



ATTO Technology, Inc.

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## **ATTO ExpressSAS Host and RAID Adapter Installation and Operation Manual**

ExpressSAS H1208 HBA  
ExpressSAS H1280 HBA  
ExpressSAS H120F HBA  
ExpressSAS H12F0 HBA  
ExpressSAS H1244 HBA  
ExpressSAS H1248 HBA  
ExpressSAS H1288 HBA

ExpressSAS H644 HBA  
ExpressSAS H608 HBA  
ExpressSAS H680 HBA  
ExpressSAS H60F HBA

ExpressSAS R644 RAID Adapter  
ExpressSAS R608 RAID Adapter  
ExpressSAS R680 RAID Adapter  
ExpressSAS R60F RAID Adapter

## **ATTO Technology, Inc.**

155 CrossPoint Parkway  
Amherst, New York 14068 USA  
[www.attotech.com](http://www.attotech.com)

Tel (716) 691-1999  
Fax (716) 691-9353

Sales support: [sls@attotech.com](mailto:sls@attotech.com)  
Technical support: Monday -- Friday, 8am-6pm EST  
[techsupp@attotech.com](mailto:techsupp@attotech.com)  
(716) 691-1999 ext. 242

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# 1 ATTO Provides Storage Solutions

*ATTO Technology ExpressSAS low-profile HBAs and RAID adapters provide 6Gb and 12Gb SAS/SATA connectivity for IT and digital video environments.*

The ATTO ExpressSAS adapter family provides enhanced reliability and performance thanks to more than 25 years of ATTO experience.

## Installation procedure

The ExpressSAS RAID adapter has a Getting Started Guide. If you have not used this guide or you are installing an ExpressSAS HBA, follow the instructions in this manual.

You will need:

- ExpressSAS adapter.
  - Access to [www.attotech.com](http://www.attotech.com) to obtain drivers, user manuals and utilities.
  - The optional low-profile bracket and its installation procedure.
  - A computer with an available x8 or x16 PCI Express expansion slot. The ExpressSAS adapter has been optimized for x8 electrical slots. Check your computer's documentation.
  - SAS/SATA storage, cables and connectors.
- 1 Download device drivers from the ATTO website for your operating system. Refer to page 9 for driver installation.
  - 2 Install the configuration software, the ATTO ConfigTool, found on [www.attotech.com](http://www.attotech.com). Refer to the ATTO Utilities Installation and Operation Manual for details.



### Note

*Logging features are only available if the ATTO ConfigTool service is installed. We recommend installing the service as a minimum configuration.*

- 3 Install the adapter. Refer to [Install Hardware](#) on page 17.
- 4 Attach SAS/SATA storage.
- 5 Configure your storage and adapter, including RAID, using the ATTO ConfigTool.



### Note

*Default settings are appropriate for most systems but you may change settings using the ATTO ConfigTool.*



## CAUTION

*Back up your system data before changing or installing any hardware.*

## ExpressSAS features

- Point-to-point technology delivers full throughput to each connected storage device
- One-click installation
- User-friendly ATTO ConfigTool provides a simple host-based utility for effortless configuration; BIOS and EFI setup utilities provide flexibility for custom applications
- Fully Thunderbolt aware, including hot plug and daisy chain support in a PCIe expansion slot
- For RAID adapters, a user-friendly GUI allows quick and easy RAID setup
- ADS™ technology alleviates data transfer bottlenecks and moves data more efficiently while managing latency
- DriveAssure™ is an ATTO exclusive combination of features for the ATTO RAID series adapters that performs predictive and corrective actions to allow the continued operation of marginal drives, while ensuring continued and uninterrupted access to data (6Gb RAID adapter only).
- CacheAssure™ provides confidence that your cached data will remain intact in the event of an unexpected power loss, while offering an environmentally friendly, maintenance-free solution. (6Gb RAID adapter only)
- Adaptive Path Optimization-has built-in intelligence to sense when multiples paths to drives are available and direct I/O accordingly.(6Gb RAID adapter only)
- Driver support for Windows®, Linux®, Mac® OS X(6Gb only), and VMware® ESX/ESXi Server (HBAs only)
- Fully support EFI-HII interface (H12xx HBAs only)
- RoHS compliant
- 3-year standard warranty

## ExpressSAS 12Gb Host HBAs

ExpressSAS 12Gb host bus adapters combine 12Gb/s SAS speeds and x8 PCI Express 3.0 to deliver low latency in real-time environments. They support a dense and efficient connection to storage from servers and workstations in datacenter, data warehousing, VOD and other high-availability, high-performance applications. Providing SAS/SATA connectivity to up to 2,048 end devices (H1208, H1244 and H1280 support 1,024 end devices), ATTO 12Gb SAS HBAs are ideal for both IT and digital video environments that require a high level of performance.

### Power Center Pro

Power Center Pro is an integrated software RAID solution that brings the performance and protection of RAID to storage devices attached to your ATTO ExpressSAS 12Gb host adapters with internal ports.

ATTO's Power Center Pro is a RAID 0, 1, 1e and 10 solution included for use with ExpressSAS 12Gb SAS HBAs with internal connections, providing a cost-effective option that adds performance and protection to your storage architecture.

To learn more about using and configuring Power Center Pro RAID groups, refer to the ATTO Utilities software manual ([www.attotech.com](http://www.attotech.com)).

### H1208 technical specifications

- 8 internal SFF-8643 SAS ports to PCIe 3.0 host interface
- Up to 12Gb/s per port performance
- Conforms to PCIe low profile form factor
- Length: 6.600"
- Height: 2.536"
- Operating temperature: 0-55 °C (32 °F-131 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.9A; 3.3V @ 0.1A, 11W
- Airflow: 100 lf/m minimum



### H1280 technical specifications

- 8 external SFF-8644 SAS ports to PCIe 3.0 host interface
- Up to 12Gb/s per port performance
- Conforms to PCIe low profile form factor
- Length: 6.600"
- Height: 2.536"
- Operating temperature: 0-55 °C (32 °F-131 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.9A; 3.3V @ 0.1A, 11W
- Airflow: 100 lf/m minimum



### H120F technical specifications

- 16 internal SFF-8643 SAS ports to PCIe 3.0 host interface
- Up to 12Gb/s per port performance
- Conforms to PCIe low profile form factor
- Length: 6.600"
- Height: 2.536"
- Operating temperature: 0-55 °C (32 °F-131 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 1.2A; 3.3V @ 0.1A, 15W
- Airflow: 200 lf/m minimum



### H1244 technical specifications

- 4 external SFF-8644, 4 internal SFF-8643 SAS ports to PCIe 3.0 host interface
- Up to 12Gb/s per port performance
- Conforms to PCIe low profile form factor
- Length: 6.600"
- Height: 2.536"
- Operating temperature: 0-55 °C (32 °F-131 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 1.2A; 3.3V @ 0.1A, 11W
- Airflow: 100 lf/m minimum



### H12F0 technical specifications

- 16 external SFF-8644 SAS ports to PCIe 3.0 host interface
- Up to 12Gb/s per port performance
- Conforms to PCIe low profile form factor
- Length: 6.600"
- Height: 2.536"
- Operating temperature: 0-55 °C (32 °F-131 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 1.2A; 3.3V @ 0.1A, 15W
- Airflow: 200 lf/m minimum



### H1248 technical specifications

- 4 external SFF-8644, 4 internal SFF-8643 SAS ports to PCIe 3.0 host interface
- Up to 12Gb/s per port performance
- Conforms to PCIe low profile form factor
- Length: 6.600"
- Height: 2.536"
- Operating temperature: 0-55 °C (32 °F-131 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 1.2A; 3.3V @ 0.1A, 15W
- Airflow: 200 lf/m minimum



## H1288 technical specifications

- 8 external SFF-8644, 8 internal SFF-8643 SAS ports to PCIe 3.0 host interface
- Up to 12Gb/s per port performance
- Conforms to PCIe low profile form factor
- Length: 6.600"
- Height: 2.536"
- Operating temperature: 0-55 °C (32 °F-131 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 1.2A; 3.3V @ 0.1A, 15W
- Airflow: 200 lf/m minimum



# ExpressSAS 6Gb Host HBAs

ATTO ExpressSAS Host HBAs are engineered for the most stringent IT server and digital media workgroup environments and are compatible with multiple operating systems, applications, and drives.

Providing SAS/SATA II connectivity to up to 1,024 end devices, the ATTO SAS Host HBA is ideal for both IT and digital video environments that require a high level of performance.

## H644 technical specifications

- Four internal SFF-8087, four external SFF-8088 ports
- Up to 6-Gb/sec per port performance
- Form factor conforms to PCI low-profile specification
- Length: 6.600"
- Height: 2.713"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 5-95% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.6A; 3.3V @ 0.2A, 8W
- Airflow: 100 lf/m minimum



## H680 technical specifications

- Eight external SFF-8088 ports
- Up to 6-Gb/sec per port performance
- Length: 6.600"
- Height: 2.846"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 5-95% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.6A; 3.3V @ 0.2A, 8W
- Airflow: 100 lf/m minimum



## H608 technical specifications

- Eight internal SFF-8087 ports
- Up to 6-Gb/sec per port performance
- Form factor conforms to PCI low-profile specification
- Length: 5.600"
- Height: 2.713"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 5-95% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.6A; 3.3V @ 0.2A, 8W
- Airflow: 100 lf/m minimum





### H60F technical specifications

- 16 internal SFF-8087 ports
- Up to 6-Gb/sec per port performance
- Form factor conforms to PCI low-profile specification
- Length: 8.638"
- Height: 2.918"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 5-95% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 1.6A; 3.3V @ 0.8A, 22W
- Airflow: 100 lf/m minimum



### H6F0 technical specifications

- 16 external SFF-8088 ports
- Up to 6-Gb/sec per port performance
- Length: 5.600"
- Height: 4.376"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 5-95% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 1.6A; 3.3V @ 0.6A, 22W
- Airflow: 100 lf/m minimum



## ExpressSAS 6Gb RAID Adapters

ATTO ExpressSAS RAID adapters are ideal for both IT and digital video environments that require a high level of protection and performance, supporting up to 256 end devices.

RAID improves data accessibility and reliability during normal operations. A RAID group is a virtual, independent single drive with data written to physical drives according to a RAID algorithm.

DriveAssure™ lets you run longer, faster and smoother without interrupting data flow while avoiding the unnecessary cost of replacing functional drives.

The ATTO ExpressSAS RAID adapters support JBOD, DVRAID™, RAID Level 0, 1, 4, 10, 5, 6, 50, 60 and advanced features such as read caching, Hot Spares, automatic RAID group rebuilding, hot swap and Simple Network Management Protocol (SNMP).

### R644 technical specifications

- Four external SFF-8088 & four internal SFF-8087 ports
- Up to 6-Gb/sec per port performance
- Form factor conforms to PCI low-profile specification
- Length: 6.600"
- Height: 2.713"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.8A; 9.6W
  - 12V @1.22A; 3.3V @ .06A, 15.05W (NVCACHE charging), 12V @1.00A; 3.3V @ .06A, 12.34W (NVCACHE charged)
- Airflow: 150 lf/m minimum



### R680 technical specifications

- Eight external SFF-8088 ports
- Up to 6-Gb/sec per port performance
- Form factor conforms to PCI low-profile specification
- Length: 6.600"
- Height: 2.713"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.8A; 9.6W
  - 12V @1.22A; 3.3V @ .06A, 15.05W (NVCACHE charging), 12V @1.00A; 3.3V @ .06A, 12.34W (NVCACHE charged)
- Airflow: 150 lf/m minimum



### R60F technical specifications

- Sixteen internal SFF-8087 ports
- Up to 6-Gb/sec per port performance
- Form factor conforms to PCI low-profile specification
- Length: 6.600"
- Height: 2.713"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.8A; 9.6W
- 12V @1.22A; 3.3V @ .06A, 15.05W (NVCACHE charging), 12V @1.00A; 3.3V @ .06A, 12.34W (NVCACHE charged)

Airflow: 150 lf/m minimum



### R608 technical specifications

- Eight internal SFF-8087 ports
- Up to 6-Gb/sec per port performance
- Form factor conforms to PCI low-profile specification
- Length: 6.600"
- Height: 2.713"
- Operating temperature: 0-40 °C (32 °F-104 °F)
- Operating humidity: 10-90% non-condensing
- Storage temperature: -40-70 °C (-40 °F-157 °F)
- Storage humidity: 5-95% non-condensing
- Power (typ): 12V @ 0.8A; 9.6W
- 12V @1.22A; 3.3V @ .06A, 15.05W (NVCACHE charging), 12V @1.00A; 3.3V @ .06A, 12.34W (NVCACHE charged)



## 2 Install Drivers

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*ATTO ExpressSAS adapters require a current device driver and hardware flash for proper operation.*

Your adapter was properly flashed before shipment. However, you must add ExpressSAS drivers to your computer before continuing with installation.

If you already have one or more ExpressSAS adapters installed and you have the latest drivers found on the ATTO website, or you followed the instructions in the Getting Started Guide, you do not need to perform any of these procedures.

Drivers are provided on the ATTO website. at <http://www.attotech.com/downloads.php>. Log in, if previously registered, or register to proceed to the download pages. Once downloaded, continue with the driver installation procedures (below) for your operating system.

### Downloading drivers from the ATTO website

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Use this procedure if you need to update drivers. The latest driver for your adapters can be found on the ATTO website.

- 1 Go to [www.attotech.com](http://www.attotech.com).
- 2 On the home page menu, put your cursor over **Downloads** then click on **Downloads**.
- 3 Register or log in if previously registered.
- 4 Select **SAS/SATA HBAs and RAID adapters** from the product list.
- 5 Select your model.
- 6 From the table, find your Operating System.

- 7 Click on the entry for the latest driver.
- 8 A download window appears. Follow the instructions for downloading the driver.  
Internet Explorer users may select **Run** to automatically run the downloaded self-extracting executable file.  
All other browser users select a download destination and run the self-extracting executable file.
- 9 Continue with the driver installation as described on the following pages for your Operating System.

### Windows

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#### Installing from the ATTO Technology website

- 1 Power on your system.
- 2 Log on to Windows as the system administrator.
- 3 Locate the ATTO driver on your system and **click unzip**. The driver files are extracted and the driver installer is launched.
- 4 For Windows 8, 7, Vista and Server 2012, 2008: If you have **User Account Control** enabled, you are asked for permission for the installer to continue. If you do not have administrator privileges, you are also asked for an administrator user name and password. Fulfill the required fields and click **Continue**.
- 5 Click **Install**.
- 6 Follow the on-screen instructions to complete the driver installation.
- 7 Continue on to [Install Hardware](#) on page 17.

