Serial Attached SCSI RAID Controllers Installation and User's Guide

CDP-00283-01-A Rev. A
Issue: July 15, 2013
### Revision History

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<th>Issue</th>
<th>Issue Date</th>
<th>Details of Change</th>
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<td>1.03</td>
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</tbody>
</table>
Contents

Adaptec by PMC Product Support ......................................................................................................................... 8
Limited 3-Year Hardware Warranty .......................................................................................................................... 10
Regulatory Compliance Statements ..................................................................................................................... 11

1 About This Guide .................................................................................................................................................. 14
   What You Need to Know Before You Begin ......................................................................................................... 14
   Terminology Used in this Guide ............................................................................................................................ 14
   How to Find More Information .............................................................................................................................. 14

2 Kit Contents and System Requirements ............................................................................................................. 16
   Kit Contents .......................................................................................................................................................... 16
   System Requirements ......................................................................................................................................... 16

3 About Your RAID Controller .............................................................................................................................. 17
   Standard RAID Controller Features ...................................................................................................................... 17
   Array-level Features ......................................................................................................................................... 17
   Advanced Data Protection Suite ............................................................................................................................ 17
   Adding a Flash Backup Module .............................................................................................................................. 18
   Upgrading the Controller Firmware ..................................................................................................................... 18
   About the Adaptec RAID 7805/7805Q .................................................................................................................... 19
   About the Adaptec RAID 71605/71605Q .................................................................................................................. 20
   About the Adaptec RAID 71605E ........................................................................................................................... 21
   About the Adaptec RAID 71685 ............................................................................................................................. 22
   About the Adaptec RAID 72405 ............................................................................................................................. 23
   About the Adaptec RAID 78165 ............................................................................................................................. 24

4 Getting Started .................................................................................................................................................... 25
   Choosing a RAID Level ........................................................................................................................................ 25
   Selecting Disk Drives and Cables .......................................................................................................................... 25
   Disk Drives ....................................................................................................................................................... 25
   Cables ............................................................................................................................................................... 25
   Replacing the Full-Height Bracket with a Low-Profile Bracket ............................................................................ 26
   Installation Options ........................................................................................................................................... 27
   Basic Installation Steps ...................................................................................................................................... 27
   Installing with an Operating System ................................................................................................................... 28
   Installing on an Existing Operating System ....................................................................................................... 28

5 Installing the Controller and Disk Drives ......................................................................................................... 29
   Before You Begin .............................................................................................................................................. 29
   Installing the Controller ................................................................................................................................... 29
   Installing a RAID Controller without Zero Maintenance Cache Protection .................................................... 29
   Installing a RAID Controller with Zero Maintenance Cache Protection ......................................................... 30
   Connecting Disk Drives to Your Controllers ....................................................................................................... 33
   Connecting Drives Directly to the Controller ........................................................................................................ 33
   Connecting Drives to a System Backplane .......................................................................................................... 33
   Connecting Solid State Drives (SSDs) .................................................................................................................... 33
   Connecting External Devices ............................................................................................................................... 34
   Next Steps ......................................................................................................................................................... 35

6 Creating a Bootable Array ................................................................................................................................. 36
   Setting the Boot Controller .................................................................................................................................. 36
   Creating an Array ................................................................................................................................................ 36
   Creating an Array with the ARC Utility .................................................................................................................. 36
   Creating an Array with maxView Storage Manager ............................................................................................ 37
   Making Your Array Bootable .................................................................................................................................. 39
Appendix A Introduction to SAS

Terminology Used in This Appendix

What is SAS?
How Do SAS Devices Communicate?
What’s a Phy?
What’s a SAS Port?
What’s a SAS Address?
What’s a SAS Connector?
Adaptec by PMC Product Support
If you have questions about installing or using your Adaptec by PMC product, check this document first—you will find answers to most of your questions. If you need further assistance, use the support options listed below. To expedite your service, have your computer in front of you.

Note: The phone numbers below are subject to change. Please visit the Support section of www.adaptec.com for the most up to date contact information.

Technical Support Identification (TSID) Number

- Before contacting Technical Support, you need your product unique TSID number. The TSID number identifies your product and support status.
- The TSID number is included on a white, bar-coded label, like this example:

![TSID Number Example]

- It’s recommended that you register your product so that you have easy access to your TSID when contacting product support.

Self Help and Support in English

- Search the Adaptec Support Knowledgebase (ASK) at ask.adaptec.com for articles, troubleshooting tips, and frequently asked questions for your product.
- For support via e-mail, submit your question at ask.adaptec.com.
- To speak with a Technical Support Specialist, call +1 408 934 7274 or +49 89 4366 5544 or +44 845 266 8773.

Technische Informationen und Support in Deutsch

- Besuchen Sie unsere Webseite www.adaptec.com/de-de
- Suchen Sie in der Adaptec Support Knowledgebase (ASK) unter ask-de.adaptec.com nach Artikeln, Tipps zur Fehlerbehebung und häufig gestellten Fragen zu Ihrem Produkt.
- Support per Email erhalten Sie unter ask-de.adaptec.com.
- Für telefonischen Support wählen Sie +49 89 4366 5522.

Техническая поддержка и информация на русском языке

- Посещаете наш сайт www.adaptec.com/ru-ru/.
- База знаний Adaptec (ASK) на сайте ask-ru.adaptec.com ask-ru.adaptec.com — статьи, советы по устранению неисправностей и часто задаваемые вопросы о Вашем продукте.
- Для поддержки по электронной почте отправьте Ваш запрос на сайте ask-ru.adaptec.com.
- Чтобы обратиться к специалисту технической поддержки по телефону, звоните на +7 499 918 7200 или +49 89 4366 5555.

日本語での技術情報とサポート

- 弊社のウェブサイト、www.adaptec.com/ja-jaをご覧ください。
- ask.adaptec.co.jp のAdaptec Support Knowledgebase (ASK) でお使いの製品の情報、トラブルシューティングのヒント、よくある質問を検索してください。
- Eメールでのサポートには ask.adaptec.co.jp から質問を送ってください。
Information Technique et d'assistance en Français

- Rechercher dans le base de connaissances Adaptec (ASK) [ask-fr.adaptec.com](http://ask-fr.adaptec.com) pour des articles, conseils de dépannage et les questions fréquemment posées pour votre produit.
Limited 3-Year Hardware Warranty

1. PMC-Sierra, Inc. ("PMC-Sierra") warrants to the purchaser of this product that it will be free from defects in material and workmanship for a period of three (3) years from the date of purchase. If the product should become defective within the warranty period, PMC-Sierra, at its option, will repair or replace the product, or refund the purchaser’s purchase price for the product, provided it is delivered at the purchaser’s expense to an authorized PMC-Sierra service facility or to PMC-Sierra.

2. Repair or replacement parts or products will be furnished on an exchange basis and will either be new or reconditioned and will be subject to original warranty term. All replaced parts or products shall become the property of PMC-Sierra. This warranty shall not apply if the product has been damaged by accident, misuse, abuse or as a result of unauthorized service or parts.

3. Warranty service is available to the purchaser by delivering the product during the warranty period to an authorized PMC-Sierra service facility or to PMC-Sierra and providing proof of purchase price and date. The purchaser shall bear all shipping, packing, and insurance costs and all other costs, excluding labor and parts, necessary to effectuate repair, replacement or refund under this warranty.

4. For more information on how to obtain warranty service, write or telephone:
   • Americas PMC-Sierra, Inc. at 1380 Bordeaux Drive Sunnyvale, CA 94089 USA, +1 408 934-7274
   • EMEA PMC-Sierra, at Lise-Meitner-Strasse 7, 85737 Ismaning, Germany, +49 89 43665544
   • Asia Pacific PMC-Sierra, at PO Box 110, Peakhurst NSW 2210, Australia, +61 2 8212-5531
   • Japan PMC-Sierra, at Tokumasu-Building 4F, 5-5-5, Higashinakano, Nakano-ku, Tokyo 164-0003, Japan, 03-3367-3970 (fax).

5. THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY PRODUCT WHICH HAS BEEN DAMAGED AS A RESULT OF ACCIDENT, MISUSE, ABUSE, OR AS A RESULT OF UNAUTHORIZED SERVICE OR PARTS.

6. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES WHICH NOW OR HEREAFTER MIGHT OTHERWISE ARISE RESPECT TO THIS PRODUCT. IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT SHALL (A) HAVE NO GREATER DURATION THAN 3 YEARS FROM THE DATE OF PURCHASE, (B) TERMINATE AUTOMATICALLY AT THE EXPIRATION OF SUCH PERIOD AND (C) TO THE EXTENT PERMITTED BY LAW BE EXCLUDED. IN THE EVENT THIS PRODUCT BECOMES DEFECTIVE DURING THE WARRANTY PERIOD, THE PURCHASER’S EXCLUSIVE REMEDY SHALL BE REPAIR, REPLACEMENT OR REFUND AS PROVIDED ABOVE. INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION LOSS OF DATA, ARISING FROM BREACH OF ANY EXPRESS OR IMPLIED WARRANTY ARE NOT THE RESPONSIBILITY OF PMC-SIERRA AND, TO THE EXTENT PERMITTED BY LAW, ARE HEREBY EXCLUDED BOTH FOR PROPERTY DAMAGE, AND TO THE EXTENT NOT UNCONSCIONABLE, FOR PERSONAL INJURY DAMAGE.

7. WITHIN THE US, SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, AND SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION OR EXCLUSIONS MAY NOT APPLY TO YOU.

8. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY DEPENDING ON WHERE YOU RESIDE.

9. FOR AUSTRALIA RESIDENTS, IF THE PRODUCT SHOULD BECOME DEFECTIVE WITHIN THE WARRANTY PERIOD, PMC-SIERRA, AT ITS OPTION, WILL REPAIR OR REPLACE THE PRODUCT, OR REFUND THE PURCHASER’S PURCHASE FOR THE PRODUCT, PROVIDED IT IS DELIVERED AT THE PURCHASER’S EXPENSE BACK TO THE PLACE OF PURCHASE AFTER PMC-SIERRA TECHNICAL SUPPORT HAS ISSUED AN INCIDENT NUMBER. IN ADDITION TO THE WARRANTIES SET FORTH HEREIN, OUR GOODS COME WITH GUARANTEES THAT CANNOT BE EXCLUDED UNDER THE AUSTRALIAN CONSUMER LAW. YOU ARE ENTITLED TO A REPLACEMENT OR REFUND FOR A MAJOR FAILURE AND FOR COMPENSATION FOR ANY OTHER REASONABLY FORESEEABLE LOSS OR DAMAGE. YOU ARE ALSO ENTITLED TO HAVE THE GOODS REPAIRED OR REPLACED IF THE GOODS FAIL TO BE OF ACCEPTABLE QUALITY AND THE FAILURE DOES NOT AMOUNT TO A MAJOR FAILURE.
Regulatory Compliance Statements

Federal Communications Commission Radio Frequency Interference Statement

Attention: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

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 harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. However, if this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.
- Use a shielded and properly grounded I/O cable and power cable to ensure compliance of this unit to the specified limits of the rules.

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

UL Compliance Statement

Adaptec by PMC products are tested and listed by Underwriters Laboratories, Inc. to UL 60950-1 Second Edition and IEC-60950-1 Second Edition standards, file numbers E175975. Adaptec by PMC products are for use only with UL listed ITE.

<table>
<thead>
<tr>
<th>Tested to Comply With FCC Standards</th>
<th>Use only with the listed ITE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMC-Sierra, Inc.</td>
<td>ASR-7805/ASR-7805Q/ASR-71605/</td>
</tr>
<tr>
<td></td>
<td>ASR-71605E/ASR-71605Q/ASR-71685/</td>
</tr>
<tr>
<td></td>
<td>ASR-72405/ASR-78165/</td>
</tr>
<tr>
<td></td>
<td>AFM-700</td>
</tr>
</tbody>
</table>

FOR HOME OR OFFICE USE
European Union Compliance Statement

This Information Technology Equipment has been tested and found to comply with EMC Directive 89/336/EEC, as amended by 92/31/EEC and 93/68/EEC, in accordance with:

  - Class B ITE radiated and conducted emissions
  - EN61000-4-2 (2009) Electrostatic discharge: ±4 kV contact, ±8 kV air
  - EN61000-4-3 (2010) Radiated immunity: 3V/m
  - EN61000-4-4 (2004) Electrical fast transients/burst: ±1 kV AC, ±0.5 kV I/O
  - EN61000-4-5 (2006) Surges: ±1 kV differential mode, ±2 kV common mode
  - EN61000-4-6 (2009) Conducted immunity: 3 V
  - EN61000-4-11 (2004) Supply dips and variations: 30% and 100%
- EN50581 (2012) Technical Documentation:
  - For the assessment of electrical and electronic products with respect to the restriction of hazardous substances

In addition, all equipment requiring U.L. listing has been found to comply with EMC Directive 73/23/EEC as amended by 93/68/EEC in accordance with EN60950 with amendments A1, A2, A3, A4, A11.

Australian/New Zealand Compliance Statement

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to the Australian/New Zealand standard AS/NZS 3548 set out by the Spectrum Management Agency.

Canadian Compliance Statement

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

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

Japanese Compliance (Voluntary Control Council Initiative)

This equipment complies to class B Information Technology equipment based on VCCI (Voluntary Control Council for Interface). This equipment is designed for home use but it may causes radio frequency interference problem if used too near to a television or radio. Please handle it correctly per this documentation.

Korean Compliance (KCC) Statement

Adaptec by PMC products are tested and certified by KCC:
KCC-REM-KHK-ASR-7xxx5

The above certification covers the following series:

- ASR-7805, ASR-7805Q, ASR-71605
- ASR-71605E, ASR-71605Q
- ASR-71685, ASR-72405, ASR-78165
- AFM-700
This equipment is home use (Class B) electromagnetic wave suitability equipment and to be used mainly at home and it can be used in all areas.
1 About This Guide

This Installation and User's Guide explains how to install your Adaptec® by PMC™ RAID controller. It also describes the utilities included in your controller kit, and provides a basic overview of Serial Attached SCSI (SAS) and Redundant Array of Independent Disk (RAID) technology.

These Adaptec Serial Attached SCSI RAID (ASR) controller models are described in this guide:

- ASR-7805, ASR-7805Q
- ASR-71605, ASR-71605E, ASR-71605Q
- ASR-71685
- ASR-72405
- ASR-78165

What You Need to Know Before You Begin

You should be familiar with computer hardware, data storage, RAID technology, and SAS and Serial ATA (SATA) technology. (For more information about SAS technology, see Introduction to SAS on page 62.) You should also be familiar with direct-attached storage (DAS) concepts and technology.

Note: Because this guide covers multiple Adaptec RAID products, some of the features and functions described may not be available for your controller. For more information, see About Your RAID Controller on page 17.

Terminology Used in this Guide

Because you can use your Adaptec RAID controller to manage data storage in a variety of configurations, the generic term “storage space” is used to refer to controller(s) and disk drives being managed with Adaptec maxView Storage Manager™ (called simply maxView Storage Manager in the remainder of this guide) or the other utilities described in this guide.

Many of the terms and concepts referred to in this guide are known to computer users by multiple names. This guide uses these terms:

- Controller (also known as adapter, board, or card)
- Disk drive (also known as hard disk, hard drive, or hard disk drive)
- Solid State Drive (also known as SSD or non-rotating storage media)
- Enclosure (also known as a RAID enclosure, storage enclosure, or disk drive enclosure)
- Array (also known as a container, logical device, or logical drive)

Note: maxView Storage Manager refers to arrays as logical drives. Your RAID controller creates arrays, which your operating system (and maxView Storage Manager) recognizes as logical drives. For more information, refer to the maxView Storage Manager User’s Guide on the Adaptec Installation DVD.

How to Find More Information

You can find more information about your Adaptec RAID controller and the software and utilities included with it by referring to these documents:

- Readme.txt—Includes updated product information and known issues; located on the Adaptec Installation DVD.
- maxView Storage Manager User’s Guide—Describes how to install and use the maxView Storage Manager software (see About maxView Storage Manager on page 57) to manage your direct attached storage; located on the Adaptec Installation DVD.
- maxView Storage Manager Online Help—Describes how to use the maxView Storage Manager software; accessible from the main window of maxView Storage Manager.
- *Adaptec RAID Controller Command Line Utility User’s Guide*—Describes how to use the included Adaptec RAID Controller Configuration (ARCCONF) command line utility (see *About the Adaptec RAID Controller Configuration Utility* on page 57) to perform basic array and configuration management functions; located on the Adaptec Installation DVD.
2 Kit Contents and System Requirements

This chapter lists the contents of your Adaptec RAID controller kit and the system requirements that must be met for you to successfully install and use your controller.

