ATTO Technology, Inc.

Installation and Operation Manual
ATTO ExpressPCI UL4S

Single Channel Ultra 320 SCSI, PCI-X Host Adapter

ATTO ExpressPCI UL4D

Dual Channel Ultra 320 SCSI, PCI-X Host Adapter

ATTO Express PCI UL5D

Dual Channel Ultra 320 SCSI PCI Express Host Adapter

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Contents

1 SCSI is a key technology for storage

Ultra320SCSI represents the seventh generation of SCSI technology, an I/O interface that increases performance while maintaining backward compatibility and legacy support.

From its roots in 5 MB/sec. transfer rates, SCSI has evolved as the leading interface for disk drive connections in high performance servers. It features maximum data transfer rates of 320 MB/second, full backward compatibility with older versions of SCSI protocols and additional features to improve performance and reliability.

Ultra320 is a powerful storage technology. All forms of digital content, from e-mail, video, film, and audio, to streaming video, and imaging, are driving the unprecedented growth in storage that pushes the I/O bandwidth, requiring more advanced interfaces to handle data transfer.

SCSI advantages

- Backward compatible with older versions of SCSI. Newer adapters will negotiate to the lower speeds of legacy devices.
- Minimal investment to upgrade technology. Older equipment may still be used with newer equipment. Upgrade does not require replacement of infrastructure.

Exhibit 1-1 How SCSI has evolved.

	Narrow	Fast/ Narrow	Ultra	Ultra/WIDE	Ultra2	Ultra160	Ultra320
Data transfer rates	<5 MB/sec	10 MB/sec	20 MB/sec	40 MB/sec	80 MB/sec	160 MB/sec	320 MB/sec
SCSI protocol	SCSI-1	SCSI-2	SCSI-3	SCSI-3	SCSI-3	SCSI-3	SCSI-3
Specification	SPI-1	SPI-1	SPI-1	SPI-1	SPI-2	SPI-3	SPI-4
Transfer type	Single-Ended	Single-Ended HVD	Single-Ended HVD	Single-Ended HVD	LVD	LVD	LVD

Glossary

Some terms used in the storage industry are defined below. More information is available through the ATTO Technology website (www.attotech.com) and the SCSI Trade Association (www.scsita.org).

Term	Definition
ANSI	American National Standards Institute
Asynchronous Information Protection	AIP: although most Ultra320traffic is sent synchronously and protected by CRC, some information is still sent asynchronously. AIP implements CRC-level error checking on asynchronous traffic ensuring end-to-end data integrity.
bit	Smallest unit of data a computer can process: a single binary digit with a value of either 0 or 1
byte	an ordered set of 8 bits
CRC	Cyclic Redundancy Checking, 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
domain validation	Before sending data, domain validation verifies that the physical connection is capable of handling the negotiated transfer speed. If the system determines that Ultra320speeds are not feasible, a slower speed is enforced.