#### Installing from a directory containing the ExpressSAS driver

- 1 Power on your system.
- 2 Log on as the system administrator.
- 3 Navigate to the directory containing the ExpressSAS driver.
- 4 Run **Setup.exe**.
- 5 Click **Install**.  
For Windows 8, 7, Vista and Server 2012, 2008: If you have **User Account Control** enabled, you are asked for permission for the installer to continue. If you do not have administrator privileges, you are also asked for an administrator user name and password. Fulfill the required fields and click **Continue**.
- 6 Follow the on-screen instructions to complete the installation.
- 7 Continue on to [Install Hardware](#) on page 17.

## OS X (ExpressSAS H6xx and R6xx only)

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- 1 Power on your system.
- 2 Double-click the downloaded driver file to launch the installer
- 3 Follow the on-screen instructions.
- 4 Continue on to [Install Hardware](#) on page 17.
- 5 Launch

## Linux

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### Note

Newer PCs may ship with UEFI firmware with Secure Boot enabled. With Secure Boot the operating system boot loaders, Linux kernel, and all kernel modules must be signed with a private key and authenticated with a corresponding public key.

When trying to load an unsigned ATTO driver on a secure boot system, you will see the following error: *modprobe: ERROR: could not insert '<driver-name>': Required key not available*

Refer to the Linux driver read me file (readme.html) contained in the driver bundle for instructions on signing and authenticating your ATTO Linux drivers.



### Note

*ExpressSAS adapters are not supported under Linux kernel 2.4.*

- 1 Power on your system.
- 2 Log in as **root**.
- 3 Verify that the kernel header files, usually included with the Linux kernel development package, are installed.
- 4 Locate the downloaded driver and copy the driver file to a directory such as `/usr/src`
- 5 Open a Terminal session and change to the directory where you stored the driver.
- 6 Open your File Browser and browse to `/mnt/cdrom/Linux/Drivers`.
- 7 Click on the driver:
  - for the ExpressSAS HBAs, the driver filename appears as **lnx\_drv\_esashba#\_XXX.tgz** where # is the product family and XXX is the driver's current version number.
  - for ExpressSAS RAID adapters, the driver filename appears as **lnx\_drv\_esasraid#\_XXX.tgz** where # is the product family and XXX is the driver's current version number.
- 8 Copy the driver file to a directory such as `/usr/src`.
- 9 Open a Terminal session.
- 10 Change to the directory where you stored the driver.
- 11 Extract the driver source:
  - for ExpressSAS HBAs: **tar xzf lnx\_drv\_esashba#\_XXX.tgz**.
  - for ExpressSAS RAID adapters: **tar xzf lnx\_drv\_esasraid#\_XXX.tgz**.
- 12 The driver files are extracted to a directory called `lnx_drv_esashba_XXX` or `lnx_drv_esasraid_XXX`.  
Navigate to that directory.
- 13 Compile and install the driver using `./install.sh`. The driver is now installed and ready to use.
- 14 Add the following line to `/etc/modprobe.conf` after installing the driver:
  - for ExpressSAS HBAs: **alias scsi\_hostHBAX esashba** where **X** is the next available HBA number.
  - for ExpressSAS RAID adapters: **alias scsi\_hostHBAX esasraid** where **X** is the next available HBA number.
- 15 Continue on to [Install Hardware](#) on page 17.

## VMware ESXi 5.x (ExpressSAS H6xx only)

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You can add an ATTO adapter and install the driver after installing ESXi 5.



### Note

*ESXi 5.0 supports H6xx*

*ESX 5.5 supports H12XX*



#### Note

Refer to Appendix B [Driver Configuration](#) on page iii for additional information on configuring and managing ExpressSAS adapters in VMware

- 1 Download the Driver Bundle from the VMware or ATTO website for your ATTO adapter. Unzip the contents of the bundle on your local workstation. Within the bundle you will find the Driver VIB file (.vib) for your ATTO adapter.
- 2 Use the Datastore Browser in the vSphere Client to upload the VIB file to your ESXi host. Alternatively, you can use a program like winscp on Windows or scp on Linux to upload the file directly to your ESXi host.
- 3 Log in to the ESXi host on the Local Tech Support Console (ESXi), or through an SSH client.
- 4 Install the VIB using the following command on the ESXi host:

```
#esxcli software vib install -v <full path to VIB file>
```

5 Once the VIB is installed, reboot the ESXi host. Some ATTO drivers for ESXi 5.0 are provided as Community Supported drivers. These are not certified by VMware. Please contact ATTO Technical Support for questions about these drivers.

To install an ATTO Community Supported driver on ESXi 5.0, the acceptance level must be changed with the following command:

```
esxcli software acceptance set --level=CommunitySupported
```

### Including Driver in boot image

VMware vSphere 5 includes the ability to dynamically construct boot images for your ESXi 5 servers. This allows you to include ATTO drivers as part of a boot image and install or boot ESXi 5 with that image. The end result is that your server(s) will boot and have ATTO drivers included without any additional steps. Consult the VMware vSphere 5 documentation for more information on using vSphere Image Builder.

## VMware ESX/ESXi 4.1 (ExpressSAS H6xx only)



#### Note

Refer to Appendix B [Driver Configuration](#) on page iii for additional information on configuring and managing ExpressSAS adapters in VMware

### ESX Installation (ESX only)

During ESX 4 installation, you may choose to install additional drivers. This will allow you to install ESX onto storage that is attached to your ATTO adapter. You will need to burn the appropriate ATTO driver ISO image to CD media.

- 1 During ESX installation, select Yes to install custom drivers and click Add.
- 2 The installer will prompt you to insert the media containing the ATTO device driver.
- 3 After you add the ATTO driver, the installer will prompt you to reinsert the ESX installation media and continue with the installation.
- 4 When the installer reaches the point to choose the location for the ESX install, you can choose local storage, or storage that is attached to your ATTO adapter.

## VMware ESX 3.5 (ExpressSAS H6xx only)



#### Note

Refer to Appendix B [Driver Configuration](#) on page iii for additional information on configuring and managing ExpressSAS adapters in VMware

### Creating a Boot or Update CD.

- 1 Download the correct driver .iso file from the VMware Drivers & Tools Download site.
- 2 Write the .iso image to a CD-ROM.
- 3 Use the CD-ROM as a Boot CD or an Update CD.



## 3 New Windows OS Installation

*When you install a new or different copy of the Windows operating system on a disk attached to an ATTO ExpressSAS adapter, you must reinstall the ATTO ExpressSAS drivers.*

If you are changing the version of Windows you are using or installing a fresh copy of your current version onto your system, you must ensure Windows recognizes your ATTO ExpressSAS and uses its drivers.

You may create an installation media (disk, CD or USB flash drive) from a file from the ATTO website, then use that media to install the adapter and its driver to the new version of Windows.

Follow these procedures after you have completed installation of the ExpressSAS adapter and you have connected storage devices (refer to [Install Hardware](#) on page 15).

### Adjusting Adapter settings with the EFI Configuration Utility

Depending on your configuration, it may be necessary to adjust adapter NVRAM settings prior to performing the Windows installation. For example, you may need to modify the device wait time. The EFI configuration utility can be launched from an EFI shell. A built-in EFI shell is included with many PC platforms. If your platform does not have a built-in EFI shell, one can be obtained at <http://tianocore.sourceforge.net>.

Once in the EFI shell, do the following to open the EFI Configuration Utility:

- 1 At the prompt, enter the **drivers -b** command. Scroll through the list of installed EFI drivers and find the **ATTO ExpressSAS driver**. There may be more than one entry based on the number and type of adapter(s). Note the two or three digit hexadecimal driver handle on the far left of the screen.
- 2 At the prompt, enter **drvcfg -s {handle}** where {handle} is the hexadecimal number from the previous step. This will launch the EFI Configuration Utility for the associated adapter.
- 3 Use the on-screen menus to configure your adapter. Help is available at the bottom of the screen.
- 4 When exiting the configuration utility, if you changed any settings, the system will restart the adapter so the new settings take effect.

- 5 At the prompt, enter **exit** to return to the EFI boot manager or **reset** to restart the system.

### Power Center Pro HBA RAID Solution

Power Center Pro is an integrated software RAID solution that brings the performance and protection of RAID to storage devices attached to your ATTO ExpressSAS 12Gb host adapters.

ATTO's Power Center Pro is a RAID 0, 1, 1e and 10 solution included for use with ExpressSAS 12Gb SAS HBAs with internal connections, providing a cost-effective option that adds performance and protection to your storage architecture.

To learn more about using and configuring Power Center Pro RAID groups, refer to the EFI section ATTO Utilities Manual on setting up RG to install the OS ([www.attotech.com](http://www.attotech.com)).

### Creating ExpressSAS installation media from a file

- 1 Go to [www.attotech.com](http://www.attotech.com).
- 2 Put your cursor over **Downloads** then click on **Driver downloads** from the splash screen menu.
- 3 Register or log in if previously registered.
- 4 Select **SAS/SATA Host & RAID adapters** from the product list.
- 5 Select your model.
- 6 From the table, find your Operating System.
- 7 Click on the entry for the latest driver.
- 8 A download window appears. Follow the instructions for downloading the driver.  
  
Internet Explorer users may select **Run** to automatically run the downloaded self-extracting executable file.  
  
All other browser users select a download destination and run the self-extracting executable file.
- 9 Uncheck **When done unzipping open \Setup.exe**.
- 10 Select a destination folder and click **Unzip** to extract the driver files.

- 11 The expanded software package contains a Scsiport driver in the base directory and a Storport driver in the Storport directory.  
Navigate to the folder with the desired ExpressSAS driver.  
Select **Scsiport** for Windows 2000 and XP.
- 12 Run **makedisk.exe**.
- 13 Follow the instructions to complete the installation.
- 14 Continue with [Install the driver into a new version of Windows 8, 7, Server 2012, 2008](#).

## Install the driver into a new version of Windows 8, 7, Server 2012, 2008

---

- 1 Start Windows text mode setup as described by your Windows documentation.
- 2 Select **Custom installation**.
- 3 The **Where do you want to install Windows** message appears. Click **Load Driver**.
- 4 Insert the ExpressSAS installation media into the appropriate slot.
- 5 Click **OK**.
- 6 Windows Setup searches for drivers matching devices in your system. If the ExpressSAS adapter is not in the **Select the driver to be installed**, click **Browse** and locate the driver.
- 7 Select the ExpressSAS adapter from the list.
- 8 Click **Next**.
- 9 The **Where to you want to install Windows** window appears. Your devices should be listed. Remove the ExpressSAS installation media.
- 10 Configure and select a partition for installing Windows.
- 11 Click **Next**.
- 12 Continue with the remainder of the Windows installation procedure.



## 4 New OS X Installation

*Boot support is available on Intel-based systems only.*

### Adjusting Adapter settings with the EFI Configuration Utility



#### Note

Depending on your configuration, it may be necessary to adjust adapter NVRAM settings prior to performing the OS X installation. For example, you may need to modify the device wait time or create a RAID group. The EFI configuration utility can be launched from an EFI shell. Unfortunately, an EFI shell is not included with Intel Macs. ATTO recommends rEFIt, which is available for free from <http://refit.sourceforge.net>. Once you have downloaded the DMG for rEFIt, do the following to open the EFI Configuration Utility:

- 1 Burn the **rEFIt DMG** file to a CD. Do not remove the CD.
- 2 Shut down the system and install the ExpressSAS adapter.
- 3 With the rEFIt CD inserted, boot the system while pressing and holding the **C** key. This will boot the rEFIt CD.
- 4 The rEFIt boot menu will appear which contains a series of icons. Release the **C** key and use the arrows to highlight the **Start EFI Shell** icon. Press **Return** to enter the EFI Shell.
- 5 At the prompt, enter the **drivers -b** command. Scroll through the list of installed EFI drivers and find the **ATTO ExpressSAS driver**. There may be more than one entry based on the number and type of adapter(s). Note the two or three digit hexadecimal driver handle on the far left of the screen.
- 6 At the prompt, enter **drvcfg -s {handle}** where {handle} is the hexadecimal number from the previous step. This will launch the EFI Configuration Utility for the associated adapter.
- 7 Use the on-screen menus to configure your adapter. Help is available at the bottom of the screen.
- 8 When exiting the configuration utility, if you changed any settings, the system will restart the adapter so the new settings take effect.
- 9 At the prompt, enter **exit** to return to the **rEFIt boot menu** or reset to restart the system.

### OS X Driver Installation



#### Note

If you already have one or more supported products installed and you are installing additional products, you do NOT need to perform this procedure unless you are updating a previously installed driver. Also, the driver may only be installed to the currently booted operating system. In addition, you must have system administrator privileges to perform driver installation. If you do not, you will be prompted for the username and password of a system administrator during the installation process.

- 1 Double-click the OS X Installer package (\*.pkg) to begin installation.
- 2 Proceed through the installation wizard using the default settings.
- 3 When installation is complete, click 'Restart' to restart the system and load the driver.

### Booting OS X from a disk attached to an ATTO product

- 1 With your hardware installed, boot your system to an existing OS X installation that you wish to boot from the ATTO-attached disk(s).
- 2 Install the ATTO driver using the procedure in the previous section.
- 3 Download the latest ConfigTool and flash bundle package from [www.attotech.com](http://www.attotech.com)
- 4 Mount the flash bundle disk image (\*.dmg).
- 5 Install and launch the ATTO ConfigTool to configure your product.
- 6 Click on your ATTO product in the left navigation panel.
- 7 In the Flash panel in the right pane, browse to the flash bundle from the mounted disk image.
- 8 Click 'Update' to flash the ATTO product.



#### Note

For H6XX products proceed to step 10.

- 9 In the RAID panel in the right pane, create RAID groups as necessary to expose a boot disk to the system.
- 10 For each ATTO product channel, in the NVRAM panel in the right pane, set the 'Boot Driver' option to 'Enabled' and commit the new settings.
- 11 Close the ATTO ConfigTool.
- 12 Launch OS X Disk Utility.
- 13 Configure and partition the ATTO-attached disk(s) as you wish using the 'RAID' and 'Partition' panels to prepare a volume for booting.
- 14 Using the 'Restore' panel, copy the currently booted OS X volume to the ATTO-attached volume. Drag and drop the source and destination volumes from the left panel and click the 'Restore' button.
- 15 Close Disk Utility.
- 16 Launch OS X System Preferences and select the Startup Disk preference pane.
- 17 Select the ATTO-attached boot volume and click 'Restart...'
- 18 Your system is now booted from the ATTO-attached volume.

## Driver Settings

A system NVRAM variable, `atto-args-esasraid2` (`atto-args-esashba2` for H6xx products), can be used to change the behavior of the ExpressSAS driver. The options are as follows:

`-e [mask]`

Specify the hexadecimal event mask for event logging, defaults to `0x00000001`. See the Driver Events section for more details.