Kit Contents

- Adaptec RAID controller
- Adaptec Installation DVD (bootable), including controller drivers, Adaptec maxView Storage Manager, ARCCONF command line utility, and documentation
- Cables (Not included in Adaptec ‘Single’ product. If your kit includes cables, the type and quantity vary—for more information, see Cables on page 25.)
- (Select models only) Low-profile bracket
- Adaptec Serial Attached SCSI RAID Controllers Quick Start Guide (on the installation DVD)

System Requirements

- PC-compatible computer with Intel Pentium, or equivalent, processor
- Motherboard with these features:
  - Support for multi-function devices where one of the devices is a PCI bridge
  - Large memory-mapped address ranges
  Refer to the Readme file on the Adaptec Installation DVD for additional motherboard compatibility information.
- One of these operating systems:
  - Red Hat® Enterprise Linux 6.3, 5.9 (32-bit and 64-bit)
  - SuSE Linux Enterprise Server 11, 10 (32-bit and 64-bit)
  - FreeBSD 9.1, 9.0 (32-bit and 64-bit)
  - Debian Linux 6 (32-bit and 64-bit)
  - Ubuntu Linux 12, 11, 10 (32-bit and 64-bit)
  - Fedora Linux 18, 17 (32-bit and 64-bit)
  - CentOS 6.3, 5.9 (32-bit and 64-bit)
  - Solaris 10, Solaris 11 Express
  - VMware ESXi 5.1, VMware ESX 4.1 Classic
  - Citrix XenServer 6.1
- 2 GB of RAM minimum
- Available compatible PCIe slot (depending on your controller model—see the descriptions in About Your RAID Controller on page 17)
- 350 MB of free disk drive space
- 16-bit SVGA color monitor with a resolution of at least 800 x 600
- DVD-ROM drive
- USB flash drive or CD burner, for creating driver disks and bootable media
About Your RAID Controller

This chapter provides an overview of the features of your Adaptec RAID controller.

Standard RAID Controller Features

- Support for SAS disk drives, SATA/SATA II disk drives, and SATA and SAS Solid State Drives (SSDs)
- Flash ROM for updates to controller firmware, BIOS, and the Adaptec RAID Configuration utility
- Disk drive hot-swapping
- Event logging and broadcasting, including email notification messages
- Multiple options for creating and managing RAID arrays—a browser-based software application (maxView Storage Manager), a BIOS-based utility (ARC), a command line utility (ARCCONF) (see Managing Your Storage Space on page 57)
- Native command queuing (NCC), which lets disk drives arrange commands into the most efficient order for optimum performance
- Support for disk drive enclosures with SES2 enclosure management hardware
- Support for a flash backup module (see Adding a Flash Backup Module on page 18)
- Support for Adaptec maxCache™ SSD read and write caching (see Modifying Cache Settings on page 76)

**Note:** Adaptec maxCache is supported on Adaptec Series Q controllers only.

- Power-management of disk drives in your storage space to reduce cooling and electricity costs (see Modifying Power Management Settings on page 76)
- Audible alarm
- I/O statistics logging

Array-level Features

**Note:** Not all features are supported by all controllers. For more information, see the maxView Storage Manager User’s Guide.

- Support for RAID 0, RAID 1, RAID 5, RAID 10, RAID 50, and simple volumes
- Support for hybrid RAID 1 and RAID 10 arrays comprised of hard drives and Solid State Drives (SSDs)
- Support for hot spares (global and dedicated)
- Support for automatic failover, so arrays are automatically rebuilt when a failed drive is replaced (applies to redundant arrays in SES2- or SAF-TE-enabled disk drive enclosures only)
- Optimized disk utilization, which ensures that the full capacity of all disk drives can be used, even if the disk drives vary in size
- Online capacity expansion, so you can increase the capacity of an array without recreating it
- Support for array migration from one RAID level to another

Advanced Data Protection Suite

- Copyback Hot Spare—You can use this feature to move data from a hot spare back to its original location after a failed disk drive is replaced.
- Striped Mirror (RAID 1E)—A RAID 1 Enhanced array is similar to a RAID 1 array except that data is both mirrored and striped, and more disk drives can be included.
- Dual Drive Failure Protection (RAID 6)—A RAID 6 array is similar to a RAID 5 array except that it includes two independent sets of parity data instead of one.
- Dual Drive Failure Protection (RAID 60)—A RAID 60 array is similar to a RAID 50 array except that it includes four independent sets of parity data instead of two.
Adding a Flash Backup Module

This table shows the flash backup module (or “zero maintenance cache protection”) supported by your Adaptec RAID controller. To purchase a flash backup module, refer to the Adaptec Web site at www.adaptec.com.

<table>
<thead>
<tr>
<th>RAID Controller</th>
<th>Flash Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptec RAID 7805/Adaptec RAID 71605/Adaptec RAID 71685/Adaptec RAID 72405/Adaptec RAID 78165</td>
<td>Adaptec Flash Backup Module AFM-700 with Supercapacitor Card (optional)</td>
</tr>
<tr>
<td>Adaptec RAID 7805Q/Adaptec RAID 71605Q</td>
<td>Adaptec Flash Backup Module AFM-700 with Supercapacitor Card (pre-installed)</td>
</tr>
</tbody>
</table>

Upgrading the Controller Firmware

To upgrade the firmware on your Adaptec RAID controller, follow the instructions in Using the Adaptec Flash Utility on page 83. You can also upgrade the controller firmware with maxView Storage Manager or the ARCCONF command-line utility. Refer to the maxView Storage Manager User’s Guide and the Adaptec Command Line Interface User’s Guide for more information. If the firmware upgrade is unsuccessful, follow the instructions in Resetting the Controller on page 61.
About the Adaptec RAID 7805/7805Q

The Adaptec RAID 7805/7805Q is a SAS RAID controller with these features:

- 2 internal mini-SAS HD connectors
- Ext. Alarm connector
- HDA mode connector
- Daughterboard connector
- PCIe x8 connector
- Mounting bracket

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form Factor</td>
<td>Low-profile MD2</td>
</tr>
<tr>
<td>Bus compatibility</td>
<td>PCIe Gen3</td>
</tr>
<tr>
<td>PCIe bus width</td>
<td>x8</td>
</tr>
<tr>
<td>Data transfer rate</td>
<td>6 Gb/s per port</td>
</tr>
<tr>
<td>Phys (Unified Serial Ports)</td>
<td>8</td>
</tr>
<tr>
<td>Standard cache</td>
<td>1024 MB DDR3</td>
</tr>
<tr>
<td>Connectors, internal</td>
<td>2 mini-SAS HD x4 (SFF-8643)</td>
</tr>
<tr>
<td>Maximum number of disk drives</td>
<td>8 direct-attached (or up to 256 with expanders)</td>
</tr>
<tr>
<td>maxCache SSD support</td>
<td>7805Q: Up to 8 solid state drives, 2TB capacity, max. See the maxCache compatibility list at <a href="http://www.adaptec.com/compatibility">www.adaptec.com/compatibility</a>.</td>
</tr>
<tr>
<td>Enclosure Support</td>
<td>IBPI and SGPIO (Serial General Purpose Input/Output)</td>
</tr>
<tr>
<td>Onboard speaker</td>
<td>Yes</td>
</tr>
<tr>
<td>Zero Maintenance Cache Protection Module</td>
<td>Adaptec Flash Backup Module AFM-700 (7805: optional, sold separately; 7805Q: standard, pre-installed)</td>
</tr>
</tbody>
</table>
About the Adaptec RAID 71605/71605Q

The Adaptec RAID 71605/71605Q is a SAS RAID controller with these features:

- **Form Factor**: Low-profile MD2
- **Bus compatibility**: PCIe Gen3
- **PCIe bus width**: x8
- **Data transfer rate**: 6 Gb/s per port
- **Phys (Unified Serial Ports)**: 16
- **Standard cache**: 1024 MB DDR3
- **Connectors, internal**: 4 mini-SAS HD x4 (SFF-8643)
- **Maximum number of disk drives**: 16 direct-attached (or up to 256 with expanders)
- **maxCache SSD support**: 71605Q: Up to 8 solid state drives, 2TB capacity, max. See the maxCache compatibility list at [www.adaptec.com/compatibility](http://www.adaptec.com/compatibility).
- **Enclosure Support**: IBPI and SGPIO (Serial General Purpose Input/Output)
- **Onboard speaker**: Yes
- **Zero Maintenance Cache Protection Module**: Adaptec Flash Backup Module AFM-700 (71605: optional, sold separately; 71605Q: standard, pre-installed)
About the Adaptec RAID 71605E

The Adaptec RAID 71605E is a SAS RAID controller with these features:

- 4 internal mini-SAS HD connectors
- Ext. Alarm connector
- HDA mode connector
- CN0, CN1, CN2, CN3
- PCIe x8 connector
- Mounting bracket