Term	Definition
double transition clocking	Increases the data line frequency to equal that of the request signal, allowing sampling on both the leading and trailing edges of the request signal. Clocking can be set to ensure compatibility with legacy devices.
flow control	The target indicates to the initiator when the last packet of a data stream will be transferred so that the initiator can flush FIFOs and terminate pre-fetch sooner than previously possible. Basically, the target warns the initiator that the transfer is almost complete so that it can prepare for the next transfer while the target completes the current transfer.
host	A processor, usually a CPU and memory, which communicates with devices over an interface
HVD	High voltage differential: uses two wires, transmitting a signal on one and its inverse on the other. At the receiving end, the difference between the two signals is measured and interpreted. Noise on the bus will affect both the signal and its inverse equally, so the difference between the two lines will remain the same and the noise cannot be misread as a signal.
initiator device	A component which originates a command
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.
LVD	Low voltage differential. SCSI signalling method that combines the benefits of HVD and single-ended technologies, allowing longer cabling configurations while consuming less power than HVD technology.
originator	An initiating device; a component which originates a command
packetization	Creates information units (IUs) from commands, data, status information, etc. which are passed as synchronous transfers. Maximizes bus use, minimizes command overhead and allows multiple commands to be transferred in a single connection
pre-compensation	Although SCSI transfer speeds have changed dramatically over the past several generations, cable specifications have remained constant. Higher speed and frequency signals have a greater potential for reflection and distortion over distance. Pre-compensation techniques slightly modify the SCSI signal to reduce the chance of these types of problems.
Quick Arbitration Select (QAS) Arbitration	The process of devices negotiating for control of the bus with built-in “quiet times” so that fast and legacy devices have an opportunity to take control of the bus. A fair, but somewhat inefficient process, QAS speeds up the arbitration process by eliminating the bus free phase. When combined with packetization, reduces command overhead and maximizes bus use.
read and write data streaming	Minimizes data transfer overhead by allowing a target to send one data stream (LQ) packet followed by multiple data packets**.** Minimizes overhead of data transfers because the target can send one data stream packet followed by multiple data packets
receiver	The ultimate destination of data transmission; a terminal device
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-ended	An electrical signal protocol that transmits information through changes in voltage. Single-ended SCSI uses standard TTL signal and ground pairs to transmit information over the SCSI bus.
training pattern	SCSI is a parallel bus technology that is dependent on signals being transmitted on parallel wires simultaneously. At higher speeds, minute differences in wire lengths and transmission characteristics could cause problems. Training pattern testing measures these minute differences and compensates for them.
Vpath™ Technology	The ATTO ExpressPCI UL4S with Vpath Technology offers data transfer rates of 320 MB/sec. With one external connector and one internal connector, Vpath Technology allows both faster and slower devices to run without impacting the speed of faster devices.

2 ATTO ExpressPCI Ultra320SCSI solutions

The Ultra320SCSI host adapter represents the seventh generation of SCSI technology, an I/O interface that is committed to increased performance while maintaining backward compatibility and legacy support. The ATTO ExpressPCI UL4S is a single channel Ultra320SCSI, PCI-X host adapter, the ATTO ExpressPCI UL4D is a dual channel Ultra320SCSI, PCI-X host adapter, and the ATTO ExpressPCI UL5D is a dual channel Ultra 320 SCSI PCI Express (PCIe) host adapter.

Today's computing applications continue to strain the host PCI bus and storage subsystem. To bring better performance and reliability to today's professional applications, the ATTO ExpressPCI UL4D and UL4S adapters deliver up to 640 MB/sec. data throughput, and take advantage of the PCI-X bus interface while the ExpressPCI UL5D delivers data throughput rates of up to 640 MB/sec. using the latest in PCI bus technology, PCIe. ATTO ExpressPCI UL4D, UL4S and UL5D adapters deliver the high bandwidth demanded in data-intensive environments such as real-time and high-definition video editing, web server and database engines.

Ultra 320 SCSI features

- Double Transition Clocking
- Domain Validation
- Cyclic Redundancy Check (CRC)
- Packetization
- Quick Arbitration Select (QAS)
- Free-Running Clock
- Read and Write Data Streaming
- Flow Control
- Training Pattern
- Pre-Compensation
- Asynchronous Information Protection (AIP)

Common features

- Supports data transfer speeds of up to 320 MB/sec. per channel
- Supports Ultra320 Specifications including:
  - Packetized SCSI
  - Double transition clocking
  - Quick Arbitration Select (QAS)
  - Cyclical Redundancy Checking (CRC)
  - Domain Validation (DV)
  - Asynchronous Information Protection (AIP)
  - Free-running clock
  - Flow control
- Advanced Data Streaming (ADS™) provides controlled acceleration of data transfers.
  - Embedded RISC processor for low overhead
  - Bus mastering eliminates CPU processing time as a bottleneck
  - Tagged command queuing allows threads to be processed efficiently
  - Disconnect/reconnect eliminates wait time between transfers
  - Optimized scatter/gather lists
- Backward compatible with legacy SCSI devices
- ASPI (Windows®) compatible
- Automatic and upper-byte termination
- Flash ROM for easy field upgrades
- RAID ready
- Environment and physical specifications
  - Operating temperature: 0-45°C
  - Humidity: 10-90% non-condensing
  - Airflow: 100 LFM (min.)
- Reliability
  - MTBF: 150,000 hours
  - MTTR: <15 minutes
- PCI signal compatibility
  - 3.3 Volts/5 Volts universal