## Changing Driver Settings in OS X

- 1 Open a Terminal window.
- 2 At the prompt, enter the command `'sudo nvram atto-args-esasraid2="[options]"'` (`'sudo nvram atto-args-esashba2="[options]"'` for H6xx products) where [options] are listed above. If you are not the root user, you will be prompted for an administrator password.
- 3 Reboot the system for the changes to take effect.



### Note

*These options are stored in system NVRAM; therefore they persist across reboots.*

*Resetting the system NVRAM by pressing and holding Command+Option+P+R during boot will remove the options.*

*You can view the current options in OS X by opening a Terminal window and entering `'nvram atto-args-esasraid2'` (`'nvram atto-args-esashba2'` for H6xx).*

*You can remove the options in OS X by opening a Terminal window and entering `'sudo nvram -d atto-args-esasraid2'` (`'sudo nvram -d atto-args-esashba2'` for H6xx).*

## Driver Events

The reporting of driver events is controlled by the event mask driver setting. See the Driver Settings section for information on how to set this mask. The hexadecimal mask value is the sum of the event type values for the events you would like to see.

The ATTO driver uses the system log to communicate driver events to the user. Each event begins with a driver and channel identifier,

ATTOExpressSASRAID2 X.Y.Z

(ATTOExpressSASHBA2 X.Y.Z for H6xx products), where X is the PCI bus number, Y is the PCI device number and Z is the PCI function

number. In general, only errors that are output for event type 'Fatal' are significant; all others are mostly for informational or diagnostic purposes. When turning on event logging, be aware that certain events reported as errors are expected. For example, a SCSI Check Condition error will be reported for the first command sent to a device after power on or a reset condition. Also, certain data underrun errors are expected by the software and are normal.

Event Type	Value (hexadecimal)	Description
Fatal	0x00000001	Fatal errors, always reported
SCSI	0x00000004	SCSI command errors
Protocol	0x00000008	SAS protocol errors
Discovery	0x00000010	Device discovery events
Resource	0x00000040	Resource usage failures
Info	0x00000080	Informational messages
Underflow	0x00000800	Data underflow errors

## 5 Install Hardware

Use this chapter as a guide to install the ATTO ExpressSAS adapter into a x8 or x16 PCI Express expansion slot on your computer. If you have followed the Getting Started Guide successfully, you do not need to read this chapter.



### CAUTION

**Back up your system data before changing or installing any hardware.**

### System requirements

The ATTO ExpressSAS adapter package contains

- ExpressSAS adapter
- ATTO ExpressSAS drivers, user manuals and utilities available for download from the ATTO website
- A low-profile or standard bracket and the installation procedure

If any of these items are missing, contact your ATTO authorized sales representative.

In addition you must have:

- A computer with an available x8 or x16 PCI Express 3.x/2.x/1.2 expansion slot. Check your computer's documentation.
- SAS/SATA storage, cables and connectors.

See [Bracket details](#) on page 19 and [Adapter board details](#) on page 23 for details of the adapters and brackets.

### SAS address

Each ATTO ExpressSAS adapter has a unique SAS address designated by the Institute of Electrical and Electronic Engineers which allows the system to recognize the ATTO ExpressSAS adapter as a unique part of your configuration.

The address is marked on the back of the board for easy identification. Please keep a reference copy of the number in a safe place.

## Installing the Adapter



### WARNING

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

1. Install system drivers before you begin hardware installation. Refer to page 7 for driver installation.
2. Power down the computer and unplug the computer from all power sources.
3. Open the case.
4. If applicable, attach the low profile or standard bracket to the adapter.
  - a. Remove the original bracket from the adapter, being careful not to damage the board. Use an ESD-safe #1 Phillips screwdriver to remove the Phillips screws at the top and bottom edges of the board.



### CAUTION

**Make sure the screwdriver is centered in the top of the screw to prevent damage to the screw. Damaging the screw can void the warranty.**

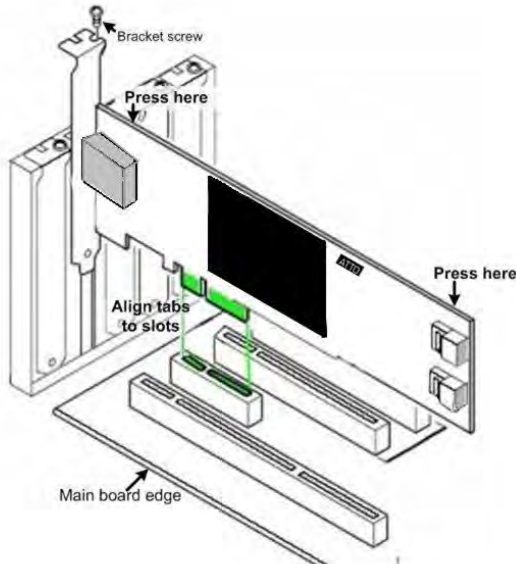
- b. Set the bracket and screws aside.
- c. Place the adapter on top of the replacement bracket, positioning the bracket so that the holes in the bracket are aligned with the openings in the board.
- d. It is recommended that you dip the screws into Loctite® 242 to decrease the chance of the threads becoming loose.
- e. Use an ESD-safe #1 Phillips torque screwdriver to tighten the screws. The screwdriver should be set to a maximum torque of 3.98 in/lbs (0.45N m).



### CAUTION

**Do not exceed the torque specification to avoid damaging the board, connectors or screws.**

- 5 Insert the ATTO ExpressSAS adapter into any open PCI Express expansion slot. If you have questions about how to install an expansion card in your system, consult your computer's documentation.



- 6 Close the case on the computer and power it up.
- 7 Installed drivers are loaded.

For Windows Server 2003

- Windows detects your ExpressSAS adapter and the **Found New Hardware** wizard appears. Proceed through the wizard with the default settings for each adapter channel. Insert the ExpressSAS installation disk when prompted.
- After adapter installation is complete, the **Found New Hardware** wizard shows an **ATTO Phantom Device** for each channel. Proceed through the wizard with default settings to complete the installation.

For Windows 8, 7, Vista and Server 2012, 2008

- Windows detects your adapter and automatically installs the required drivers.

If drivers do not load, refer to page 9 for driver installation and troubleshooting.

- 8 Turn off power to the computer.

## Installing CacheAssure (ExpressSAS R6xx only)

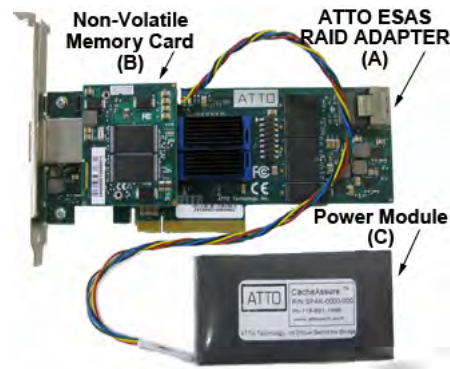
Adding CacheAssure to your adapter (marked 'A' in Exhibit 5-1) requires the installation of two modules; Non-Volatile Memory Card (B) and Power Module (C).



### WARNING

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

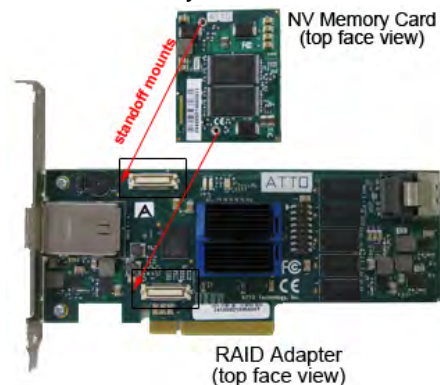
Exhibit 5-1 ESAS RAID adapter with CacheAssure



## Non-Volatile (NV) Memory Card Installation

- 1 Power down the computer and unplug the computer from all power sources.
- 2 Open the case.  
*If you have purchased the ESAS RAID adapter bundled with CacheAssure, the NV Memory Card is pre-assembled to the RAID adapter. If so, please go directly to the [Power Module Installation](#) section. If you are adding CacheAssure to a previously purchased SAS RAID adapter, continue to step 3.*
- 3 Gently remove your ATTO 6Gb SAS adapter from the PCI Express expansion slot. If you have questions about how to remove an expansion card from your system, consult your computer's documentation.
- 4 Remove the NV Memory Card from its electrostatic safe packaging.
- 5 Holding the RAID adapter firmly, plug the NV Memory Card into the RAID adapter with ATTO logos in matching direction and the standoff mounts closer to the adapter's bracket. See [Exhibit 5-2](#).

Exhibit 5-2 NV Memory Card Installation



### CAUTION

Make sure the NV Memory Card is evenly aligned on both sides. If the card is placed incorrectly, damage to the Memory or adapter may occur. This may void your warranty.



- 6 Make sure the NV Memory Card is firmly seated by gently pushing the card down onto the ATTO RAID adapter, as shown:



- 7 Turn the adapter over so that you can see the back of the printed circuit board. Use the two supplied screws to finish secure the NV Memory Card onto your RAID adapter.



- 8 Use an ESD-safe crosshead screwdriver to secure the screws.

## Power Module Installation



### Note

*It is the user's preference to install the Power Module while the ATTO adapter is outside of the computer, or install the Power Module while the adapter is seated in its PCI Express slot. If you have questions about how to remove an expansion card from your system, consult your computer's documentation. In these directions, we will assume the card is seated in its PCI Express slot.*

- 1 Remove the Power Module from its electrostatic safe packaging.
- 2 Select an area for placement of the Power Module inside of the computer. Make sure it can be mounted securely and that the Power Module's power cord can reach the adapter, specifically the NV Memory Card's power jack.
- 3 Use the heavy-duty, industrial adhesive, shown in [Exhibit 5-3](#) to mount the module. Remove one side of the paper backing and apply it to the Power Module.

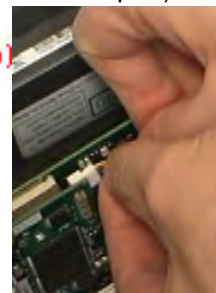
*Exhibit 5-3 Applying mount adhesive*



- 4 Remove and expose the other side of the adhesive.
- 5 Mount the Power Module into the computer.
- 6 Plug the Power Module power cord into the Non-Volatile Module (on the RAID adapter).



Plug  
(undemeth)



The plug is keyed so that it can only be plugged in one way. Make sure that the plug is fully inserted.

- 7 Close your computer case.
- 8 You may power on your system.



### WARNING

Be careful handling the Power Module after it has been installed and powered. It may be live with power. If the board is mishandled while it is attached it may become shorted and/or damaged.

## Bracket details

Exhibit 5-4 ExpressSAS H1208 HBA brackets.

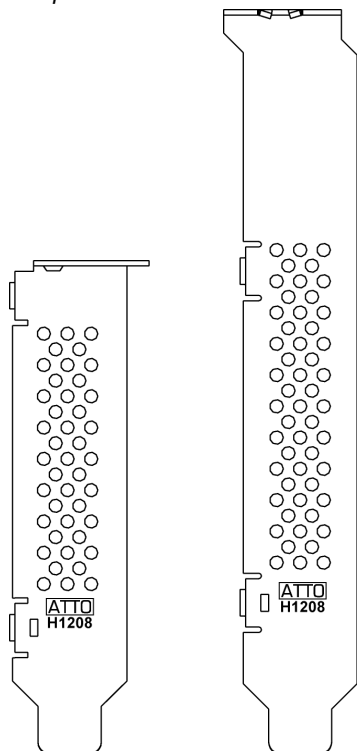


Exhibit 5-6 ExpressSAS H120F HBA brackets.

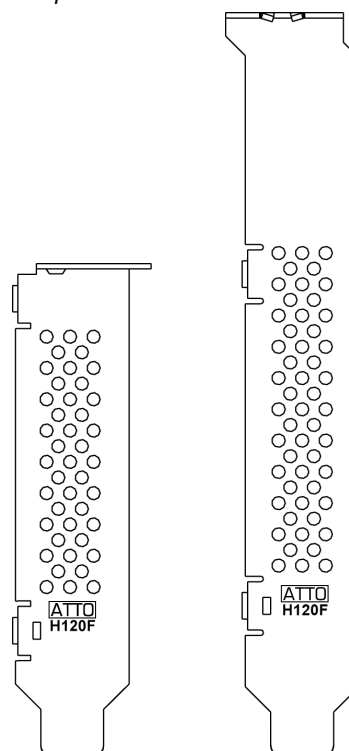


Exhibit 5-5 ExpressSAS H1280 HBA brackets.

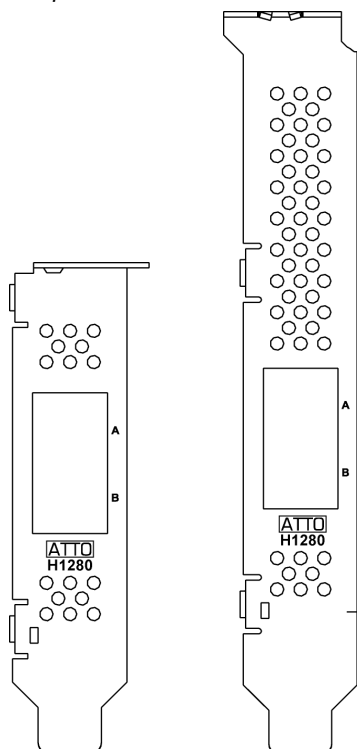


Exhibit 5-7 ExpressSAS H12F0 HBA brackets.

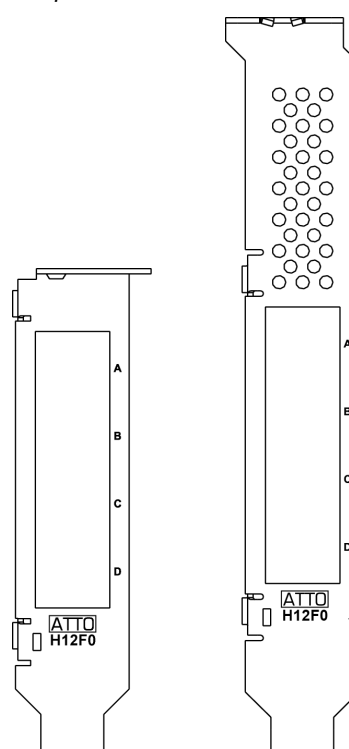




Exhibit 5-8 ExpressSAS H1288, H1248, and H1244 HBA brackets

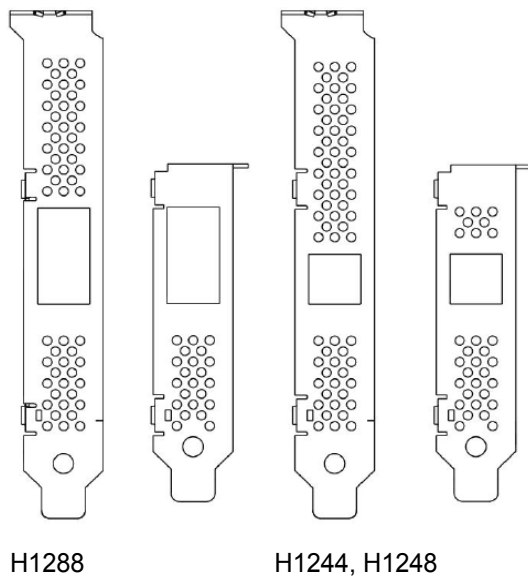


Exhibit 5-9 ExpressSAS H644 HBA brackets.