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
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<tbody>
<tr>
<td>Form Factor</td>
<td>Low-profile MD2</td>
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<td>Bus compatibility</td>
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<td>Data transfer rate</td>
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<td>Phys (Unified Serial Ports)</td>
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<tr>
<td>Standard cache</td>
<td>256 MB DDR3</td>
</tr>
<tr>
<td>Connectors, internal</td>
<td>4 mini-SAS HD x4 (SFF-8643)</td>
</tr>
<tr>
<td>Maximum number of disk drives</td>
<td>16 direct-attached (or up to 256 with expanders)</td>
</tr>
<tr>
<td>Enclosure Support</td>
<td>IBPI and SGPIO (Serial General Purpose Input/Output)</td>
</tr>
<tr>
<td>Onboard speaker</td>
<td>Yes</td>
</tr>
<tr>
<td>Zero Maintenance Cache Protection Module</td>
<td>No</td>
</tr>
</tbody>
</table>
About the Adaptec RAID 71685

The Adaptec RAID 71685 is a SAS RAID controller with these features:

- Full Height, Half Length Form Factor
- PCIe Gen3 Bus compatibility
- x8 PCIe bus width
- 6 Gb/s per port Data transfer rate
- 24 Phys (Unified Serial Ports)
- 1024 MB DDR3 Standard cache
- 4 mini-SAS HD x4 (SFF-8643) Connectors, internal
- 2 mini-SAS HD x4 (SFF-8644) Connectors, external
- 24 direct-attached (or up to 256 with expanders) Maximum number of disk drives
- IBPI and SGPIO (Serial General Purpose Input/Output) Enclosure Support
- Yes Onboard speaker
- Adaptec Flash Backup Module AFM-700 (optional, sold separately) Zero Maintenance Cache Protection Module
About the Adaptec RAID 72405

The Adaptec RAID 72405 is a SAS RAID controller with these features:

- 4 internal mini-SAS HD connectors
- 2 internal mini-SAS HD connectors
- HDA mode connector
- Ext. Alarm connector
- Daughterboard connector
- PCIe x8 connector
- Mounting bracket

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form Factor</td>
<td>Full Height, Half Length</td>
</tr>
<tr>
<td>Bus compatibility</td>
<td>PCIe Gen3</td>
</tr>
<tr>
<td>PCIe bus width</td>
<td>x8</td>
</tr>
<tr>
<td>Data transfer rate</td>
<td>6 Gb/s per port</td>
</tr>
<tr>
<td>Phys (Unified Serial Ports)</td>
<td>24</td>
</tr>
<tr>
<td>Standard cache</td>
<td>1024 MB DDR3</td>
</tr>
<tr>
<td>Connectors, internal</td>
<td>6 mini-SAS HD x4 (SFF-8643)</td>
</tr>
<tr>
<td>Maximum number of disk drives</td>
<td>24 direct-attached (or up to 256 with expanders)</td>
</tr>
<tr>
<td>Enclosure Support</td>
<td>IBPI and SGPIO (Serial General Purpose Input/Output)</td>
</tr>
<tr>
<td>Onboard speaker</td>
<td>Yes</td>
</tr>
<tr>
<td>Zero Maintenance Cache Protection Module</td>
<td>Adaptec Flash Backup Module AFM-700 (optional, sold separately)</td>
</tr>
</tbody>
</table>
About the Adaptec RAID 78165

The Adaptec RAID 78165 is a SAS RAID controller with these features:

- 2 internal mini-SAS HD connectors
- 2 external mini-SAS HD connectors
- PCIe x8 connector
- Mounting bracket
- HDA mode connector
- Ext. Alarm connector
- Daughterboard connector
- PCIe x8 connector

**Note:** To provide optimal cooling for the Adaptec 78165 controller, it is recommended to provide air intake through the ventilated full-height bracket. For more information about cooling requirements, see *Environmental Specifications* on page 90.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form Factor</td>
<td>Low-profile MD2</td>
</tr>
<tr>
<td>Bus compatibility</td>
<td>PCIe Gen3</td>
</tr>
<tr>
<td>PCIe bus width</td>
<td>x8</td>
</tr>
<tr>
<td>Data transfer rate</td>
<td>6 Gb/s per port</td>
</tr>
<tr>
<td>Phys (Unified Serial Ports)</td>
<td>24</td>
</tr>
<tr>
<td>Standard cache</td>
<td>1024 MB DDR3</td>
</tr>
<tr>
<td>Connectors, internal</td>
<td>2 mini-SAS HD x4 (SFF-8643)</td>
</tr>
<tr>
<td>Connectors, external</td>
<td>4 mini-SAS HD x4 (SFF-8644)</td>
</tr>
<tr>
<td>Maximum number of disk drives</td>
<td>24 direct-attached (or up to 256 with expanders)</td>
</tr>
<tr>
<td>Enclosure Support</td>
<td>IBPI and SGPIO (Serial General Purpose Input/Output)</td>
</tr>
<tr>
<td>Onboard speaker</td>
<td>Yes</td>
</tr>
<tr>
<td>Zero Maintenance Cache Protection Module</td>
<td>Adaptec Flash Backup Module AFM-700 (optional, sold separately)</td>
</tr>
</tbody>
</table>
4 Getting Started

This chapter provides the basic information you need to set up your disk drives and arrays the way you want them. It describes the options you have for installing your Adaptec RAID controller and disk drives and creating arrays for storage. It also describes how to prepare your controller for installation into a low-profile computer cabinet.

Choosing a RAID Level

This section provides a brief overview of the RAID levels supported by your Adaptec RAID controller, including the minimum and maximum number of disk drives required by each.

- **RAID 0 (Non-redundant Array)**—Stripes data across multiple disk drives. Improved performance but no redundancy (see Non-redundant Arrays (RAID 0) on page 67).
- **RAID 1 Array**—Created from two disk drives where one disk drive is a mirror of the other (the same data is stored on each disk drive). Redundancy, but reduced capacity (see RAID 1 Arrays on page 68).
- **RAID 1E Array**—Similar to a RAID 1 array except that data is mirrored and striped, and more disk drives can be included (see RAID 1 Enhanced Arrays on page 68).
- **RAID 5 Array**—Stripes data for improved performance and uses parity data to provide redundancy (see RAID 5 Arrays on page 70).
- **RAID 10 Array**—Built from two or more equal-sized RAID 1 arrays, stripes and mirrors data across multiple disk drives. Redundancy and improved performance (see RAID 10 Arrays on page 69).
- **RAID 50 Array**—Built from multiple disk drives configured as two or more RAID 5 arrays, stripes stored data and parity data across all disk drives (see RAID 50 Arrays on page 71).
- **RAID 6 Array**—Similar to a RAID 5 array except that it includes two independent sets of parity data instead of one (see RAID 6 Arrays on page 72).
- **RAID 60 Array**—Similar to a RAID 50 array except that it includes four independent sets of parity data instead of two (see RAID 60 Arrays on page 72).

See Comparing RAID Levels on page 73 to see how many disk drives you must connect to your RAID controller to support the RAID level you want.

Selecting Disk Drives and Cables

**Disk Drives**

Your SAS controller supports SAS disk drives, SATA disk drives, and SATA and SAS Solid State Drives (SSDs). When selecting disk drives for your RAID array, ensure that all the disk drives have the same performance level. You can use different-sized disk drives in the array, but the array will be limited to the capacity of the smallest and slowest disk drive. For more information about arrays, refer to the maxView Storage Manager User's Guide or online Help. For more information about compatible disk drives, refer to the Adaptec Web site at www.adaptec.com/compatibility.

**Cables**

Depending on your requirements, you can use any of the cables listed below. Cable connectors are keyed so that you can't insert them incorrectly. For more information about cabling options for your RAID controller, visit the Adaptec Web site at www.adaptec.com.

**Note:** We recommend using only Adaptec SAS cables.
Adaptec SAS Adapter 7xxx5 Cables

Internal mini-SAS HD to mini-SAS HD (SFF-8643 to SFF-8643)—Connects to a backplane or enclosure.

External mini-SAS HD to mini-SAS HD (SFF-8644 to SFF-8644)—Connects to a backplane or enclosure.

Replacing the Full-Height Bracket with a Low-Profile Bracket

If you are installing your Adaptec RAID controller into a low-profile computer cabinet, replace the original full-height bracket with the low-profile bracket included in your distribution kit. The full-height bracket is mounted on the front of the controller, the low-profile bracket is mounted on the back of the controller, as shown in the figure below.

![Diagram showing full-height bracket and low-profile bracket](image)

To replace the full-height bracket with the low-profile bracket:

1. Remove the full-height bracket from the controller board. The full-height bracket is installed on the front side of the controller, with the mounting screws inserted from the back of the controller, as shown in the Figure 1.
   Using a Phillips head screw driver, remove the mounting screws, as shown in Figure 2, then set the screws aside for use in the next step.
2. Attach the low-profile bracket to the controller board. The low-profile bracket is installed on the **back** side of the controller, with the mounting screws inserted from the front of the controller, as shown in Figure 3.

Insert the screws through the holes on the front of the controller, then fasten the screws to the bracket with a Phillips screwdriver.