UL4D, UL4S specific features

- Accelerated PCI bus management
  - PCI Bus Master rate of 1-GB/sec.
  - PCI-X 1.0a compliant
  - PCI 2.2 compliant
  - 64-bit/133 Mhz PCI-X (backward compatible with standard PCI)
- Power
  - 0.75 typical/2.0 max. Amps @ + 5.0 /VDC
  - 0.05 Amps @ + 12.0 VDC

UL4D specific features

- Two external VHDCI and two internal high-density 68-pin connectors
- Supports up to 30 SCSI bus IDs (15 per channel)
- Dimensions

  Length: 6.521"

  Height: 4.450"

UL4S specific features

- One external high-density 68-pin connector and one internal high-density 68-pin connector
- Dimensions
  - Length: 6.521”
  - Height: 4.200”

UL5D specific features

- Two external VHDCI and two internal high-density connectors.
- Supports up to 30 SCSI bus IDs (15 per channel)
- Dimensions
  - Length: 7.5”
  - Height: 4.376”
- PCI Express (PCIe) bus management
  - PCI Bus master rate 2-GB/sec.
  - PCI-Express 1.0b compliant
- Power
  - 1.61 typical/2.03 max. Amps @ +3.3 VDC
  - 0.65 typical/1.46 Amps @ + 12.0 VDC

SCSI host adapter selection guide

Single Channel	ExpressPCI Ultra 320	ExpressPCI Ultra 160
Max. transfer rate	320 MB/sec	160 MB/sec.
LVD	√	√
HVD		
64-bit (PCI)	√	√
32-bit (PCI)	√	√
33 MHZ (PCI)	√	√
133 MHZ (PCI-X)	√	
Bus ID support	30	30
Part number	EPCI-UL4S	EPCI-UL3S

Dual Channel--2 independent channels	ExpressPCI Ultra 320	ExpressPCI Ultra 320	ExpressPCI Ultra 160
Max. transfer rate	640 MB/sec	640 MB/sec	320 MB/sec.
LVD	√	√	√
64-bit (PCI)		√	√
32-bit (PCI)		√	√
33 MHZ (PCI)		√	√
133 MHZ (PCI-X)		√	
Bus ID support	30	30	30
x4PCIe	√		
Part number	EPCI-UL5D	EPCI-UL4D	EPCI-UL3D

3 Hardware installation

Install the ATTO ExpressPCI Ultra320host adapter and attach your SCSI devices to it using the instructions below. To get the best performance from your ATTO Express Ultra320 host adapters, use Ultra 320 SCSI devices.

CAUTION

Remember to back up your system data before changing or installing hardware.

System requirements

The ATTO ExpressPCI host adapter package contains the host adapter, the ATTO ExpressPCI CD and a warranty and registration card. If any items are missing, contact your ATTO authorized sales representative.

To install and use the ATTO ExpressPCI UL4D and UL4S SCSI adapters you need:

- : A computer with an available 64-bit PCI-X expansion slot (preferred) or a standard 64- or 32-bit PCI expansion slot.
- The complete ATTO ExpressPCI SCSI host adapter package.

To install and use the ATTO ExpressPCI UL5D you will need

- A computer with an available x4 PCI Express expansion slot or larger, such as x8 or x16.
- The ATTO ExpressPCI SCSI host adapter package.

CAUTION

ATTO ExpressPCI host adapters contain components that are sensitive to electrostatic discharge (ESD). ESD can cause damage to the ExpressPCI host adapter. Please follow standard methods to avoid ESD.

Installation

Remember to back up your system data before changing or installing hardware.

1 Plan your SCSI device connections.

If connecting both internal and external devices to the ATTO ExpressPCI SCSI adapter, be sure to have the appropriate cables to connect devices.

2 Set SCSI device termination. Devices at both ends of the SCSI bus must be terminated.

Devices in the middle of the bus, including the ATTO ExpressPCI adapter, must have termination removed or disabled. ATTO ExpressPCI SCSI adapters select the proper termination if left in auto termination mode.

3 Set SCSI IDs. Each device on the SCSI bus requires a unique SCSI ID, one different from the host adapter ID. The default setting for the ATTO ExpressPCI adapter is 7.