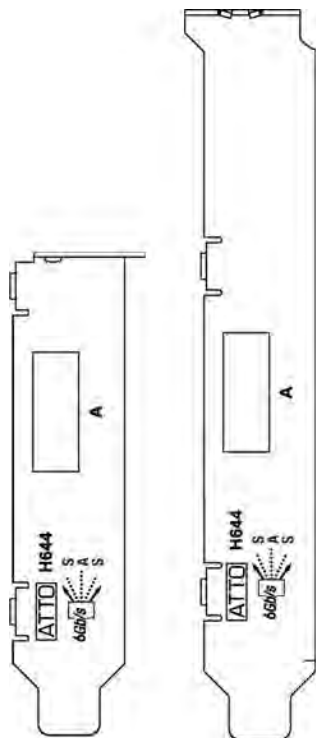


Exhibit 5-10 ExpressSAS H608 HBA brackets.

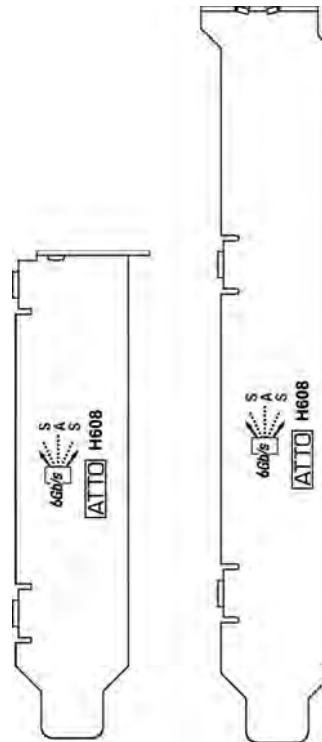


Exhibit 5-11 ExpressSAS H680 HBA brackets.

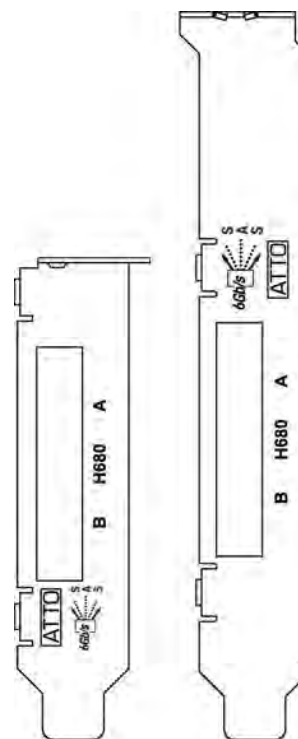


Exhibit 5-12 ExpressSAS H60F HBA brackets.

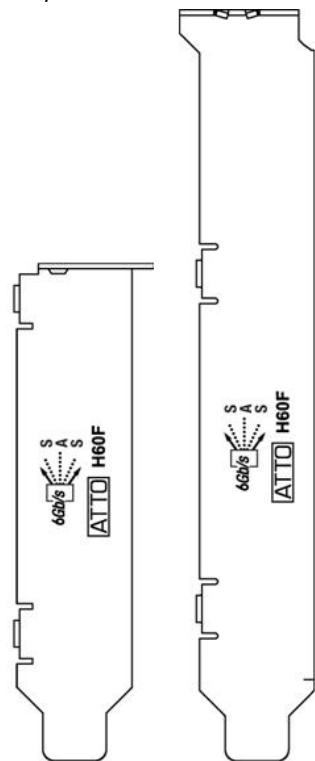


Exhibit 5-14 ExpressSAS R644 adapter brackets.

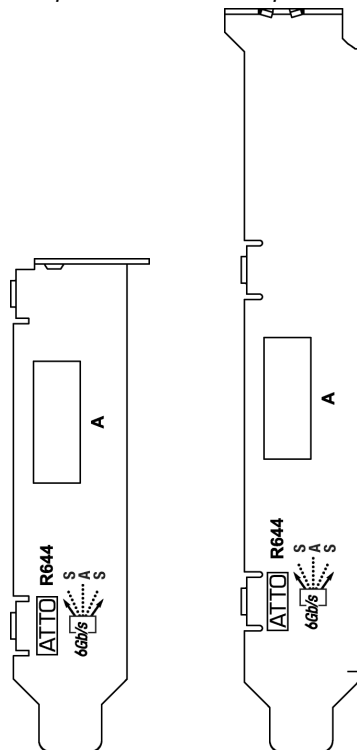


Exhibit 5-13 ExpressSAS H6F0 HBA bracket.

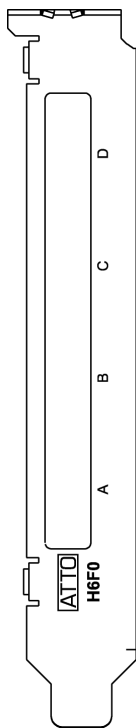


Exhibit 5-15 The ExpressSAS R608 adapter brackets

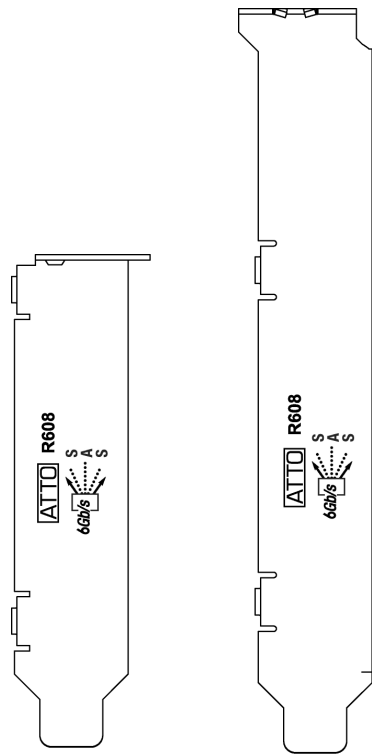


Exhibit 5-16 ExpressSAS R680 adapter brackets.

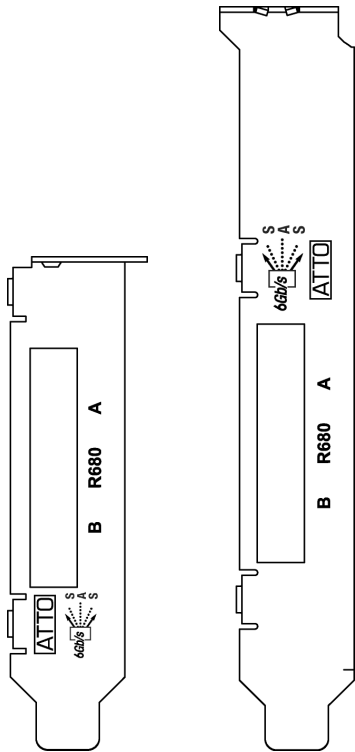
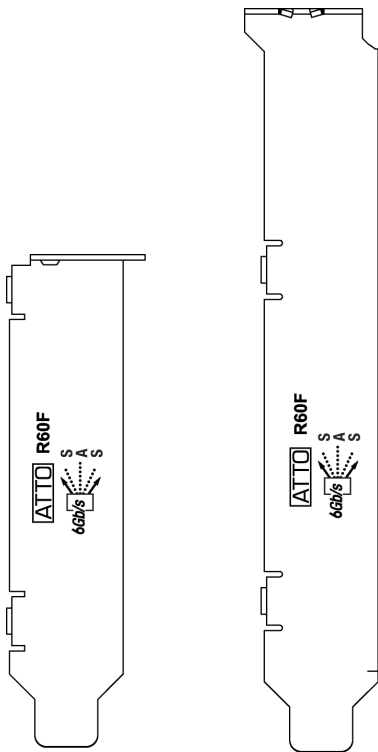


Exhibit 5-17 The ExpressSAS R60F adapter brackets



## Adapter board details

Exhibit 5-18 ExpressSAS H1208 HBA board.

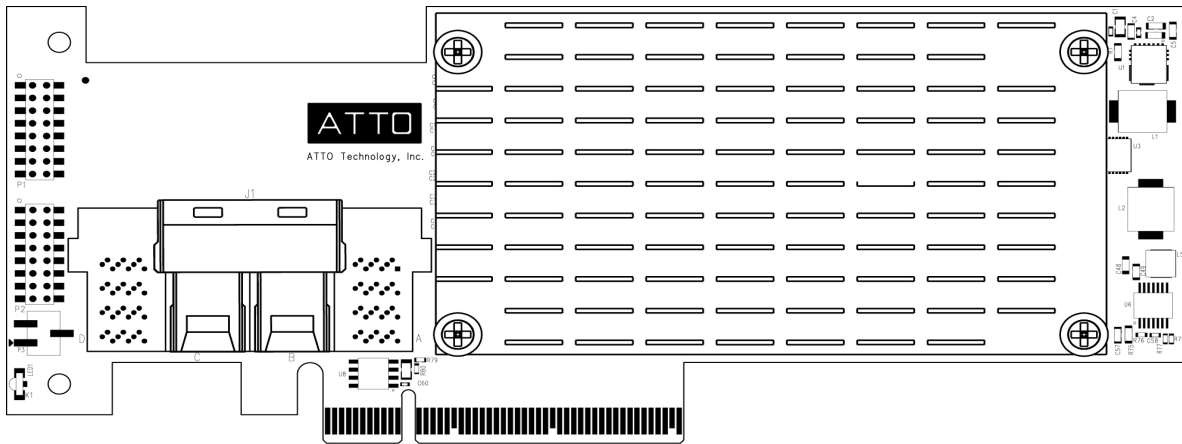


Exhibit 5-19 ExpressSAS H1280 HBA board.

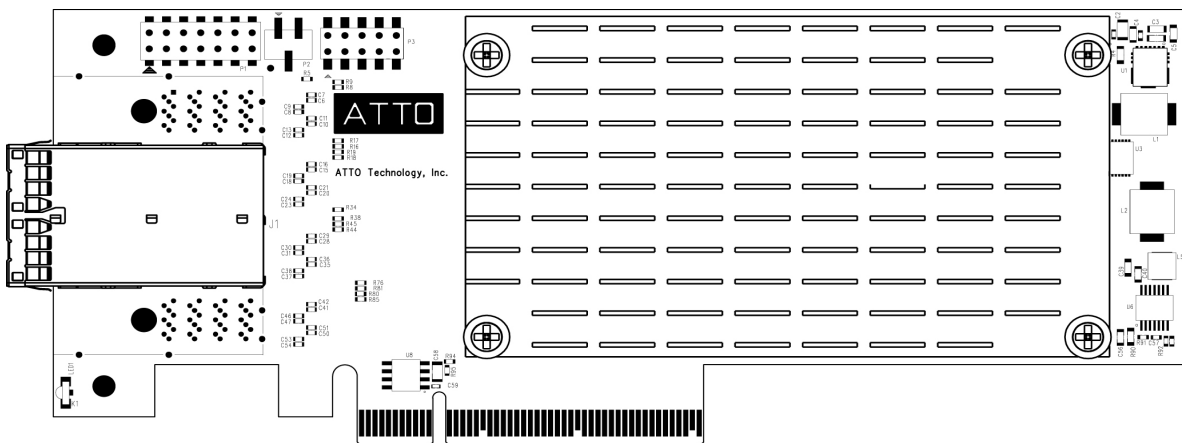


Exhibit 5-20 ExpressSAS H120F HBA board.

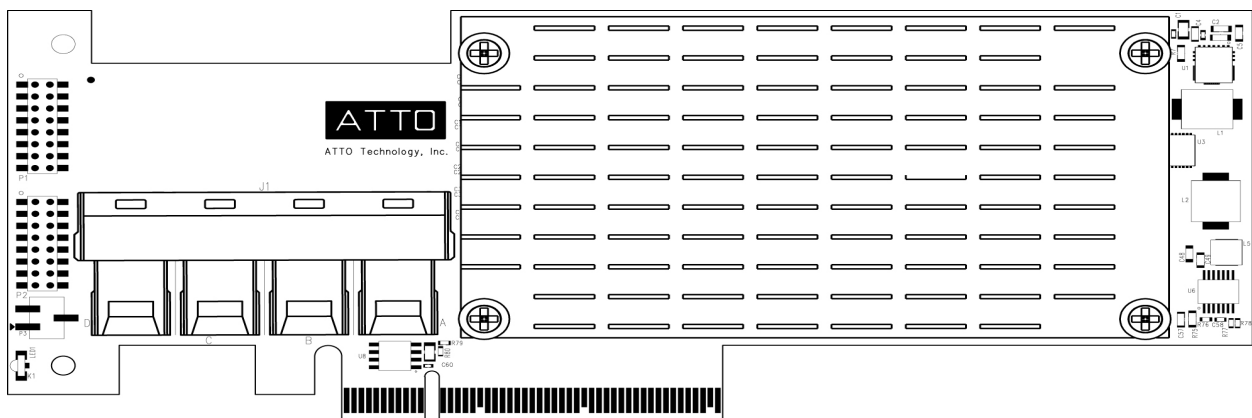


Exhibit 5-21 ExpressSAS H12F0 HBA board.

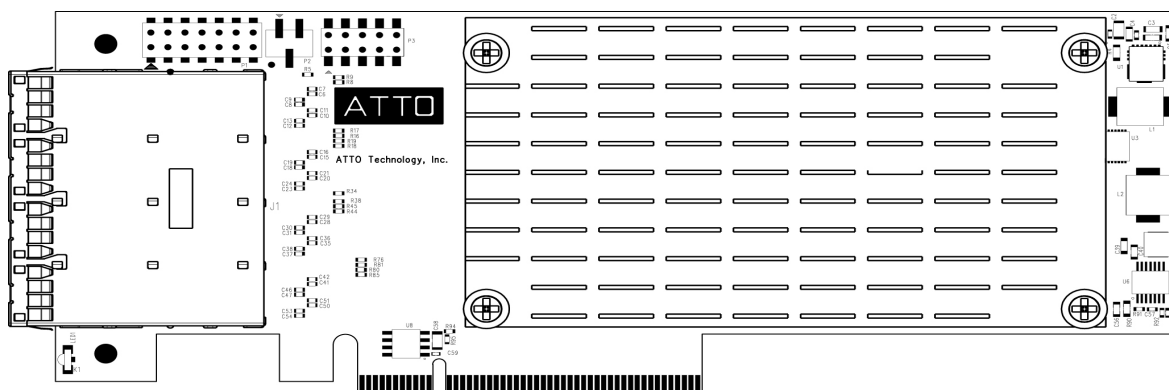


Exhibit 5-22 ExpressSAS H1288 HBA board.