**Caution:** The mount points on the low-profile bracket have a smooth or flat side and a raised side that looks like a spacer (see Figure 3). Be sure to install the bracket with the flat side against the controller PCB and the raised side facing away from the PCB.

**Caution:** The torque on the mounting screws should be a maximum of 3.0-4.0 lbf-in to avoid deformation. Be sure that the controller is not bent after attaching the low-profile bracket to the controller board.

### Installation Options

When you install your Adaptec RAID controller, you can choose to create a bootable array and then install your operating system and the controller driver on that array.

Alternatively, you can complete a standard installation, where the controller driver is installed on an existing operating system.

### Basic Installation Steps

This section describes the installation process. Follow the steps for the installation option you’ve chosen.
Installing with an Operating System

1. Install and connect your controller and internal disk drives (see Installing the Controller and Disk Drives on page 29).
   If your controller has an external connector, you can connect external disk drives as well (or instead).

2. Set the boot controller (see Setting the Boot Controller on page 36).

3. Create a bootable array (see Creating an Array on page 36).

4. Install your operating system and the controller driver (see Installing the Driver and an Operating System on page 40.)

5. Install maxView Storage Manager and begin to manage your data storage (see Managing Your Storage Space on page 57).

Installing on an Existing Operating System

1. Install and connect your controller and internal disk drives (see Installing the Controller and Disk Drives on page 29).
   If your controller has an external connector, you can connect external disk drives as well (or instead).

2. Install the controller driver (see Installing the Driver on an Existing Operating System on page 52).

3. Install maxView Storage Manager and begin to manage your data storage (see Managing Your Storage Space on page 57).
5 Installing the Controller and Disk Drives

This chapter explains how to install your Adaptec RAID controller, and how to install and connect internal and external disk drives.

Before You Begin

• Read Safety Information on page 89.
• Familiarize yourself with your RAID controller’s physical features and the RAID levels that it supports (see Standard RAID Controller Features on page 17).
• Ensure you have the right quantity of disk drives for the RAID level you want to use for your arrays (see Selecting Disk Drives and Cables on page 25).
• If you are installing the RAID controller into a low-profile computer cabinet, replace the original full-height bracket with the low-profile bracket included in the kit (see Replacing the Full-Height Bracket with a Low-Profile Bracket on page 26).

Installing the Controller

This section describes how to install the Adaptec RAID controller into your computer cabinet. Adaptec RAID controllers come in two basic configurations: standard and zero maintenance cache protection with batteryless backup (ZMCP). ZMCP uses flash memory and a supercapacitor module to protect the cache without a battery.

Follow one of these sets of instructions:
• To install an Adaptec RAID controller without zero maintenance cache protection, see the next section.
• To install an Adaptec RAID controller with zero maintenance cache protection, see Installing a RAID Controller with Zero Maintenance Cache Protection on page 30.

Caution: Be sure to handle the controller by its bracket or edges only.

Installing a RAID Controller without Zero Maintenance Cache Protection

To install an Adaptec RAID controller without zero maintenance cache protection:

1. Turn off your computer and disconnect the power cord. Open the cabinet, following the manufacturer’s instructions.

2. Select an available PCIe expansion slot that’s compatible with your RAID controller and remove the slot cover, as shown below. (PCIe bus compatibility is marked to the controller figures in About Your RAID Controller on page 17.)
3. Insert the RAID controller into the expansion slot and press down gently but firmly until it clicks into place. When installed properly, the RAID controller should appear level with the expansion slot.  
   **Caution:** Touch a grounded metal object before handling the RAID controller.

4. Secure the bracket in the expansion slot, using the retention device (for instance, a screw or lever) supplied with your computer.

5. Prepare and install your internal disk drives, following the instructions in *Connecting Disk Drives to Your Controllers* on page 33.

   If you are not installing internal disk drives, close your computer cabinet, reattach the power cord, then continue with *Connecting External Devices* on page 34.

### Installing a RAID Controller with Zero Maintenance Cache Protection

Adaptec RAID controllers with zero maintenance cache protection (Adaptec Series Q controllers) include a flash module daughterboard and a supercapacitor module. The daughterboard is pre-installed on these controller. On Adaptec RAID controllers with *optional* zero maintenance cache protection (see *Adding a Flash Backup Module* on page 18), the daughterboard is user installed. The supercapacitor module is always user installed.

The following instructions describe how to install the supercapacitor module on a Series Q controller using the *mounting plate* method. It assumes that the daughterboard is already installed. Refer to the flyer, in the flash module distribution kit, for details about installing the daughterboard on the controller, as needed; the flyer also describes other supercapacitor installation options.

**Warning:** Do NOT remove or insert a fully charged supercapacitor module. Always discharge the unit first to avoid damage to the controller or flash backup module. The factory ships with discharged units, so they are safe to install when you receive them. To ensure that an installed unit is discharged, switch your system OFF, then wait 5 minutes. After a dirty shutdown, wait 3 minutes after backup is complete, then remove the unit.

To install an Adaptec RAID controller with zero maintenance cache protection:

1. Assemble the mounting plate and attach the supercapacitor module:
   a) Attach the full-height bracket and mounting clip to the mounting plate. The full-height bracket is installed on the front side of the mounting plate (the side with the bents), with the mounting screws inserted from the back, as shown in the figure below. (Be sure to attach the mounting plate to the bracket with recessed side at the bottom!) Attach the mounting clip to the front of the mounting plate with four (4) Phillips screws. The large friction clip should face the front of the mounting plate.
b) Insert the supercapacitor module into the mounting clip. The supercapacitor module snaps securely into place between the large and small friction clips, as shown in the figure below. Be sure to orient the supercapacitor module such that the connecting cable faces the rear of the mounting plate.

c) Set the mounting plate aside; continue with the steps below.

2. Turn off your computer and disconnect the power cord. Open the cabinet, following the manufacturer’s instructions.

3. Select an available PCIe expansion slot that’s compatible with your RAID controller and remove the slot cover, as shown in the figure below. (PCIe bus compatibility is marked on the controller figures in About Your RAID Controller on page 17.) Be sure to choose a slot in the backplane with an empty slot next to it; you will use the empty slot to install the supercapacitor mounting plate, after you install the controller. Remove the slot cover for the mounting plate, then continue with the next step.
4. Insert the RAID controller into the expansion slot and press down gently but firmly until it clicks into place. When installed properly, the RAID controller should appear level with the expansion slot. Secure the bracket in the expansion slot, using the retention device (for instance, a screw or lever) supplied with your computer.

   **Caution:** Touch a grounded metal object before handling the RAID controller.

5. Attach the supercapacitor module to the RAID controller by inserting the connector into the socket on the flash module daughterboard, as shown in the figure below. (The connector attaches to the socket in only one direction.) Use the included extender cable if you need extra length to reach the connector on the daughterboard.

6. Install the mounting plate in the empty slot next to the controller, as shown in the next figure. After securing the mounting plate to the card cage, verify that the supercapacitor module and mounting plate sit above (and do not touch) the PCIe slot.

7. Prepare and install your internal disk drives, following the instructions in *Connecting Disk Drives to Your Controllers* on page 33.

   If you are not installing internal disk drives, close your computer cabinet, reattach the power cord, then continue with *Connecting External Devices* on page 34.

8. Restart your computer.

   The supercapacitor starts charging automatically. It should reach full charge in 5-6 minutes.
Connecting Disk Drives to Your Controllers

You can connect SAS disk drives, SATA disk drives, and SATA and SAS Solid State Drives (SSDs) to your Adaptec RAID controller. (See www.adaptec.com/compatibility for a list of compatible drives.) There are no jumpers or switches to set before installation.

If you plan to build a bootable array, ensure that you install at least the minimum number disk drives required to support the RAID level you want. See Choosing a RAID Level on page 25 for more information.

**Note:** Although you can connect both SAS and SATA disk drives to your SAS controller, we recommend that you do not combine SAS and SATA disk drives within the same array. See What is SAS? on page 62 for more information.

You have two connection options:

- To connect directly to the controller, see the following section.
- To connect to a backplane, see Connecting Drives to a System Backplane on page 33.

To connect Solid State Drives to your controller, see Connecting Solid State Drives (SSDs) on page 33.

Connecting Drives Directly to the Controller

In a direct-attach connection, SAS or SATA disk drives are connected directly to a SAS card with SAS cables. The number of direct-attached disk drives is limited to four per internal SAS connector. (For more information about direct-attach connections, see How are Disk Drives Identified in SAS? on page 64.)

1. Install your internal SAS or SATA disk drives, following the instructions in your system's documentation.
2. Use internal mini-SAS HD cables to attach the disk drives to the controller, as required.
3. When all internal disk drives have been installed and attached to the controller, close your computer cabinet, reattach the power cord, then continue with Connecting External Devices on page 34.