If you need to change this setting, refer to the *ExpressPCI Utilities Installation and Operation* manual. Also refer to your SCSI device documentation to determine the current SCSI ID and how to change it. Wide (16-bit) SCSI devices can be assigned IDs 0 to 7 and 8 to 15, while Narrow (8-bit) devices can only be assigned IDs ranging from 0 to 7.

4 Review system documentation to select an appropriate slot to install your adapter. The combined power consumption of the expansion slots must not exceed the limits for your system. If you have more than one expansion card installed, ensure power consumption is within the limits outlined for your system.

5 Power down the computer and unplug the computer from all power sources.

6 Open the case.

7 Install the adapter in any open PCI expansion slot. Consult your computer's documentation if you have questions about how to install an expansion card in your system.

8 Connect SCSI devices by inserting a SCSI cable to the connector on the ATTO ExpressPCI host adapter until you hear a click. Refer to Chapter 3.1 when selecting cables.

9 Close the computer case and power it up.

ATTO ExpressPCI host adapters come preconfigured to operate properly in a variety of common system setups. However, some systems may benefit by tuning the adapter for optimal performance. Refer to the *ATTO ExpressPCI Utilities Installation and Operation* manual for more information on changing host adapter settings.

3.1 Cabling and termination

Cables and devices must be chosen to maximize performance and minimize the electrical noise from the high-speed data transfers available with the SCSI protocol. Cabling and termination methods become important considerations.

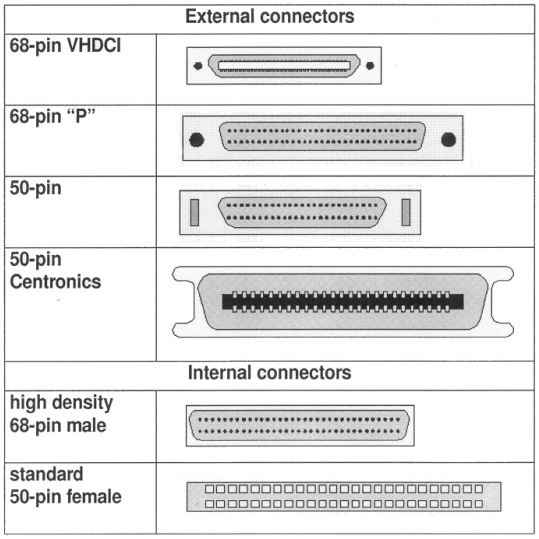
The following table lists the maximum number of devices you may connect at specific cable distances using differential and single-ended SCSI in various SCSI environments.

Exhibit 3-2 The development of SCSI capabilities

STA terms	Bus speed MB/sec. max.	Bus width bits	Max. bus lengths, meters			Max. device support
			Single-ended	LVD	HVD	
SCSI-1	5	8	6	-	25	8
Fast SCSI	10	8	3	-	25	8
Fast Wide SCSI	20	16	3	-	25	16
Wide Ultra/WIDE SCSI	40	16	-	-	25	16
Wide Ultra/WIDE SCSI	40	16	1.5	-	-	8
Wide Ultra/WIDE SCSI	40	16	3	-	-	4
Ultra2 SCSI	80	16	-	12	-	16
Ultra160 SCSI	160	16	-	12	-	16
Ultra320SCSI	320	16	-	12	-	16

Cable types

Use high quality Ultra 320-rated, well-insulated SCSI cables to ensure error free communications. The illustration at right depicts several internal and external cable connectors.



Setting up cables and termination

The ExpressPCI Ultra320SCSI host adapter supports two types of SCSI signaling: Low Voltage Differential (LVD) and Single-Ended. Devices on the same SCSI bus must use the same signaling, either LVD or Single-Ended.

To set up cabling and termination:

1. Determine whether you are using a single channel or dual channel host adapter model. One external connector indicates a single channel host adapter; two external connectors indicate a dual channel host adapter.
2. Determine if SCSI devices are going to be installed internally or externally.

- Total bus cable length varies by host adapter and type of attached devices. Refer to Exhibit 3-2 for details on maximum cable length.