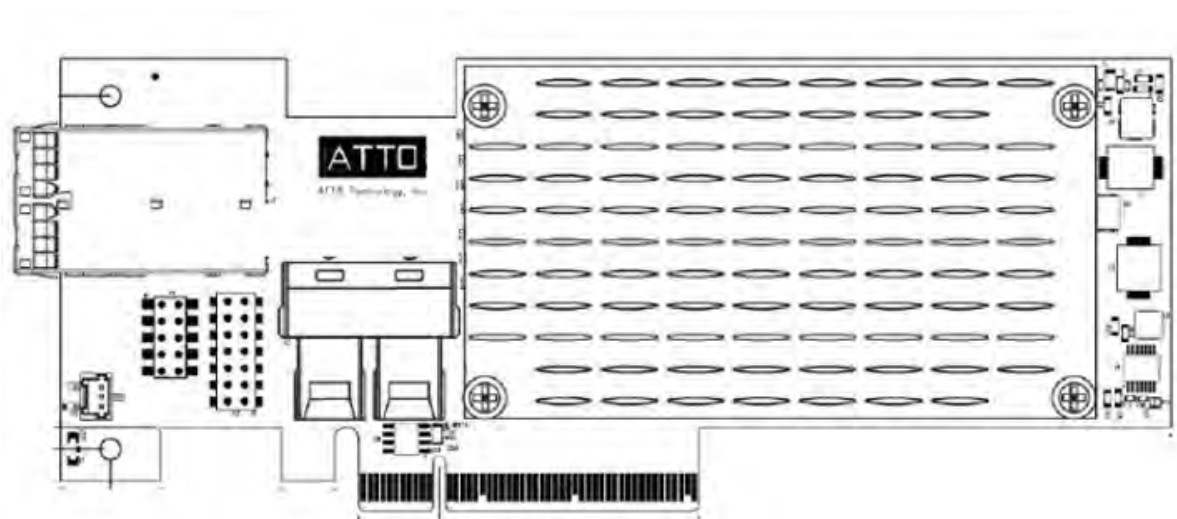


Exhibit 5-23 ExpressSAS H1248 HBA board.

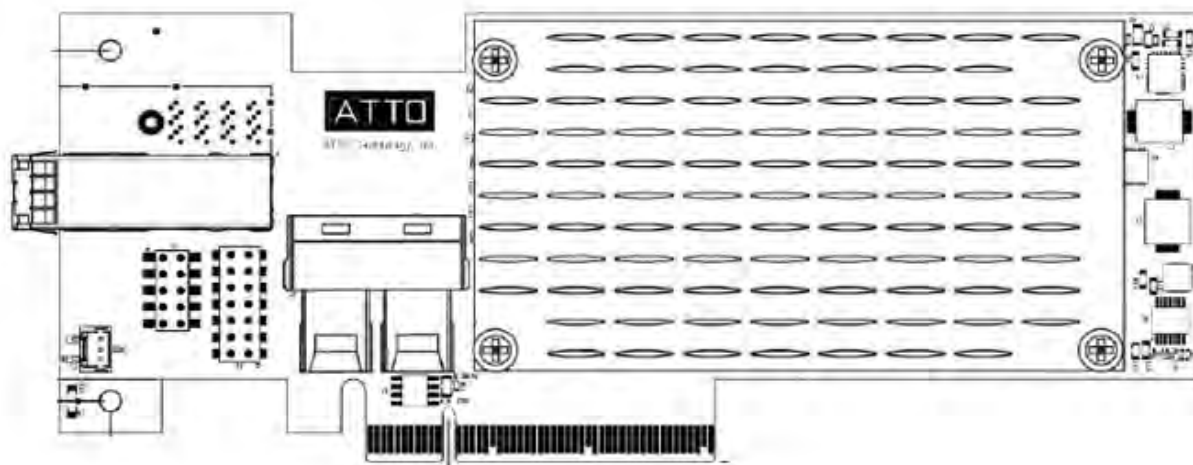


Exhibit 5-24 ExpressSAS H1244 HBA board.

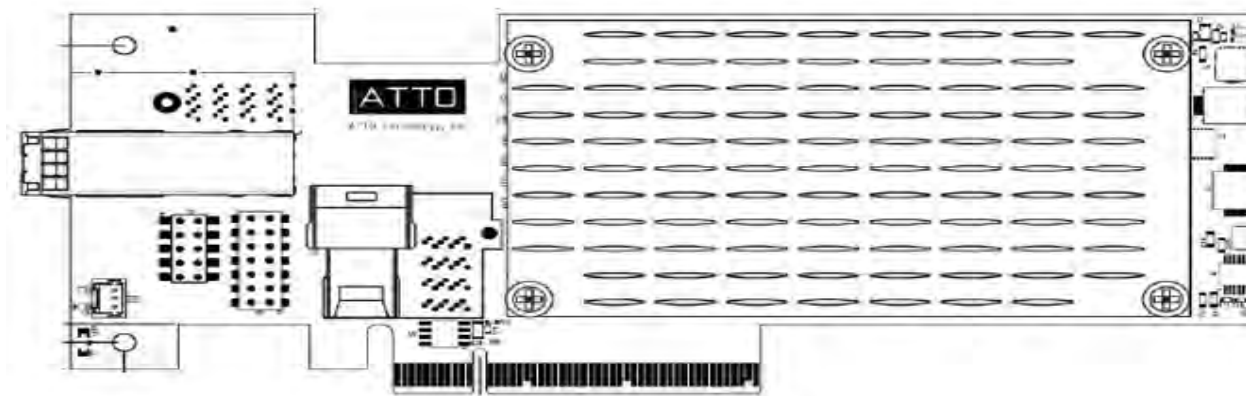


Exhibit 5-25 ExpressSAS H644 HBA board.

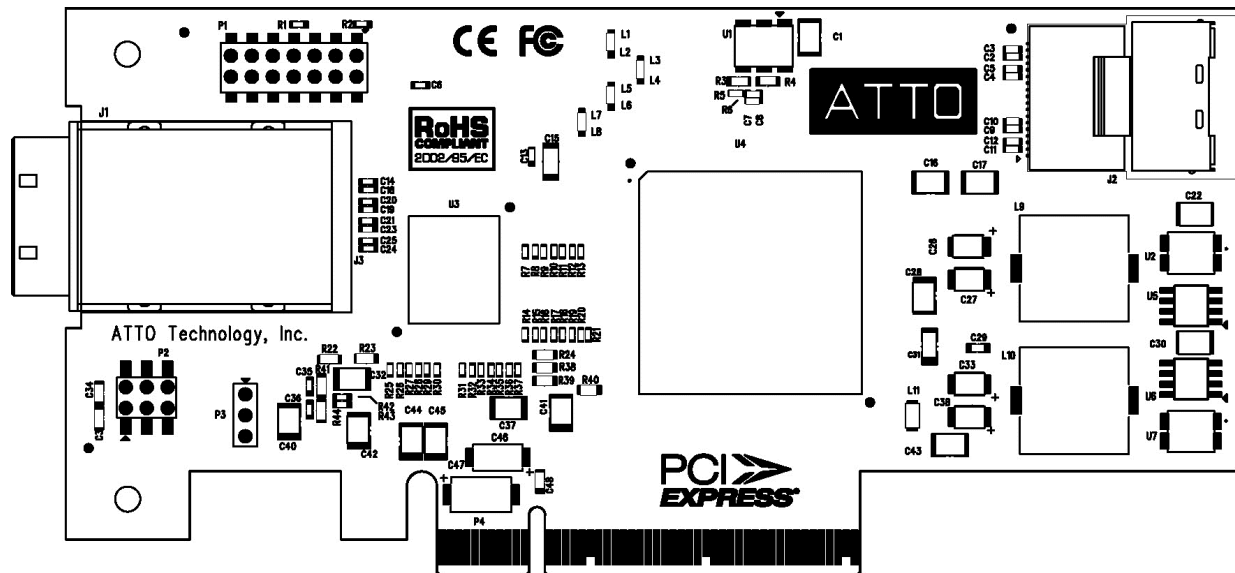


Exhibit 5-26 ExpressSAS H608 HBA board.

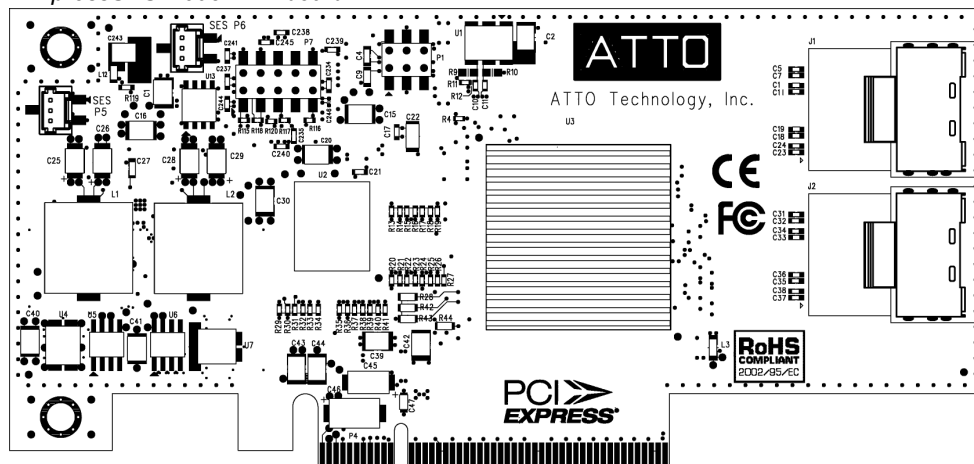


Exhibit 5-27 ExpressSAS H680 HBA board.

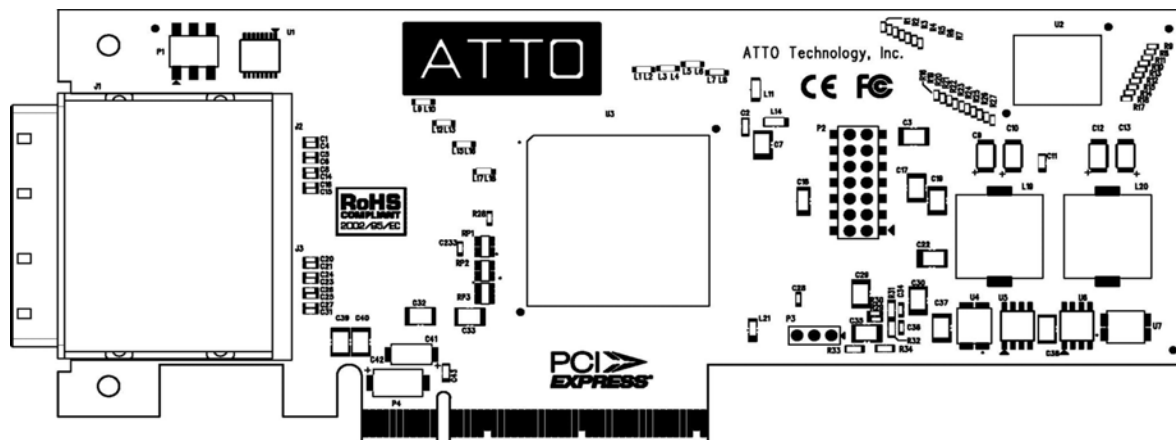


Exhibit 5-28 ExpressSAS H60F HBA board.

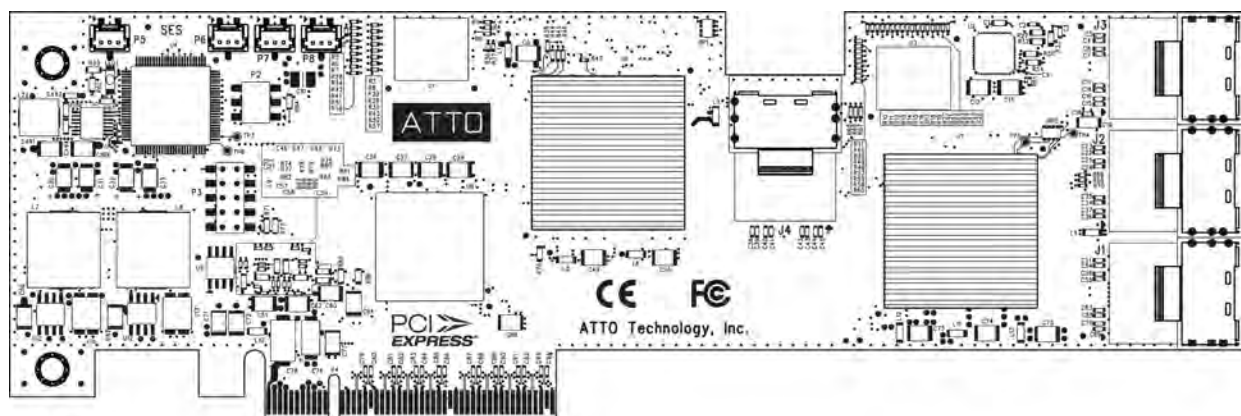
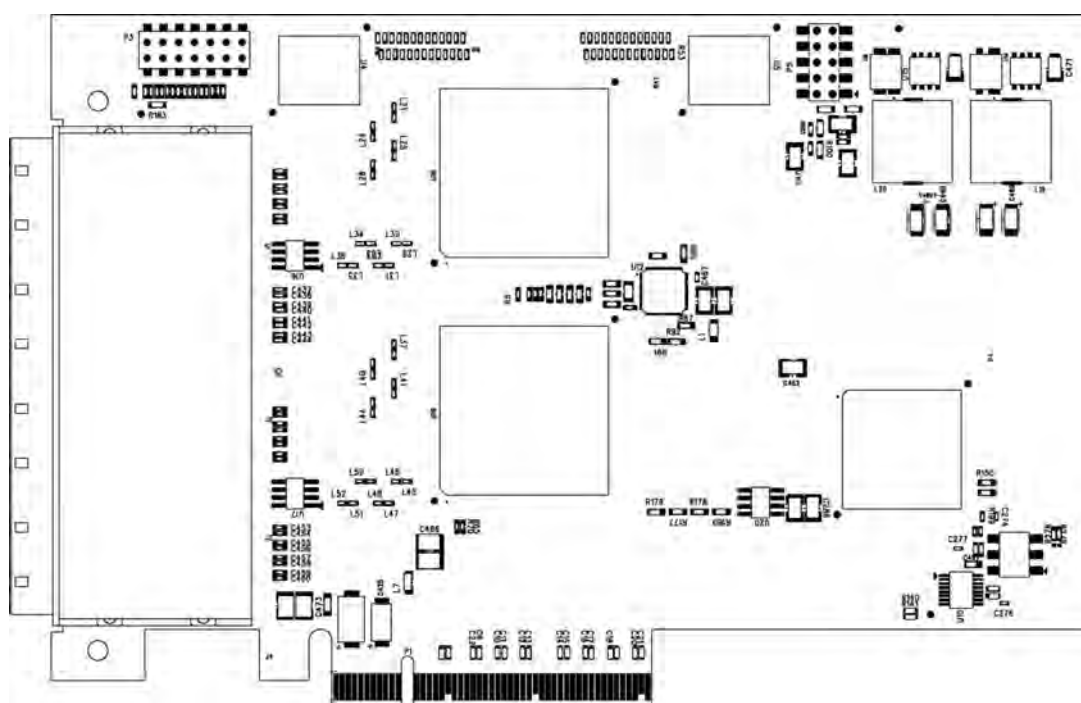
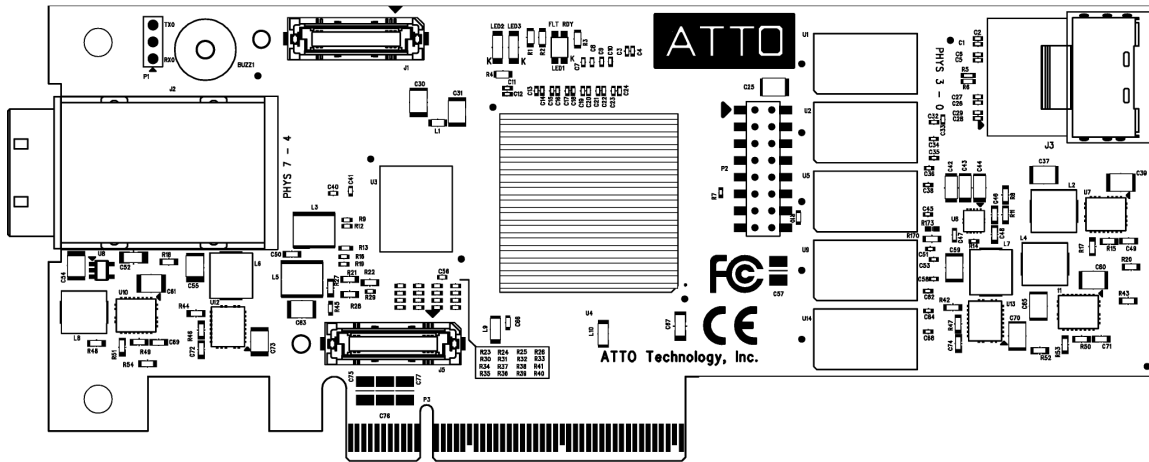