Connecting Drives to a System Backplane

In a backplane connection, disk drives and SAS cards are attached to and communicate with each other through a system backplane.

The number of disk drives is limited to the number of slots available on the backplane. Some backplanes have embedded SAS expanders and can support up to 128 end devices. (For more information about backplane and expander connections, see How are Disk Drives Identified in SAS? on page 64.)

1. Connect one or more internal SAS or SATA disk drives to the backplane. (Refer to your system's documentation for more information.)
2. Use an internal mini-SAS HD cable to connect the controller to the backplane, as required.
3. When all internal disk drives have been installed and connected, close your computer cabinet, reattach the power cord, then continue with Connecting External Devices on page 34.

Connecting Solid State Drives (SSDs)

To connect a Solid State Drive to your controller, you can use a direct-attached connection or a backplane connection, as required. If your server does not have a standard 2.5-inch drive tray, you must use a bracket/SLED which enables the SSD to fit properly.

**Note:** For Adaptec maxCache applications or hybrid RAID arrays (comprised of hard drives and SSDs) you can use any Solid State Drive on the compatibility list. See www.adaptec.com/compatibility for a list of compatible SSDs. Adaptec maxCache is supported on Adaptec Series Q controllers only.

In a direct-attach connection (described in the steps below), you connect SSDs directly to the controller with SAS cables (mini-SAS to SATA). In a backplane connection, use the appropriate cable for your backplane type (see Connecting Drives to a System Backplane on page 33 for more about backplane connections). For maxCache caching applications, you can connect a maximum of 8 maxCache-compatible SSDs to a controller. For RAID arrays, Adaptec controllers support a maximum of 256 drives, including SSDs (for details, see About Your RAID Controller on page 17).
1. Install the SSDs in your server. For servers with a standard 2.5-inch drive tray, install the SSD directly into the tray. If your server does not have a standard 2.5-inch drive tray, use a bracket or adapter which enables it to fit properly.

2. Use an internal mini-SAS HD to SATA cable, as required, to attach the SSD(s) to the controller, as shown in the example below.

3. When all SSDs have been installed and connected, close your computer cabinet, reattach the power cord, then continue with Connecting External Devices on page 34.

**Connecting External Devices**

**Note:** If you are not connecting any external devices, see the following section, Next Steps on page 35.
Use high-quality cables to connect your controller to your external device(s), such as disk drives or disk drive enclosures. We recommend using only Adaptec cables. For more information about cabling options for your controller, see Cables on page 25.

**Next Steps**

If you are installing the controller driver and an operating system onto a bootable array, continue with Creating a Bootable Array on page 36.

If you are completing a standard installation onto an existing operating system, continue with Installing the Driver on an Existing Operating System on page 52.
6 Creating a Bootable Array

This chapter explains how to set your Adaptec controller to be the boot controller, and how to create a bootable array.

**Note:** If you are completing a standard installation onto an existing operating system, you don’t have to complete this task. Skip to *Installing the Driver on an Existing Operating System* on page 52.

**Setting the Boot Controller**

**Note:** If your system won’t contain more than one bootable controller, skip to the next section, *Creating an Array* on page 36.

Your Adaptec RAID controller supports bootable disk drives and bootable arrays. To enable your system to boot from either a disk drive or an array connected to your controller:

1. Enter the system setup.
2. Navigate to the drive boot sequence.
3. Move the boot controller to the top of the list.

For more information, refer to your computer documentation.

**Creating an Array**

This section explains how to create an array.

A RAID 5 array is created in the examples shown in this section because RAID 5 provides the most security and best performance with a minimum of three disk drives. However, you can choose to create an array with a different RAID level; you can also change array level later, after the operating system is installed.

You can create an array using any of these tools:

- Adaptec RAID Configuration Utility (ARC)—BIOS-based menus and keyboard navigation (see the following section).
- maxView Storage Manager—Graphical software application (running from a bootable installation DVD) that you can navigate with your mouse (see *About maxView Storage Manager* on page 57).
- ARCCONF—Command line utility. For instructions, refer to the *Adaptec RAID Controller Command Line Utility User’s Guide*.

You can use any of these tools, but the ARC utility is the quickest and easiest tool for this task.

**Note:** We recommend that you do not combine SAS and SATA disk drives within the same array. maxView Storage Manager displays a warning if you try to create a logical drive using a combination of SAS and SATA disk drives. See *What is SAS?* on page 62 for more information.

**Creating an Array with the ARC Utility**

The ARC utility is menu-based. Instructions for completing tasks appear on-screen. Menus can be navigated using the arrows, Enter, Esc, and other keys on your keyboard.

To create a RAID 5 array:

1. Power on your computer. When prompted, press Ctrl+A to enter the ARC utility.

   **Note:** On servers that support the Unified Extensible Firmware Interface, or uEFI, ARC utility options are presented with a uEFI/HII interface rather than the Adaptec Ctrl-A interface described below. To begin using the ARC utility with the uEFI/HII interface, see *Ctrl-A or uEFI/HII?* on page 74.

2. If you have more than one controller of the same model or family in your computer, select your controller, then press Enter.
3. Select **Logical Device Configuration**, then press **Enter**.

4. Select **Initialize Drives**, then press **Enter**.

5. Select at least three disk drives for the array, press **Insert** for each selected disk drive, then press **Enter**.
   
   **Caution:** During initialization, all data is deleted from the disk. Before continuing, back up any data you want to keep.

6. Press **Y**, then press **Enter**.
   The selected disk drives are initialized, then the Logical Device Configuration screen appears.

7. Select **Create Array**, then press **Enter**.

8. Select the disk drives that were just initialized, press **Insert** for each selected disk drive, then press **Enter**.

9. When the Array Properties screen opens, follow the instructions in the following table.

<table>
<thead>
<tr>
<th>Property Line</th>
<th>Entry or Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Array Type</td>
<td>Select <strong>RAID 5</strong>, then press <strong>Enter</strong>.</td>
</tr>
<tr>
<td>Array Label</td>
<td>Type a name, then press <strong>Enter</strong>.</td>
</tr>
<tr>
<td>Array Size</td>
<td>Press <strong>Enter</strong>, then press <strong>Enter</strong> again to use the default granularity of GB.</td>
</tr>
<tr>
<td>Stripe Size</td>
<td>Press <strong>Enter</strong> to use the default (256 KB).</td>
</tr>
<tr>
<td>Read Caching</td>
<td>Press <strong>Enter</strong> to use the default (Enable).</td>
</tr>
<tr>
<td>Write Caching</td>
<td>Press <strong>Enter</strong> to use the default (Enable always), then press <strong>Y</strong> to confirm.</td>
</tr>
<tr>
<td>Create RAID via</td>
<td>Press <strong>Enter</strong> to use the default (Build/Verify).</td>
</tr>
<tr>
<td>MaxCache Read</td>
<td>Press <strong>Enter</strong> to use the default (Enable)</td>
</tr>
<tr>
<td>MaxCache Write</td>
<td>Press <strong>Enter</strong> to use the default (Disable)</td>
</tr>
<tr>
<td>[Done]</td>
<td>Press <strong>Enter</strong>.</td>
</tr>
</tbody>
</table>

10. When a cache warning message displays, type **Y**.

11. Once the array is created, a message displays telling you that the array can now be used. Press any key to return to the Logical Device Configuration menu.
   You can start using the array immediately. However, performance is reduced until the build process is complete.

12. Press **Esc** until the Exit utility window appears.

13. Select **Yes**, then press **Enter**.
   The computer restarts.


**Creating an Array with maxView Storage Manager**

This section describes how to use the maxView Storage Manager configuration wizard to build an array.

**Note:** You will need the Adaptec Installation DVD to complete this task.

To create a RAID 5 array:

1. Insert the Adaptec Installation DVD into your DVD drive, then restart your computer.

2. When prompted, select the language you want, then press **Enter**.
3. Review the license information, then press Enter.
   The DVD main menu opens.

4. Click Launch Configuration Utility.
   maxView Storage Manager opens.

5. On the ribbon, in the Logical Disk group, click Create Logical Drive.

6. When the wizard opens, ensure that Express Configuration is selected, then click Next.

7. Review the logical drive configuration summary.
   maxView Storage Manager uses the term logical drive when referring to an array (see Terminology Used in this Guide on page 14).
   The following example shows a RAID 5 array, ready to be created.
8. Click Finish. maxView Storage Manager builds the logical drives.

9. Partition and format your logical drive. The logical drives you created appear as a physical disk drives on your operating system. You must partition and format these logical drives before you can use them to store data.

10. Close all windows, then click Reboot to restart your system.

11. Remove the Adaptec Installation DVD. For information on installing and using maxView Storage Manager as a full software application, refer to the maxView Storage Manager User’s Guide.