- If you combine Wide 16-bit and Narrow 8-bit devices on the same connector, connect the Wide devices first (closest to the connector).
- Please refer to the documentation for your SCSI devices to determine if they are Wide or Narrow, UltraWIDE SCSI, Ultra2 SCSI, Ultra160 or Ultra 320.

3 Determine which terminator to use

- Use an LVD terminator if you are only using LVD devices.

  Although you can use a Single-Ended terminator, all devices will be limited to Ultra SCSI speeds. Single-Ended devices require a Single-Ended terminator. If you use an LVD terminator with Single-Ended devices, the system may hang or devices may not be seen on the SCSI bus. Some termination manufacturers provide automatically sensing terminators.
- External terminators should be attached to the last external device in the SCSI chain.

  Don't use any other termination on the external SCSI chain. The last device on an internal SCSI chain should also be terminated. This can be done in several ways. Many Single-Ended Ultra SCSI and earlier devices provide a jumper setting for applying termination: place a jumper over the pins designated for termination on the last device on the internal cable. Check with your drive manufacturer if you are not sure which pins to use.
- LVD Ultra2 and Ultra160 SCSI devices cannot supply their own termination.

  Use an internal ribbon cable which has a SCSI terminator attached to the end of it, connect the unterminated end of the cable to the host adapter card and the internal drives to the subsequent connectors. The terminator should be at the opposite end of the cable from the host adapter card.
- Wide (16-bit) and Narrow (8-bit) devices can be connected together on the same connector of the host adapter card, but wide devices must be attached first, followed by narrow devices.

  To terminate the SCSI bus, the cable or adapter used to convert from a wide (68-pin) connector to a narrow (50-pin) connector provides partial termination, allowing upper 8-bits (or byte) of the wide SCSI bus to be properly terminated. A narrow terminator should be used on the last narrow device to terminate the rest of the SCSI bus. A SCSI bus without partial termination between the wide and narrow devices may at first appear to work correctly, but occasional I/O errors occur without proper termination.
- If you use both internal and external connectors and mix Single-Ended and LVD devices on the same bus, even if using different connectors, the host adapter card will operate with Single-Ended signaling at UltraSCSI speeds.
- Automatic termination: when both internal and external connectors are used, the host adapter card detects the presence of devices and turns off termination. If devices are removed from one connector of the card, the host adapter automatically detects the change, and enables its own termination.
- Software controlled termination: You may have to override the host adapter's automatic termination if only narrow devices are attached to one connector and wide devices are attached to the other connector on the same bus. The host adapter must supply partial termination to the upper 8-bits (byte), but not automatically. Please refer to your ExpressPCI Utilities manual for instructions on setting the host adapter's termination to Upper Byte.
- Termination power: host adapters supply termination power to the bus at all times and many SCSI devices are also able to supply termination power. SCSI signal quality, particularly with long or marginal quality cables, may be improved if the device supplies the termination power. Contact your device manufacturer for more information on your device's ability to supply termination power.

4 Installing drivers

After installing the ATTO ExpressPCI host adapter, you must configure your system to recognize and use it by installing drivers for your operating system.

Note

If you already have one or more ExpressPCI adapters installed and you are installing additional adapter(s), you do not need to perform any of these procedures unless you are updating a previously installed driver.

After installing the ATTO ExpressPCI host adapter, you must configure your system to recognize and use it by

- installing drivers for your operating system
- updating the adapter firmware if necessary

ATTO ExpressPCI adapters ship with the latest firmware installed. If you are performing a new adapter installation, you do not need to update the firmware. If you are upgrading a previously installed driver, update the adapter firmware to ensure proper operation.

Visit the ATTO Technology website, www.attotech.com, for the latest drivers and firmware.

Windows installation

1 Download the Windows driver package containing the following files from www.attotech.com.

```
Win_NT.txt Windows NT 4.0
Win_2000.txt Windows 2000
Win_XP.txtWindows XP
WinSrv03.txtWindows Server 2003
```

If you do not have any of these files in the driver package, the operating system is not supported by the driver.

2 Open the appropriate file and follow the installation instructions.

3 Update the adapter firmware using the ATTO Configuration Tool or the ExpressPCI BIOS Setup Utility. Refer to Use the ATTO Configuration Tool and Use the ExpressPCI BIOS Setup Utility on page 10.