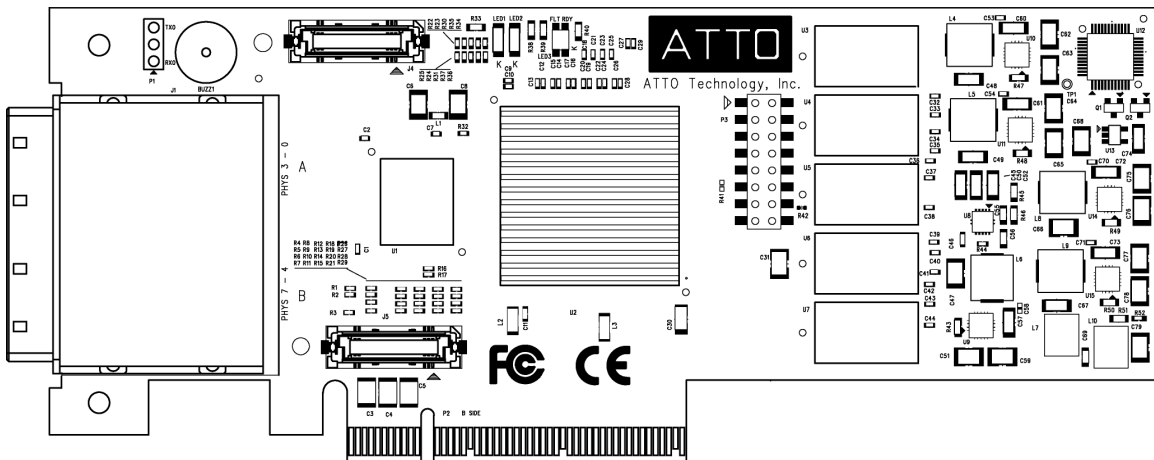
Exhibit 5-29 ExpressSAS H6F0 HBA board.



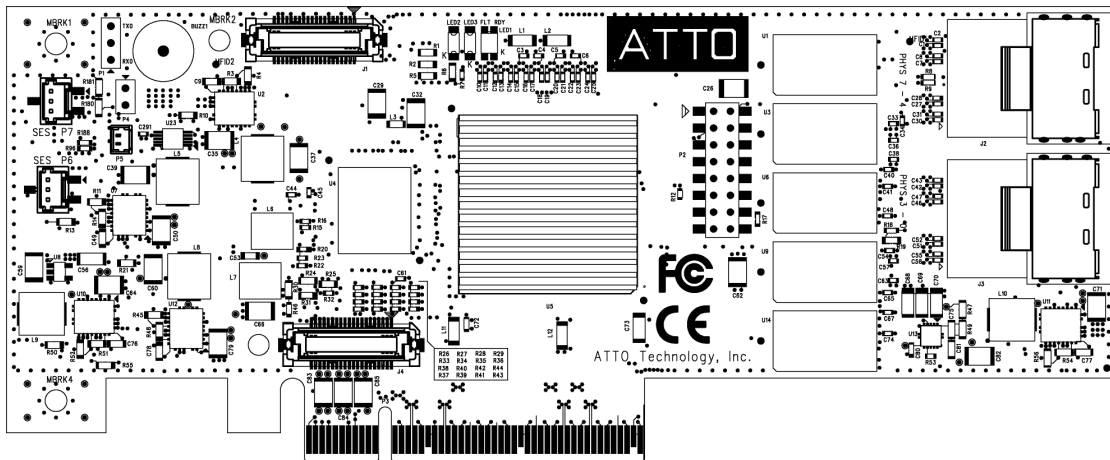
*Exhibit 5-30 ExpressSAS R644 adapter board.*



*Exhibit 5-31 ExpressSAS R680 adapter board.*



*Exhibit 5-32 ExpressSAS R608 adapter board.*





## 6 Adaptive Path Optimization (ExpressSAS RAID only)

Often users need redundancy and improved performance. This can be achieved using dual SAS domains via adaptive path optimization. In this configuration, multiple physical connections to drives are created to eliminate pathway failure concerns (i.e. external cable failure, expander failure, RAID controller failure, or failure in a spanned JBOD configuration), as well as to distribute data movement over all available connections to maximize performance. To take advantage of multiple domains, devices must be dual-ported and cabled properly.

- 1 In a standard configuration, a single cable is connected to a storage array (see [Exhibit 6-1](#)) for basic connectivity. As an alternative, most SAS/SATA storage arrays have a second connector for daisy chaining additional storage. This connector may also be used to provide a redundant connection from your ATTO ExpressSAS RAID adapter (see [Exhibit 6-1](#)). This eliminates a single point of failure between the adapter and storage and may also provide a performance improvement. As a third option, SAS drives have two connections to each drive that can be used to provide even more options for improved performance and redundancy. To take advantage of this option, connect a cable from your ExpressSAS RAID adapter to each expander port on your storage array (see [Exhibit 6-1](#)).

Exhibit 6-1



Exhibit 6-2



Exhibit 6-3



### Note

Refer to documentation from your storage array vendor for additional information on cabling to your particular array.

- 2 Adaptive path optimization occurs when multiple paths to a drive are available. It automatically configures primary and alternate paths for highest levels of redundancy, as well as highest data transfer rates. Using event-driven algorithms, it evaluates and adaptively re-configures data path assignments for optimal performance. No user intervention is required for this feature. For the cost of a cable, you get:
  - Automatic configuration
  - Redundancy and improved performance
  - Path matching that is RAID Group aware
  - Automatic and balanced failover/failover capabilities.
  - Stable configurations

## 7 Data Path and LED Control

This chapter provides the instructions that define the internal cable connections for data path and LED control, needed for hard drive backplanes. This section applies to the following models: R608; R60F; H608; and H60F. These adapters have been designed to affect LED Control functionality through an SGPIO interface or an I2C interface. These interfaces require different cable connections and those connections are specified in this chapter.

### Connections on the H608 and H60F

The following diagrams show the connections for Mini-SAS cables and I2C cables on the H608 and H60F.

Exhibit 7.1-1 H608 connectors

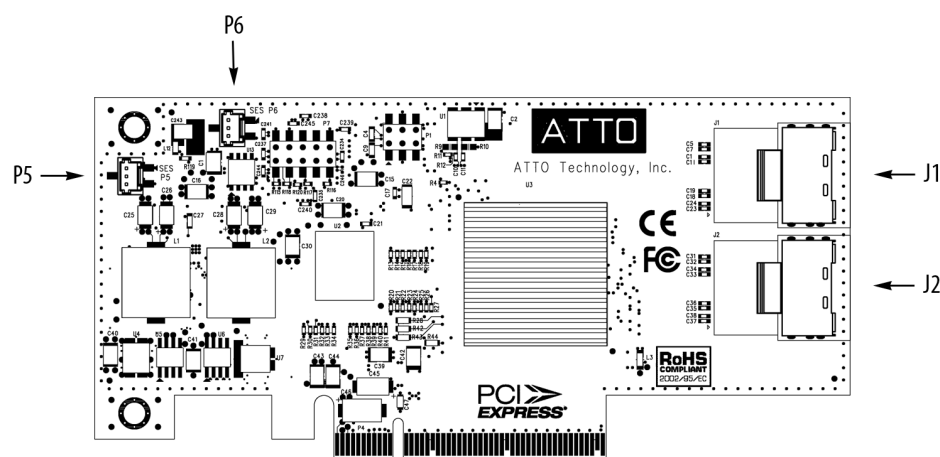
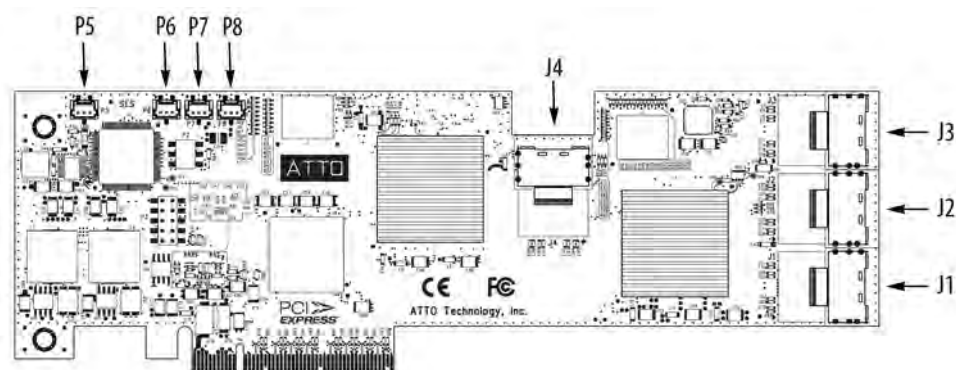


Exhibit 7.1-2 H60F connectors



## Connections on the R608 and R60F

The following diagrams show the connections for Mini-SAS cables and I2C cables on the R608 and R60F.

Exhibit 7.1-3 R608 connectors

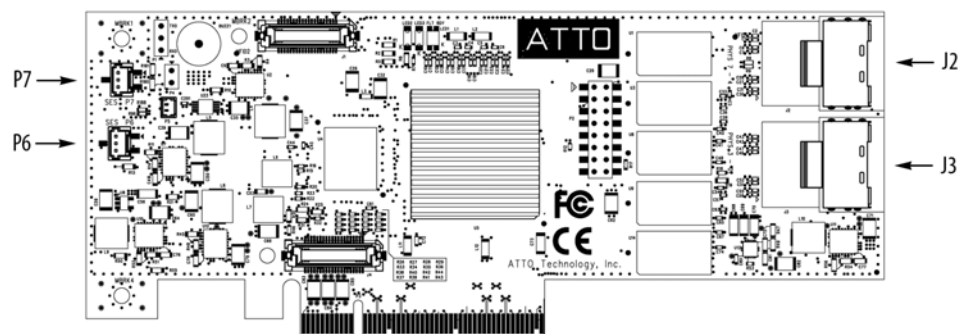


Exhibit 7.1-4 R60F connectors

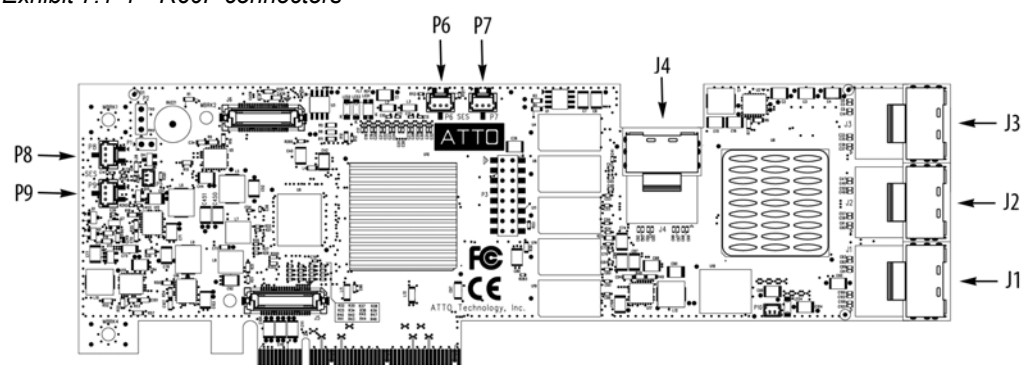


Exhibit 7.1-5 ESAS HBA and RAID adapter summary

	R608	R60F	H608	H60F
<b>Overall</b>	<b>Count</b>			
Number of I2C Buses	2	2	2	4
Number of I2C Headers	2	4	2	4
Number of Mini-SAS Connectors	2	4	2	4
<b>I2C BUS</b>	<b>I2C Headers</b>			
1 – 1st header	P7	P8	P6	P5
1 – 2nd header	n/a	P9	n/a	n/a
2 – 1st header	P6	P6	P5	P6
2 – 2nd header	n/a	P7	n/a	n/a
3 – 1st header	n/a	n/a	n/a	P7
4 – 1st header	n/a	n/a	n/a	P8
<b>PHYs</b>	<b>Label of Mini-SAS Connector</b>			
0-3	J3	J1	J2	J1
4-7	J2	J2	J1	J2
8-11	n/a	J3	n/a	J4
12-15	n/a	J4	n/a	J3