12. Continue with the following section.

**Making Your Array Bootable**

Use the ARC Utility to make the array bootable (see *Creating Bootable Arrays* on page 75). Then continue with *Installing the Driver and an Operating System* on page 40.
Installing the Driver and an Operating System

This chapter explains how to install your Adaptec RAID controller driver and an operating system on a bootable array (see Creating a Bootable Array on page 36).

To install the driver on an existing operating system, see Installing the Driver on an Existing Operating System on page 52.

Before You Begin

- Install and connect your Adaptec RAID controller and internal disk drives (see Installing the Controller and Disk Drives on page 29).
- Create a bootable array (see Creating a Bootable Array on page 36).
- Create a driver disk (see the following section).

Note: For up-to-date operating system version support, visit the Adaptec Web Site at www.adaptec.com. From the main menu select Support>Knowledgebase>Find Answers. Select your controller type and OS to generate a list of supported operating systems and to download the latest drivers.

Creating a Driver Disk

This section describes how to create a driver disk for the operating systems that require one. You will need a USB flash drive or writable CD to complete this task.

- Windows operating systems do not require a driver disk. For Windows, the driver is loaded directly from the Adaptec Installation DVD; see Installing with Windows on page 42.
- For Debian Linux, Ubuntu Linux, and VMware ESX 4.1, you must create the driver disk manually on a USB flash drive (“USB stick”) or writable CD. See the instructions for your operating system, below.
- For Red Hat 6 and Cent OS 6 DKMS driver installation, see Red Hat Linux 6, Cent OS 6 with Dynamic Kernel Module Support on page 42.
- For VMware ESXi 5.x, see Installing with VMware ESXi 5.x on page 48.
- For Citrix XenServer, see Installing with Citrix XenServer on page 51.
- For all other OSs, create the driver disk using the Create Diskette menu on the Adaptec Installation DVD.

To create a driver disk using the Create Diskette menu:

1. Set your system BIOS so that your computer boots from the DVD drive.
2. Turn on your computer, then insert the Adaptec Installation DVD.
3. Click Create Diskette, then select your operating system and version.
4. When prompted, insert a USB flash drive, then click OK.
   The system creates the driver disk on the USB drive.
5. Remove and label the driver disk.
6. Continue with the instructions for your operating system:
   - For Red Hat Linux 5 or Cent OS 5, see Installing with Red Hat Linux 5 or Cent OS 5 on page 42.
   - For Red Hat Linux 6, Cent OS 6, or Fedora Linux, see Red Hat Linux 6, Cent OS 6, Fedora Linux without Dynamic Kernel Module Support on page 43.
   - For SuSE Linux, see Installing with SuSE Linux Enterprise Server on page 44.
   - For Solaris, see Installing with Solaris on page 46.
   - For FreeBSD, see Installing with FreeBSD on page 47.
Creating a Driver Disk for Debian Linux or Ubuntu Linux

Note: You will need the Adaptec Installation DVD and a USB flash drive to complete this task.

To create a driver disk for Debian or Ubuntu Linux:

1. Insert and mount the Adaptec Installation DVD:

   ```
   mount /dev/cdrom /mnt/cdrom
   ```

2. Insert and mount a USB flash drive:

   ```
   mount /dev/sda1 /mnt/aacraid-driver
   ```

3. Change to the Linux driver directory on the Adaptec Installation DVD, locate the .tgz archive file for your Debian or Ubuntu operating system version (32-bit or 64-bit), then extract the contents of the archive to a temporary location.

4. Copy the contents of the archive to the USB drive by typing this command:

   ```
   cp /<tempdir>/* /mnt/aacraid-driver
   ```

   where `tempdir` is the temporary location of the driver files.

5. Unmount and remove the Adaptec Installation DVD and USB drive.

6. Continue with Installing with Debian Linux on page 44 or Installing with Ubuntu Linux on page 45.

Creating a Driver Disk for VMware ESX 4.1

Note: You will need the Adaptec Installation DVD and a writeable CD to complete this task.

To create a driver disk for VMware ESX 4.1:

1. Insert and mount the Adaptec Installation DVD:

   ```
   mount /dev/cdrom /mnt/cdrom
   ```

2. Insert and mount a writable CD:

   ```
   mount /dev/cdrom1 /mnt/cdrom1
   ```

3. Change to the Linux driver directory on the Adaptec Installation DVD, locate the VMware iso image, `vmware-aacraid-400.4.2.1.xxxxx-esx4.1.iso` (where `xxxxx` is the build number), then burn the iso to the CD.

   Note: Use whatever tool you prefer to burn the CD, such as an interactive (GUI-based) tool or the Linux command line.

4. Unmount and remove the Adaptec Installation DVD and CD drive.

5. Continue with Installing with VMware ESX 4.1 on page 47.
Installing with Windows

**Note:** The following instructions apply to all supported Windows operating systems. You will need your Windows Installation CD to complete this task.

To install the Adaptec RAID controller driver while installing Windows:

1. Insert your Windows CD, then restart the computer.
2. Follow the on-screen instructions to begin the Windows installation.
3. When prompted to specify a location for Windows, select **Load Driver**.
4. Insert the Adaptec Installation DVD, browse to the driver location, then click **OK**. The 64-Bit driver is located within the AMD64 folder.
5. When the Adaptec driver is found, press **Next**. You may see the message ‘No drives were found’. Repeat **Step 3**, **Step 4**, and **Step 5**. On the second attempt, the driver will load successfully.
6. Click **Next** again to accept the default partition configuration, or refer to your Windows documentation to configure partitions manually.
7. Follow the on-screen instructions to complete the installation.
8. Continue with **Managing Your Storage Space** on page 57.

Installing with Red Hat Linux 5 or Cent OS 5

**Note:** You will need the installation CD for your operating system to complete this task.

To install the Adaptec RAID controller driver while installing Red Hat Linux 5 or Cent OS 5:

1. Insert your installation CD.
2. Restart your computer.
3. When the first installation screen appears, insert the USB driver disk.
4. Type this command at the Boot: prompt and press Enter:

```
linux dd
```
5. Select **Yes** to indicate that you have a driver disk, then select the driver image from the USB drive (typically, `/dev/sda1`).
6. Complete the Linux installation, following the on-screen instructions.
7. Continue with **Managing Your Storage Space** on page 57.

Installing with Red Hat Linux 6, Cent OS 6, or Fedora Linux

Follow the instructions in this section to install the controller driver with Red Hat Linux 6, Cent OS 6, or Fedora Linux. We recommend that you install the driver with **Dynamic Kernel Module Support**, or DKMS. DKMS ensures that the driver remains installed across OS or online updates. The DKMS instructions are valid for Red Hat 6 and Cent OS 6 only.

**Red Hat Linux 6, Cent OS 6 with Dynamic Kernel Module Support**

**Note:** You will need your OS installation CD and a USB flash drive to complete this task. You must have root privileges to install the driver image.

To install the Adaptec RAID controller driver while installing Red Hat 6 or Cent OS 6:

1. Copy `aaccraid-1.2.1.29900-dd.img` and `aaccraid.conf` from the Linux driver directory on the Adaptec Installation DVD to a USB flash drive. Remove the USB drive when you are finished.
2. Insert the OS installation CD, then restart your computer.
3. When the graphical Welcome screen appears, press Tab, then insert the USB driver disk.
4. Make sure that "Install a new system or upgrade an existing system" is highlighted, then, at the end of the "vmlinuz initrd=initrd.img" line press Space, type the following command, and press Enter:

    linux dd

5. Select Yes to indicate that you have a driver disk, then select the driver image from the USB drive (typically, /dev/sda1).

6. Complete the Linux installation, following the on-screen instructions, then reboot.

7. Assuming the USB driver disk is /dev/sda1, type the following commands to ensure that the driver remains installed when you update the OS:

    mount /dev/sda1 /mnt
    cp /mnt/aacraid.conf /etc/depmod.d/aacraid.conf

8. Continue with Managing Your Storage Space on page 57.

Red Hat Linux 6, Cent OS 6, Fedora Linux without Dynamic Kernel Module Support

Note: You will need the Installation CD for your operating system to complete this task. You must have root privileges to install the driver image.

To install the Adaptec RAID controller driver while installing Red Hat 6, Cent OS 6, or Fedora Linux:

1. Insert your installation CD.

2. Restart your computer.

3. When the Welcome screen appears, press Enter at the boot prompt, type CTRL+ALT+F2 to switch to the shell, then continue the installation by selecting your language and keyboard.

