options=1
device – configuration – mode=0
fc – tape=0
Select Enter to exit:
```

To change a parameter, type the number corresponding to the option and press *Enter*. To exit from the configuration screen, press *Enter* without entering any data.

A description and list of possible values for each parameter is listed once it has been selected:

ATTO ProTools – FC-66 Configuration for hba0:

Maximum fibre channel frame size

Range: 512, 1024 or 2048 bytes

Enter new value for max – frame – length [1024]

To change the value, type the new value and press *Enter*, or press *Enter* alone to leave the setting unchanged. Once *Enter* has been pressed, the utility goes back to the previous screen.

Appendix A SCSI host adapter selection guide

ATTO Technology offers a number of SCSI and Fibre Channel solutions for storage. The following chart compares the features of ExpressPCI SCSI host adapters.

Supported platforms: Sun Solaris; Linux; NetWare; SCO Unix; Windows 2000, 95/98, NT, and Macintosh OS and OS X.

Complete RAID packages are also available and include an ExpressPCI SCSI host adapter, ExpressRAID software and appropriate cable(s). Add "-KIT" suffix to host adapter product code (i.e. EPCI-UL3D-KIT)

Single Channel	ExpressPCI Ultra 320	Express PCI Ultra 3	Express PCI Ultra Wide
Max. transfer rate	320 MB/sec	160 MB/sec.	40 MB/sec.
LVD	√	√	
HVD			
64-bit	√	√	
32-bit	√	√	√
33/66 MHZ	√	√	
133 MHZ	√		
Bus ID support	30	30	15
Part number	EPCI-UL4S	EPCI-UL3S	EPCI-PSC

Dual Channel--- 2 independent channels	ExpressPCI Ultra 320	Express PCI Ultra 3
Max. transfer rate	640 MB/sec	320 MB/sec.
LVD	√	√
64-bit	√	√
32-bit	√	√
33/66 MHZ	√	√
133 MHZ	√	
Bus ID support	30	30
Part number	EPCI-UL4S	EPCI-UL3D

Appendix B Fibre Channel Host Adapter Guide

Each ATTO Technology Fibre Channel host adapter supports the following platforms: Macintosh OS and OSX, Windows NT/2000/XP, 95/98 and Linux.

Complete RAID packages are also available and include an ExpressPCI host adapter, ExpressRAID software and appropriate cable(s). Add “-KIT” suffix to host adapter product code (i.e. EPCI-3300-KIT).

	ExpressPCI FCSW	Express PCI FC 2600	ExpressPCI FC 3300	ExpressPCI FC 3321	Express PCI FC 3305
Fibre Channel ports	1	1	1	2	1
Optical interface	Fixed SW SC		Fixed SW LC	Fixed SW LC	
Copper interface		HSSDC			HSSDC
Max. transfer rate	200 MB/sec. full duplex	200 MB/sec. full duplex	400 MB/sec. full duplex	400 MB/sec. per channel full duplex	400 MB/sec. full duplex
Class 2 transfers	✓	✓	✓	✓	✓
Class 3 transfers	✓	✓	✓	✓	✓
Full duplex	✓	✓	✓	✓	✓
66 MHz backward compatible with 33 MHz	✓	✓	✓	✓	✓
64- and 32-bit PCI support	✓	✓	✓	✓	✓
Windows® XP/2000/NT; Windows 95/98; Linux and Macintosh® OS, OS X	✓	✓	✓	✓	✓
RAID support	✓	✓	✓	✓	✓
Max. cable length	500 m	25 m (175 m with MIA)	500 m	500 m	25 m (175 m with MIA)
Part number	EPCI-FCSW- 000	EPCI-2600-000	EPCI-3300-000	EPCI-3321-000	EPCI-3305-000
Complete RAID packages are also available. To receive the ATTO ExpressPCI host adapter, ExpressRAID software and appropriate cable(s), add “-KIT” to host adapter product code (i.e., EPCI-2600-000-KIT) when ordering.					

Appendix C Contact ATTO Technology, Inc.

While we do our best to provide you all the information you will need to use our products, we recognize that additional assistance is sometime required. If you have questions about installing, using or obtaining any of our products, you may contact us at:

ATTO Technology, Inc.
155 CrossPoint Parkway
Amherst, NY 14068

The information you need to answer your questions may be available 24-hours a day on our web site (www.attotech.com/). You may also contact our support departments at the following e-mail addresses.

Sales Support: sls@attotech.com
Technical Support: techsupp@attotech.com

Telephone customer service and sales support is available Monday through Friday between 8 a.m. and 8 p.m. EST at the following numbers:

(716) 691-1999 voice
(716) 691-9353 fax