## Connecting data cables to hard drive backplanes

Exhibit 7-2 Connect an R608 or R60F to several different backplane configurations ([Examples](#) start on page 37)

<i>Mini-SAS Connector</i>	<i>PHYs</i>	<i>Backplane</i>	<i>Backplane Slots</i>
<b>R608 - 2 x4 Backplanes (See example 1.)</b>			
J3	0-3	1	1-4
J2	4-7	2	1-4
<b>R608 - 1 x6 Backplane</b>			
J3	0-3	1	1-4
J2	4-5	1	5-6
<b>R608 - 1 x8 Backplane</b>			
J3	0-3	1	1-4
J2	4-7	1	5-8
<b>R60F - 1 x4 Backplanes</b>			
J1	0-3	1	1-4
J2	n/a	n/a	n/a
J3	n/a	n/a	n/a
J4	n/a	n/a	n/a
<b>R60F - 1 x6 Backplanes</b>			
J1	0-3	1	1-4
J2	4-5	2	5-6
J3	n/a	n/a	n/a
J4	n/a	n/a	n/a
<b>R60F - 1 x4 &amp; 1 x6 Backplanes (See example 3.)</b>			
J1	0-3	1	1-4
J2	4-7	2	1-4
J3	8-9	2	5-7
J4	n/a	n/a	n/a
<b>R60F - 1 x16 Backplane</b>			
J1	0-3	1	1-4
J2	4-7	1	5-8
J3	8-11	1	9-12
J4	12-15	1	13-16

Exhibit 7-3 Connect an H608 or H60F to several different backplane configurations ([Examples](#) start on page 37)

<i>Mini-SAS Connector</i>	<i>PHYs</i>	<i>Backplane</i>	<i>Backplane Slots</i>
<b>H608 - 2 x4 Backplanes (See example 1.)</b>			
J2	0-3	1	1-4
J1	4-7	2	1-4
<b>H608 - 1 x6 Backplane</b>			
J2	0-3	1	1-4
J1	4-5	1	5-6
<b>H608 - 1 x8 Backplane</b>			
J2	0-3	1	1-4
J1	4-7	1	5-8
<b>H60F – 2 x4 Backplanes</b>			
J1	0-3	1	1-4
J2	4-7	2	1-4
J4	n/a	n/a	n/a
J3	n/a	n/a	n/a
<b>H60F - 1 x6 Backplanes</b>			
J1	0-3	1	1-4
J2	4-5	2	5-6
J4	n/a	n/a	n/a
J3	n/a	n/a	n/a
<b>H60F - 1 x4 &amp; 1 x6 Backplanes (See example 3.)</b>			
J1	0-3	1	1-4
J2	4-7	2	1-4
J4	8-9	2	5-7
J3	n/a	n/a	n/a
<b>H6F - 1 x16 Backplane</b>			
J1	0-3	1	1-4
J2	4-7	1	5-8
J4	8-11	1	9-12
J3	12-15	1	13-16

## **Connecting an internal Mini-SAS to SATA Fan-out cables**

A mini-SAS to SATA fan out cable has a mini-SAS connector (SFF-8087) on one end and four SATA connectors on the other end. Plug the mini-SAS connector into the appropriate 'Jn' connector on the adapter. Plug each of the SATA connectors into the drive backplane. The cable attached to each SATA cable should have a number that indicates the connection order within the mini-SAS connector. The number on the cable indicates the order that the SATA cable should be connected to drive slots on the backplane. Consult the documentation for your

backplane to determine the relationship from the SATA connector to drive slot.

## **Connecting an internal Mini-SAS to internal Mini-SAS cables**

A mini-SAS to mini-SAS cable has a mini-SAS (SFF-8087) connector at each end of the cable. Plug one end into the appropriate 'Jn' connector on the adapter. Plug the other end into the appropriate connector on the drive backplane. Consult the documentation for your backplane to determine the relationship from the Mini-SAS connector to drive slot.

## **LED Control for Internal SAS Connectors**

---

This section provides the instructions that define the cable connections needed to exercise LED Control for hard drive backplanes. This section applies to the following models: R608; R60F; H608; and H60F. These adapters have been designed to support LED Control functionality through an SGPIO interface or an I2C interface. These interfaces require different cable connections and those connections are specified in this chapter.

should have an additional connector that is an 8 wire connector. This connector must be connected to an SGPIO header on the hard drive backplane. (See Example 2) Consult the documentation for your backplane to determine the relationship from the SGPIO connector to the drive slots.

Note, the SGPIO sideband connector is not standard and the connector must match the connector on the backplane. Please see the backplane's and cable's documentation for more details

### **Using SGPIO for LED Control**

#### **SGPIO with an internal mini-SAS to mini-SAS cable**

The signals for SGPIO are included within the Mini-SAS connector located on the adapter. These signals are routed to the hard drive backplane based upon the cable used for the backplane connection. Consult the documentation for your backplane to determine if it supports SGPIO.

#### **SGPIO with an internal Mini-SAS to SATA Fan-out cables**

Follow the instructions for a connection with internal Mini-SAS to SATA Fan-out cables. The fan out end

### **Using SES-I2C for LED Control**

The signals for LED Control via I2C are generated at the I2C headers of the adapter. The signals are carried on a 3 wire cable and connected to the hard drive backplane. Consult the documentation for your backplane to determine if it supports LED Control via I2C.

In general an I2C cable is needed for each group of four drives. However, there are hard drive backplanes that have more drives per I2C cable. The I2C cables should be connected according to the table on the next page.

Exhibit 7-4 SES-I2C Wire chart for R608 or R60F ([Examples](#) start on page 37)

<i>Mini-SAS Connector</i>	<i>I2C Header</i>	<i>PHYs</i>	<i>Backplane</i>	<i>Backplane Slots</i>	<i>I2C Address</i>
<b>R608 - 2 x4 Backplanes (See example 1.)</b>					
J3	P7	0-3	1	1-4	C0
J2	P6	4-7	2	1-4	C0
<b>R608 - 1 x6 Backplane</b>					
J3	P7	0-3	1	1-4	C0
J2	n/a	4-5	1	5-6	n/a
<b>R608 - 1 x8 Backplane</b>					
J3	P7	0-3	1	1-4	C0
J2	P6	4-7	1	5-8	C2
<b>R60F – 2 x4 Backplanes</b>					
J1	P8	0-3	1	1-4	C0
J2	P9	4-7	2	1-4	C2
J3	n/a	n/a	n/a	n/a	n/a
J4	n/a	n/a	n/a	n/a	n/a
<b>R60F - 1 x6 Backplanes</b>					
J1	P8	0-3	1	1-4	C0
J2	n/a	4-5	1	5-6	n/a
J3	n/a	n/a	n/a	n/a	n/a
J4	n/a	n/a	n/a	n/a	n/a
<b>R60F - 1 x4 &amp; 1x6 Backplane (See example 3.)</b>					
J1	P8	0-3	1	1-4	C0
J2	P6	4-7	2	1-4	C2
J3	n/a	8-9	2	5-6	n/a
J4	n/a	n/a	n/a	n/a	n/a
<b>R60F - 1 x16 Backplane</b>					
J1	P8	0-3	1	1-4	C0
J2	P8	4-7	1	5-8	C2
J3	P6	8-11	1	9-12	C0
J4	P6	12-15	1	13-16	C2

Exhibit 7-5 SES-I2C Wire chart for R608 or R60F ([Examples](#) start on page 37)

<i>Mini-SAS Connector</i>	<i>I2C Header</i>	<i>PHYs</i>	<i>Backplane</i>	<i>Backplane Slots</i>	<i>I2C Address</i>
<b>H608 - 2 x4 Backplanes (See example 4.)</b>					
J2	P6	0-3	1	1-4	C0
J1	P5	4-7	2	1-4	C0
<b>H608 - 1 x6 Backplane</b>					
J2	P6	0-3	1	1-4	C0
J1	n/a	4-5	1	5-6	n/a
<b>H608 - 1 x8 Backplane</b>					
J2	P6	0-3	1	1-4	C0
J1	P5	4-7	1	5-8	C0
<b>H60F – 2 x4 Backplanes</b>					
J1	P5	0-3	1	1-4	C0
J2	P6	4-7	2	1-4	C0
J4	n/a	n/a	n/a	n/a	n/a
J3	n/a	n/a	n/a	n/a	n/a
<b>H60F - 1 x6 Backplanes</b>					
J1	P5	0-3	1	1-4	C0
J2	n/a	4-5	1	5-6	n/a
J4	n/a	n/a	n/a	n/a	n/a
J3	n/a	n/a	n/a	n/a	n/a
<b>H60F - 1 x4 &amp; 1x6 Backplane (See example 5.)</b>					
J1	P5	0-3	1	1-4	C0
J2	P6	4-7	2	1-4	C0
J4	n/a	8-9	2	5-6	n/a
J3	n/a	n/a	n/a	n/a	n/a
<b>H60F - 1 x16 Backplane</b>					
J1	P5	0-3	1	1-4	C0
J2	P6	4-7	1	5-8	C0
J4	P7	8-11	1	9-12	C0
J3	P8	12-15	1	13-16	C0

## I2C Header Pin-out

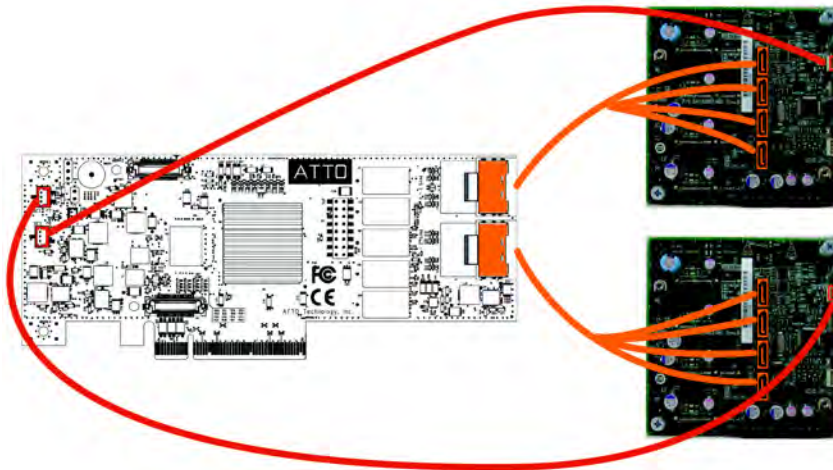
The following chart specifies the pin-out for I2C headers on the ESAS RAID and ESAS HBAs.

Pin	Signal
1	Data
2	Ground
3	Clock

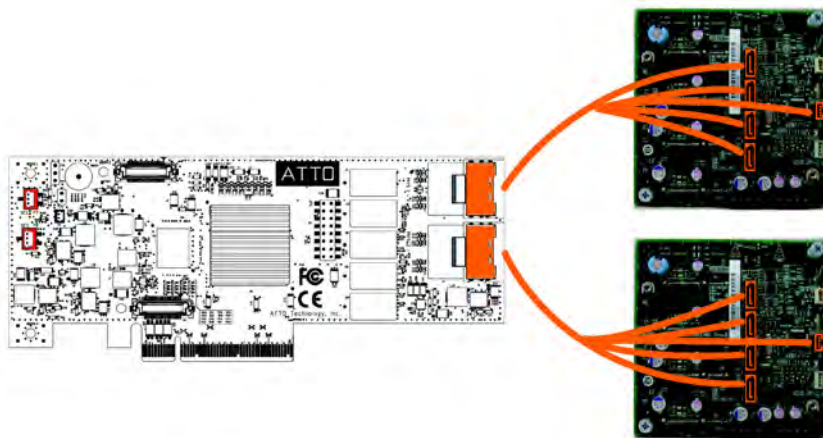


## Example Configurations

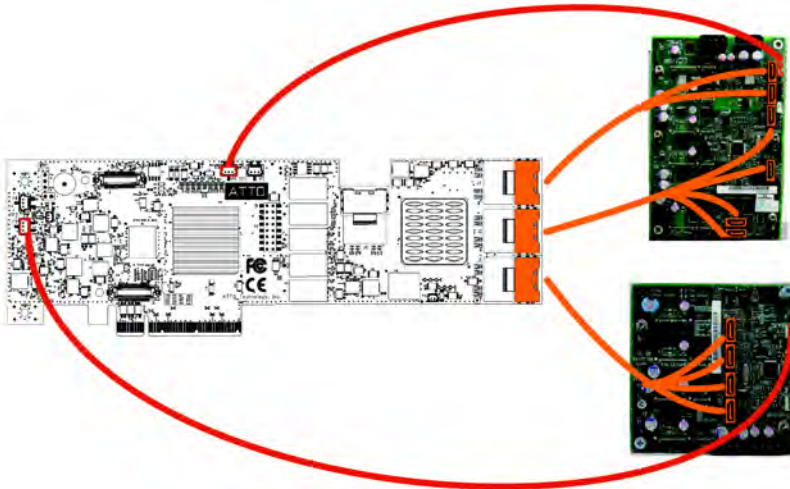
*Example 1 R608 with 2 Intel x4 backplanes. The backplanes are controlled by SES-I2C*



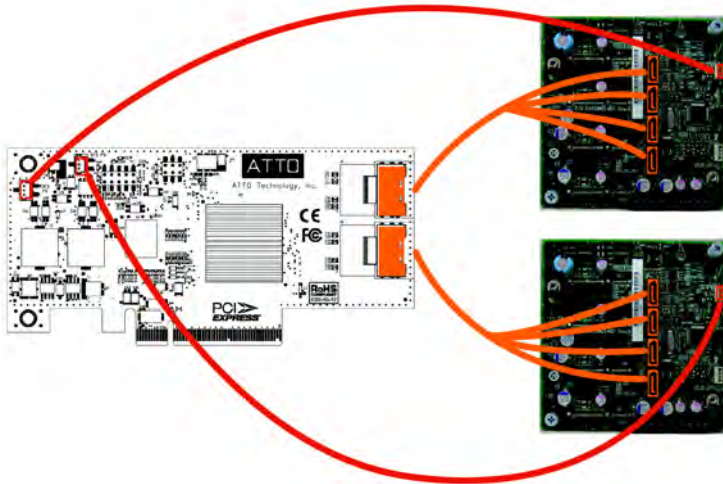
*Example 2 R608 with 2 Intel x4 backplanes. The backplanes are controlled by SGPIO*



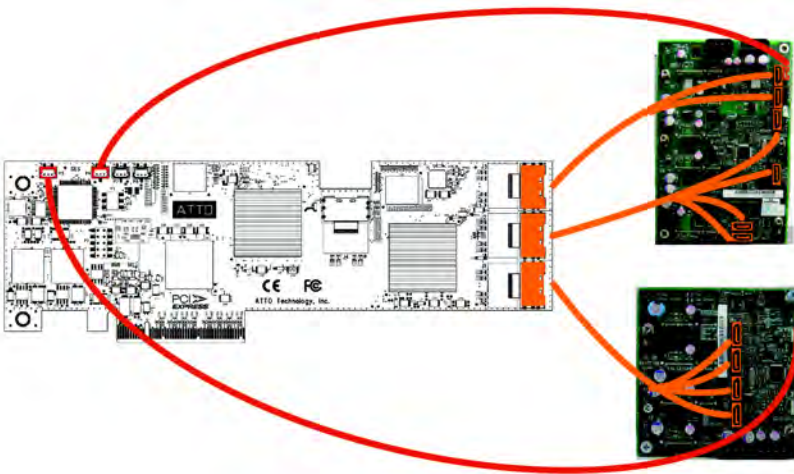
*Example 3 R60F with an Intel x6 backplane and an Intel x4 backplane. The backplanes are controlled by SES-I2C*



*Example 4 H608 with 2 Intel x4 backplanes. The backplanes are controlled by SES-I2C*



*Example 5 H60F with an Intel x6 backplane and an Intel x4 backplane. The backplanes are controlled by SES-I2C*



## 8 Troubleshooting

This chapter contains solutions for the most common problems you might encounter. If you need additional assistance, please refer to the ATTO Technology website ([www.attotech.com](http://www.attotech.com)) or contact an ATTO Technology authorized representative.