Mac OS X Installation

1 Open the Mac OS X driver package from the ATTO Technology website, www.attotech.com.

2 Follow the procedures in the **ReadMe.htm** file release notes and procedures to install the driver.

3 Update the adapter firmware using the ATTO Configuration Tool. Refer to Use the ATTO Configuration Tool on page 10.

Linux Installation

1 Open the Linux driver package from the ATTO Technology website, www.attotech.com.

2 View the **readme.txt file** in the driver patch package for release notes and installation instructions.

ATTO provides patches for the LSI Logic Fusion-MPT driver in the Linux 2.4 and 2.6 kernels to allow the driver to operate on your ExpressPCI host adapter.

3 Update the adapter firmware if necessary using the ExpressPCI BIOS Setup Utility. Refer to Use the ExpressPCI BIOS Setup Utility on page 10.

5 Updating hardware flash

ATTO ExpressPCI adapters ship with the latest firmware installed. If you are performing a new adapter installation, you do not need to update the firmware. If you are upgrading a previously installed driver, update the adapter firmware to ensure proper operation.

Visit the ATTO Technology website, www.attotech.com, for the latest drivers and firmware.

Use the ATTO Configuration Tool

1 Download the most recent version of the Configuration Tool from the ATTO web site, www.attotech.com.

Refer to the ATTO Utilities Installation and Operation Manual for additional information on downloading and using the Configuration Tool.

2 Download the flash bundle for your adapter from the ATTO web site and extract them to your desktop.

3 Install the **Configuration Tool** on your system.

4 Launch the **Configuration Tool**.

5 In the **Device** window, select your adapter

6 In the **Flash** window, click on the **Browse** button to find the flash bundle that you previously downloaded to your desktop.

7 Click **Update** to update your flash ROM.

8 Reboot your system for the flash changes to take effect.

Use the ExpressPCI BIOS Setup Utility

Note

BIOS utilities are not available on Itanium systems. Use the ATTO Configuration Tool to update flash on Itanium systems.

1 Download the latest Windows driver package from the ATTO Technology website.

2 Run **makedisk.bat** in the Windows driver package and follow the instructions for creating the driver floppy disk.

3 Reboot the PC.

4 During the reboot, an ATTO Technology banner displays that the host adapter is detected.

5 Enter **Control-Z** when prompted to begin the setup utility within a few seconds after the banner appears.

If you do not enter **Control-Z** soon enough after the banner appears, repeat steps 3-5.

6 In the utility, select the **Upgrade Flash ROM** option.

7 Insert the driver disk from step 1 into the floppy drive.

8 Follow the on-screen instructions.

9 Remove the disk and reboot your system for the flash ROM changes to take effect.

6 Maximizing performance in Windows

If you are getting less performance than you expect, there are several things you can do such as making sure you are using the latest ATTO driver, setting the registry entry for large block transfers, using ATTO ExpressRAID for setting up RAID groups, increasing transfer size, and analyzing your system's I/Os.

While the factory settings on your ExpressPCI host adapter should provide excellent performance for a wide range of applications, you may improve performance by modifying some of the system factors which affect your ExpressPCI host adapter.

For example, the ATTO driver can transfer well over a megabyte with one SCSI command.

Note

You must use an ATTO driver when using ATTO ExpressRAID software.

This procedure is available for Windows only.

Use the latest ATTO driver

Determine which drive is currently in use, then install the latest ATTO driver found at www.attotech.com.

1. Using the **Device Manager**, select **SCSI & RAID Controllers**
2. Examine the **Driver** tab for your SCSI adapter. If the driver is not **express2.sys**, install the **express2.sys** driver.
3. Either remove the previously-installed driver or disable it using the **Devices** applet. If the system has a built in Symbios or LSI adapter, do not disable the driver for that adapter.

Set registry for large block transfers

If your application requires large block transfers, set the registry entry correctly for the MaximumSGList keyword. Several files supplied with the device driver download package can set values in the range of 64KB to 8MB. The files are ASCII text files with **.reg** extension and can be viewed with any suitable editor. The files also explain the registry setting and how to change the setting.

Set up RAID groups

Instead of using the RAID functionality built into Windows OS, use the ATTO ExpressRAID software for the most efficient performance.

ATTO ExpressRAID requires one less level of driver through which commands must pass and fewer commands are required to pass through the driver hierarchy.

Other advantages of ATTO ExpressRAID striping:

- You can boot your system off striped drives
- Stripe sets created with ExpressRAID are recognizable by DOS and Windows
- You can stripe removable-media drives with ExpressRAID.

If you have purchased the striping option, additional information about ExpressRAID is available in the file **Stripe.txt** on the CD which has been included with your ATTO ExpressPCI adapters.

Increase transfer size

If you are writing to an application that uses a lot of sequential disk I/O to a contiguous area on disk, you should use as large a transfer size as possible to reduce overhead on the system, on the SCSI bus and within disk drives.

Analyze your I/Os

For large sequential data transfers, use **Direct I/O** by selecting **FILE_FLAG_WRITE_THROUGH** and **FILE_FLAG_NO_BUFFERING** flags with your **CreateFile** call to avoid the overhead of copying data from one area of memory to another, to reduce the number of SCSI commands which must be executed and to leave system pages available for other data.

If your application requires a small number of I/Os and the transfers are rather small, however, you may get better performance by letting the system cache your data in the system pages.

You might want to use over-lapped I/O using the **FILE_FLAG_OVERLAPPED** option with the **CreateFile** call. Overlapped I/O allows the application to send many commands to the device at once.

The ATTO Disk Benchmark program, included with the ExpressPCI Utilities on the CD shipped with your ExpressPCI adapter, shows the effect of using the above I/O modes.

- If you turn off Direct I/O and set the file size to a value significantly less than the amount of memory in your computer, you may observe some artificially high transfer rates because very little I/O is actually being performed by the SCSI device: all the activity is involved in transferring data between the application and the system pages.
- As you increase the file size to a value more than the amount of memory in your computer, performance degrades significantly.
- If you turn on Direct I/O, you can see the effect of removing the system pages from the overhead picture.
- If you use overlapped I/O, performance improves in low to medium transfer sizes.
- However, depending on the amount of memory in your computer, you may not be able to use queue depths greater than 4 or 5.

Appendix A Standards and compliances

The equipment described in this manual generates and uses radio frequency energy. The Technical Specification sheet for a particular ATTO ExpressPCI host bus adapter list certifications for that model.

FCC standards: radio and television interference

WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Canadian standards

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

European standards

Declaration of Conformity

This following statement applies to the ATTO ExpressPCI host bus adapter.

This device has been tested in the basic operating configuration and found to be compliant with the following European Union standards:

Application of Council Directive: 89/336/EEC

Standard(s) to which conformity is declared: EN55024:1998

This Declaration will only be valid when this product is used in conjunction with other CE approved devices and when the entire system is tested to the applicable CE standards and found to be compliant.

The EPCI-UL4D-0R0, EPCI-UL4S-0R0 and EPCI-UL5D-0R0 comply with Directive 2002/95/EC on the Restriction of the Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS).

Appendix B ATTO product guide

The following SCSI accessories are available through ATTO Technology and authorized resellers. Contact an ATTO Technology authorized sales representative to order.

Cables

CBL-F68R-681	Internal Ribbon - 68-pin “P/68-pin “P” - 0.5m
CBL-F68R-682	Internal Ribbon - Triple 68-pin “P/68-pin “P” - 1m
CBL-FP68-C3	System Cable - HD68/50-pin Centronics - 1m
CBL-U68E-681	System Cable - HD68/HD68 fine pitch - 1m
CBL-F68E-686	System Cable - HD68/HD68 fine pitch - 2m
CBL-F68E-003	System Cable - HD68/HD68 fine pitch - 3m
CBL-HD60-681	System Cable - High Density 60-pin/HD68 - 1m
CBL-VHDC-003	Cable, SCSI, VHDCI to VHDCI - 3m
CBL-V68E-001	System Cable - Very High Density VHDCI 68-pin/HD/68 - 1m

Optical cables

CBL-FCFI-05x	5 m. cable– Duplex 50 Micron Multi-mode FC/Optical
CBL-LCSC-003	3 m. 50/125 optical cable (LC to SC)
CBL-LCSC-010	10 m. 50/125 optical cable (LC to SC)

Terminators

TERM-V68E-002	Terminator, VHDCI, Active, LVD
TERM-V68L-LVD	Terminator - 68-pin “P” Low Voltage Differential
ADAP-50AF-68P	Adapter - 50-pin “A” Female to 68-pin “P” Female

A variety of Fibre Channel and SCSI products are also available from ATTO Technology. Please contact your ATTO sales representative for product descriptions and part number information.