### General suggestions

- Check each cable connection on every device.
- Verify all cables are in proper working condition. Loose or broken cables are often the cause of errors or problems.
- Check that devices are plugged into an AC outlet and are turned on before you add power to your computer.
- Ensure you have the latest driver for your operating system and that the driver is installed (refer to [page 9](#)).
- Ensure the ExpressSAS adapter is installed properly in the computer (refer to [Install Hardware](#) on page 15).

### If the RAID adapter is not accessible

- 1 Open the ATTO **ConfigTool** from the ATTO Utilities which can be downloaded from the ATTO website. Refer to the *ATTO Utilities Installation and Operation Manual* for additional information.



#### Note

Logging features are only available if the ATTO ConfigTool service is installed. We recommend installing the service as a minimum configuration.

- 2 If the adapter does not appear in the **Device Listing**, make sure it is properly seated in the PCI slot.

- a. Remove power from the PC.
- b. Remove the case.
- c. Check the PCI slot.
- d. Replace the case.
- e. Apply power.



#### Note

If it is properly seated and devices are still not accessible, contact an ATTO Technology authorized representative.

- 3 Verify the driver is loaded.
  - a. Click on the adapter name in the **Device Listing** to view the **Basic Info** screen.
  - b. If the **Driver Information** section indicates **Unknown: driver not loaded**, reinstall the driver (refer to [page 9](#)).
  - c. If reinstalling the driver does not fix the problem, contact an ATTO authorized representative.
- 4 Reset the NVRAM for all channels to defaults and reboot. If the problem persists, contact an ATTO authorized representative.



#### Note

For OS X systems, when calling ATTO Technical Support, please have a printout of the IOreg listing and output from the Apple System Profiler available.

# Appendix A Glossary

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## Glossary

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*Some terms used in the SAS/SATA industry are defined below. More information is available through the ATTO Technology website ([www.attotech.com](http://www.attotech.com)), or the Storage Area Networking Industry Association ([www.snia.org](http://www.snia.org)).*

Term	Definition
ANSI	American National Standards Institute
Auto Negotiation	Hardware senses and automatically responds depending on configuration
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
CPU	Central Processing Unit: the portion of the computer that actually performs computations
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)
Host	A processor, usually a CPU and memory, which communicates with devices over an interface
I2C	(Inter-Integrated Circuit) is a multi-master serial single-ended computer bus that is used to attach low-speed peripherals to a motherboard, backplane or embedded system
I2C Header	I2C header is a connector on the adapter used to connect an I2C cable
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
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
PHY	A physical connection between the adapter and a drive on the backplane. Each mini-SAS connector carries signals for four phys
Port	An access point in a device
Port Address	Also port number; the address, assigned by the PCI bus, through which commands are sent to a adapter board
Port Number	See port address
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.
SEP	SCSI Enclosure Process. A SEP is a device, typically a backplane, that is capable of executing SCSI SES commands
SES	SCSI Enclosure Services. A SCSI specification that defines SCSI commands for controlling an enclosure. These commands include the capability to control LED indicators on an enclosure

<b>Term</b>	<b>Definition</b>
SES-I2C	SES over I2C. I2C is used to transport the SES protocol instead of SCSI, SAS, Fibre Channel etc
SGPIO	A serial GPIO protocol used to control LED indicators on a backplane
Sideband Connector	Connector on Mini-SAS cables used to carry an SGPIO signal
Transfer Rate	The rate at which bytes or bits are transferred, as in megabytes or gigabits per second

# Appendix B VMware Configuration & Management

## Driver Configuration

Use the `esxcfg-module` command to query and configure the ATTO adapter driver parameters. In the examples that follow, `<driver name>` should be replaced with the ATTO driver name.

Configuration changes made with the `esxcfg-module -s` command are persistent across system reboots. However, the changes will not take effect until the system is rebooted.

To obtain a list of available driver parameters:

```
# esxcfg-module -i <driver name>
```

The following table lists the configurable parameters along with a brief description.

To list the driver parameters that have been set:

```
# esxcfg-module -g <driver name>
```

To set a driver parameter:

```
# esxcfg-module -s param=value <driver name>
```

PARAMETER	DESCRIPTION
<code>atto_log_mask</code>	Defines the log mask for sending ATTO driver information to the system log. Default is 0 (none).
<code>atto_max_sectors</code>	Maximum number of disk sectors in a single data transfer. Default is 65535 (largest possible value).
<code>can_queue</code>	Maximum number of commands per adapter channel. Default is 128.
<code>change_notification</code>	Enable notifying the OS of the arrival and departure of target devices. Default is 1 (on).
<code>cmd_per_lun</code>	Maximum number of commands per LUN. Default is 16.
<code>cmd_retry_count</code>	Maximum number of retries allowed for a command. Default is 20.
<code>event_log_mask</code>	A bit mask of events to report to the system log. Default is 0x00000001 (critical events only).
<code>heap_initial</code>	Initial heap size allocated for the driver.
<code>heap_max</code>	Maximum attainable heap size of the driver.
<code>io_time_out</code>	Time (in seconds) before an I/O command is timed out by the driver. Set to 0 for no timeout. Default is 30.
<code>num_sas_addr</code>	Number of SAS addresses to assign to the adapter's PHYs. Addresses are assigned sequentially from the base address. Valid settings are 1, 2, 4, 8. Default is 1.
<code>num_sg_lists</code>	Number of SGL pages. Default is 256.



PARAMETER	DESCRIPTION
num_targets	Maximum number of target devices. Default is 256.
old_device_reset	Use the old device reset method. Default is 0 (use new method).
sg_tablesize	Maximum number of entries in a scatter/gather table. A value of 255 means that the S/G table be any size. Default is 255.
sgl_page_size	Scatter/Gather List page size in number of S/G entries. Default is 128.
use_tm_completions	Wait for task management commands to complete before returning from handler. Default is 1 (enabled).
use_transport_layer	Attached to the SCSI transport layer. Default is 1 (enabled).
use_multiqueue	Distributes I/O across queues based on CPU affinity. This may result in reduced CPU cost per I/O. Default is 0 (disabled).

## Adapter Management

On VMware ESX/ESXi you can identify and manage ATTO adapters using the VMware vSphere Client, or the Service Console. On ESXi, the Service Console is referred to as Local Tech Support Mode.

### vSphere Client

With VMware vSphere Client, you can identify ATTO adapters on a VMware ESX/ESXi system, and view the attached storage devices.

- 1 Start vSphere Client from your local workstation and select the host containing one or more ATTO adapters.
- 2 Click the Configuration tab, and then select Storage adapters under Hardware in the left pane.
- 3 A list of all storage adapters in the system is displayed. The Model, Identifier (SAS address) and Targets are shown for each adapter channel.

### Service Console

Using the Service Console, information about each adapter channel can be found in the `/proc/scsi` filesystem, under `/proc/scsi/<driver name>`.

To view details on a specific adapter channel, run the following command:

**# cat /proc/scsi/<driver name>/<channel>**

This command displays the following information:

- Adapter type
- Driver, BIOS and Firmware versions
- Driver Parameters
- Adapter Model and Identifier (WWN or SAS address)
- Virtual Port Information
- Discovered Targets
- Driver Statistics

A sample output is shown below:

```
~ # cat /proc/scsi/esas2hba/6
ATTO ExpressSAS 6Gb HBA
Driver version 1.60b1
Flash version 09/27/2011
Firmware version 1.16.16
Copyright 2001-2011
http://www.attotech.com
```

#### Driver Parameters:

```
-----  
num_sas_addr=1, sgl_page_size=512,  
num_targets=256, event_log_mask=0x00000001,  
num_sg_lists=1024, cmd_per_lun=7,  
can_queue=128, sg_tablesize=255,  
atto_max_sectors=65535, cmd_retry_count=20,  
io_time_out=30, change_notification=1,  
old_device_reset=0
```

#### HBA Information:

```
-----  
Model: ATTO ExpressSAS H680  
SAS Address: 50010860:00104a40
```

#### Discovered Devices:

```
# TargetID SAS Address  
-----  
None
```

#### Statistics:

```
-----  
Time elapsed (ms)      : 86530  
Commands completed    : 0  
Outstanding commands  : 0  
Max outstanding commands: 0
```

## ATTO CLI Tools

ATTO provides a set of Command Line Interface (CLI) tools for managing ATTO adapters from the Service Console of an ESX/ESXi host. These tools are distributed in a compressed TAR file with the name: `vmw_app_hbacli_{date}.tgz`. Replace {date} with the actual date-string.

To install ATTO CLI Tools on an ESX/ESXi host:

- 1 Copy the TAR file to the ESX/ESXi host.
- 2 Extract the contents of the tar file using: `tar xvzf <tar file>`
- 3 Change to the extracted directory using `cd vmw_app_hbacli_{date}`
- 4 Run the installer: `./cli_install.sh`
- 5 Follow the instructions to complete the installation.

The following ATTO CLI tools are available:

**atinfo** - View basic information about ATTO adapters and their attached devices.

**atflash** - View and update the flash version of ATTO adapters.

**atfcnv** - View and modified parameters in the NVRAM of ATTO Celerity HBAs to fine-tune HBA performance and behavior. You can save and restore NVRAM settings from a file using this tool.

**atsasnv** - View and modify parameters in the NVRAM of ATTO ExpressSAS adapters to fine-tune adapter performance and behavior. You can save and restore NVRAM settings from a file using this tool.



#### Note

*On ESX 4.x, the ATTO CLI Tools should NOT be installed on a VMFS volume. Instead, they should be installed in an appropriate location on the local disk, such as /usr/sbin. On ESXi 4.x and ESXi 5.0, the CLI tools should be installed on permanent storage, such as a VMFS volume.*



# Appendix C Standards and Compliances

*The equipment described in this manual generates and uses radio frequency energy. The Technical Specification sheet for the ATTO ExpressSAS adapter shows certifications for each model.*



## FCC standards: radio and television interference

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in 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 B 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 ExpressSAS 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:

EN55024:2002; EN55022:2002 CLASS B

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 ATTO ExpressSAS adapters comply with Directive 2011/65/EU on the Restriction of the Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS). Contact your ATTO representative regarding RoHS compliant products.

## Appendix D Safety and Warranty

*All ATTO adapter products have been tested to meet applicable safety standards when operated in proper electrical and thermal environments.*

### Safety

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Please review the specifications for your specific adapter before installing and operating it in any computer system to ensure compatibility.

### Installation

Before installing an ATTO adapter product into your computer system, unplug the computer from its electrical power source and allow adequate time for electrical discharge and the internal components to cool down before removing the computer system cover. This will decrease the risk of personal injury from electrical shock or touching the hot surface of an electrical component.

Once an ATTO adapter is installed in a computer system, the computer cover must be reinstalled properly before turning the computer system back on.

### Operation

ATTO adapters require adequate cooling to function properly. If you have any questions as to the airflow provided by your computer system, please refer to your computer system manual or contact your computer system manufacturer.

To facilitate proper air circulation, ATTO adapters should never be operated in a computer system without the cover installed or with an inoperable fan as this may cause safety or thermal problems which could damage the ATTO adapter and void the warranty.

### ATTO Technology, Inc. limited warranty

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ATTO Technology, Inc. ("ATTO") warrants to the original purchaser of this product ("Product") that the Product is free from defects in material and workmanship for the term described for this specific Product on ATTO's website ([www.attotech.com](http://www.attotech.com)). ATTO's liability shall be limited to replacing or repairing any defective product at ATTO's option. There is no charge for parts or labor if ATTO determines that this product is defective.

PRODUCTS WHICH HAVE BEEN SUBJECT TO ABUSE, MISUSE, ALTERATION, NEGLECT, OR THOSE PRODUCTS THAT HAVE BEEN SERVICED, REPAIRED OR INSTALLED BY UNAUTHORIZED PERSONNEL WILL NOT BE COVERED UNDER THIS WARRANTY. DAMAGE RESULTING FROM INCORRECT CONNECTION OR AN INAPPROPRIATE APPLICATION OF THIS PRODUCT SHALL NOT BE THE RESPONSIBILITY OF ATTO. LIABILITY UNDER THIS LIMITED WARRANTY IS LIMITED TO ATTO PRODUCT(S). DAMAGE TO OTHER EQUIPMENT CONNECTED TO ATTO PRODUCT(S) IS THE CUSTOMER'S RESPONSIBILITY. THIS LIMITED WARRANTY IS MADE IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. ATTO DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT IMPLIED WARRANTIES CANNOT BE EXCLUDED, SUCH IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE EXPRESS WARRANTY PERIOD APPLICABLE TO THE PRODUCT. BECAUSE SOME STATES OR JURISDICTIONS DO NOT ALLOW LIMITATIONS ON THE DURATION OF IMPLIED WARRANTIES, THE ABOVE MAY NOT BE APPLICABLE. ATTO'S RESPONSIBILITY TO REPAIR OR REPLACE A DEFECTIVE PRODUCT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY.

ATTO IS NOT RESPONSIBLE FOR DAMAGE TO OR LOSS OF ANY DATA, PROGRAMS OR ANY MEDIA. THE PRODUCTS ARE NOT INTENDED FOR USE IN: (I) MEDICAL DEVICES OR THE MEDICAL FIELD; OR (II) USE IN RUGGED APPLICATIONS.

ATTO IS NOT LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, IRRESPECTIVE OF WHETHER ATTO HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. NO ATTO DEALER, AGENT OR EMPLOYEE IS AUTHORIZED TO MAKE ANY MODIFICATION, EXTENSION OR ADDITION TO THIS WARRANTY.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.