Fibre Channel solutions

FC Rack System	Modular Fibre Channel rack
ATTO FibreBridge™	Fibre Channel-to-SCSI bridge
ATTO FibreCenter™	Fibre Channel Hub
ATTO iPBridge	iSCSI bridge

Software

ATTO Utilities	Configuration and management software

Celerity FC storage adapter selection guide

Product Features	Celerity FC-44ES	Celerity FC-42ES	Celerity FC-42XS	Celerity FC-41XS	Celerity FC-24XL	Celerity FC-22XH
Fibre Channel Ports	4	2	2	1	4	2-4[1]
FC protocol	4-Gb	4-Gb	4-Gb	4-Gb	2-Gb	2-Gb
Maximum Transfer Rate (half duplex)	1.6 GB/sec	800 MB/sec	800 MB/sec	400 MB/sec	800 MB/sec	400 MB/sec
Maximum Transfer Rate (full duplex)	2 GB/sec	1 GB/sec	1 GB/sec[2]	800 MB/sec	1 GB/sec[2]	800 MB/sec
Bus Type	PCIe	PCIe	PCI-X	PCI-X	PCI-X	PCI-X
Bus Characteristics[3]	8 lane	8 lane	64-bit 133 MHz	64-bit 133 MHz	64-bit 133 MHz	64-bit 133 MHz
Optical Interface	SFP LC	SFP LC	SFP LC	SFP LC	SFP LC	SFP LC
Maximum Cable Length	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	500m@1-Gb 300m@2-Gb	500m@1-Gb 300m@2-Gb
Advanced Data Streaming (ADS™) Technology	✓	✓	✓	✓	✓	✓
Software RAID Support[4]	✓	✓	✓	✓	✓	✓
Developer's Kit (Target Mode & API)	✓	✓	✓	✓	✓	✓
Developer's Kit (Advanced)					✓	
Integrated Offload & Processing Center (IOPC)					✓	
Onboard Memory for Direct Memory Transfers					✓	
Integrated Hub Technology						✓
Windows Support	✓	✓	✓	✓	✓	✓
Linux (Red Hat) Driver Support	✓	✓	✓	✓	✓	✓

1 ATTO onboard hub technology allows for up to four external connections to two FC channels
2 Performance ceiling is constrained by 133 MHz PCI-X bus transfer speed
3 Backward compatible to 32-bit and 33 MHz PCI; FC-24XL and FC-22XH are 3.3V; FC-21PS is 3.3V/5V Universal
4 ATTO ExpressStripe for OS X available; other software RAID supported

SCSI adapter selection guide

Product Features	Ultra 320			Ultra 160	
	UL5D	UL4D	UL4s	UL3D	UL3S
Max. transfer rate (MB/sec.)	640	640	320	320	160
Low Voltage Differential	√	√	√	√	√
Single-ended SCSI	√	√	√	√	√
Number of SCSI Channels	2	2	1	2	1
Number of SCSI IDs supported	30	30	30	30	30
Cable distances (m)	12.5	12.5	12.5	12.5	12.5
32-bit PCI compatible		√	√	√	√
64-bit PCI compatible		√	√	√	√
33 MHZ PCI		√	√	√	√
133 MHZ PCI-X		√	√		
x4 PCI Express	√				
Windows NT/2000/XP, 95/98 support	√	√	√	√	√
Linux support	√	√	√	√	√
Mac OS X support		√	√	√	√
RoHS compliant version available?	√	√	√		

Appendix C Contact ATTO Technology, Inc.

Customer service, sales information and technical support are available by phone Monday through Friday, Eastern Standard Time 8:00 a.m. to 8:00 p.m., or by e-mail and web site 24-hours a day.

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