4. Insert the USB driver disk.

5. Assuming the USB drive is assigned to /dev/sda1, type the following commands to load the controller driver:

    mkdir /mnt2 /AACRAID
    mount /dev/sda1 /mnt2
    cp -r /mnt2/* /AACRAID
    umount /mnt2
    cd /AACRAID
    sh ./fc-pre-install.sh

6. Press ALT+F6 to switch back to the installation screen, then click Next.

7. Follow the on-screen prompts to continue the installation. When prompted to reboot the system, press CTRL+ALT+F2 to switch to the console. Do not reboot before completing Step 8!

8. Type the following commands to complete the driver installation:

    mkdir /mnt/sysimage/tmp/AACRAID
    cp -r /AACRAID/* /mnt/sysimage/tmp/AACRAID
    chroot /mnt/sysimage/
    cd /tmp/AACRAID
    sh ./fc-post-install.sh
    exit

9. Press ALT+F6 to switch back to the installation screen, finish the installation, then reboot.

10. Continue with Managing Your Storage Space on page 57.
Installing with SuSE Linux Enterprise Server

To install the Adaptec RAID controller driver while installing SuSE Linux:

1. Insert the first SuSE Installation CD.
2. Restart your computer.
3. When the SuSE installation selection screen appears, choose the type of installation you want, press the F6 key, then select Yes to indicate that you have a driver disk. (If F6 is not shown on the screen, you may have an older version of SuSE; press the Alt key instead.)
4. Insert the USB driver disk.
5. Type this command on the 'Boot Options' line and press Enter:
   
   `linux dd`

6. When prompted to "Please choose the Driver Update medium," highlight the USB partition, then select OK.
   
   If the "choose Driver Update medium" screen is displayed again, assume that the driver was accepted and select Back.
7. Follow the prompts to continue the installation.
   
   Note: For SuSE Linux 11, switch to the console by typing CTRL+ALT+F2 when the installation is between 50%-90% complete, type this command:

   `cp -a /update/install /mnt/tmp`

   ...then press CTRL+ALT+F7 to return to the installation screen and complete the installation as usual.
8. Complete the installation, following the on-screen instructions.
9. Continue with Managing Your Storage Space on page 57.

Installing with Debian Linux

Note: You will need your Debian Installation CD to complete this task. You must have root privileges to install the driver image.

To install the Adaptec RAID controller driver while installing Debian Linux:

1. Insert the Debian Installation CD, then restart your computer.
2. When the Welcome screen appears, select Graphical Install. Continue the installation until you see the "Configure Network" screen, then type CTRL+ALT+F2 to switch to the console.
3. Insert the USB driver disk, then type the following command to scan for the device:

   `fdisk -l`

   Assuming the USB drive is assigned to /dev/sda1, type the following commands to begin loading the driver:

   `mkdir /AACRAID`
   `mount /dev/sda1 /mnt`
   `cp -R /mnt/* /AACRAID`
   `umount /mnt`
   
   Note: The following steps assume you are installing Debian 6 using kernel 2.6.32-5.

5. Copy the driver file to the /lib/modules directory:

   Debian 32-bit:
cp -f /AACRAID/aacraid.ko-PRE_MOD  
/lib/modules/2.6.32-5-486/kernel/drivers/scsi/aacraid/aacraid.ko

Debian 64-bit:

cp -f /AACRAID/aacraid.ko  
/lib/modules/2.6.32-5-amd64/kernel/drivers/scsi/aacraid/aacraid.ko

6. Remove the USB drive.
7. Install the loadable module:
   Debian 32-bit:
   insmod /lib/modules/2.6.32-5-486/kernel/drivers/scsi/aacraid/aacraid.ko

   Debian 64-bit:
   insmod /lib/modules/2.6.32-5-amd64/kernel/drivers/scsi/aacraid/aacraid.ko

8. Press CTRL+ALT+F5 to switch back to the installation screen, then follow the on-screen prompts to continue the installation.
   Note: Do not press Continue at the end of the installation until you complete Step 9!

9. When prompted to reboot the system, press CTRL+ALT+F2 to switch to the console.
10. Type the following commands to complete the driver installation:
    Debian 32-bit:
    cp -f /AACRAID/aacraid.ko-POST_MOD  
    /target/lib/modules/2.6.32-5-486/kernel/drivers/scsi/aacraid/aacraid.ko
    chroot /target
    /sbin/depmod -a 2.6.32-5-486
    update-initramfs -u -v
    exit

    Debian 64-bit:
    cp -f /AACRAID/aacraid.ko  
    /target/lib/modules/2.6.32-5-amd64/kernel/drivers/scsi/aacraid/aacraid.ko
    chroot /target
    /sbin/depmod -a 2.6.32-5-amd64
    update-initramfs -u -v
    exit

11. Press CTRL+ALT+F5 to switch back to the installation screen, then reboot.
12. Continue with Managing Your Storage Space on page 57.

**Installing with Ubuntu Linux**

   **Note**: You will need your Ubuntu Installation CD to complete this task. You must have root privileges to install the driver image.

To install the Adaptec RAID controller driver while installing Ubuntu Linux:

1. Insert the Ubuntu Installation CD, then restart your computer.
2. When the installation menu appears, select **Install Ubuntu Server**. Continue the installation until the "Configure Network" screen appears, then type CTRL+ALT+F2 to switch to the console.
3. Insert the USB driver disk, then type the following command to scan for the device:

   `fdisk -l`
4. Assuming the USB drive is assigned to /dev/sda1, type the following commands to begin loading the driver:

```bash
mkdir /AACRAID
mount /dev/sda1 /mnt
cp -R /mnt/* /AACRAID
umount /mnt
```

**Note:** The following steps assume you are installing Ubuntu 10 or 11, using kernel 2.6.32-28. For Ubuntu 12 or higher, the driver files aacraid.ko-PRE_MOD and aacraid.ko-POST_MOD are both replaced by the single file aacraid.ko.

5. Copy the driver file to the /lib/modules directory:

```bash
cp -f /AACRAID/aacraid.ko-PRE_MOD /lib/modules/2.6.32-28-generic/kernel/drivers/scsi/aacraid/aacraid.ko
```

6. Remove the USB drive.

7. Install the loadable module:

```bash
insmod /lib/modules/2.6.32-28-generic/kernel/drivers/scsi/aacraid/aacraid.ko
```

8. Press CTRL+ALT+F1 to switch back to the installation screen, then follow the on-screen prompts to continue the installation.

   **Note:** Do not press Continue at the end of the installation until you complete Step 9!

9. When prompted to reboot the system, press CTRL+ALT+F2 to switch to the console.

10. Type the following commands to complete the driver installation:

    - Ubuntu 32-bit:
      ```bash
croot /target
/sbin/depmod --a 2.6.32–28-generic-pae
update-initramfs -u -v
exit
```

    - Ubuntu 64-bit:
      ```bash
croot /target /sbin/depmod --a 2.6.32–28-server
update-initramfs -u -v
exit
```

11. Press CTRL+ALT+F1 to switch back to the installation screen, then reboot.

12. Continue with *Managing Your Storage Space* on page 57.

### Installing with Solaris

**Note:** This task is not necessary if you are installing Solaris 10 Update 2 or later. Instead, you can choose to install Solaris using the in-box driver and update it either during or after the installation is complete, if required.

**Note:** If necessary, you can create a driver disk by burning a CD with the aac_solaris-x86.iso file, available on the Adaptec Installation DVD.

To install the Adaptec RAID controller driver while installing Solaris:

1. Start your computer.
2. Interrupt the autoboot, press the **ESC** key. The Device Configuration Assistant (DCA) Utility will open.
3. Select **Apply driver updates**.
4. Insert the driver disk or other update media, then press **Return**.
5. Complete the Solaris installation, following the instructions included with your operating system.

### Installing with FreeBSD

**Note:** You will need your FreeBSD Installation CD to complete this task.

To install the Adaptec RAID controller driver while installing FreeBSD:

1. Insert the FreeBSD Installation CD.
2. Insert the USB driver disk.
3. Restart your computer. (Be sure to boot from the installation CD!)
4. When the FreeBSD start screen opens, select 2 for ‘Escape to Loader Prompt’.
5. Type: `load kernel`
6. Type this command to locate the USB drive: `lsdev`
7. Assuming the USB drive is `disk2s1`, type this command:
   ```
   load disk2s1:aacu.ko
   ```
8. Type this command: `boot`
9. Complete the FreeBSD installation, as usual. When finished, remove the installation CD, but not the USB driver disk, then reboot.
   **Note:** Be sure the system is configured to boot from the controller's bootable array, not the USB drive!

10. To ensure that the driver is loaded automatically as a module at boot time, repeat Steps 4-7, then complete the steps below.
11. Type this command to boot to the kernel: `boot`
12. Login as root, then type:
   ```
   dmesg
   ```
13. Assuming the USB drive is `da1s1`, type this command to mount the drive:
   ```
   mount -t msdosfs /dev/da1s1 /mnt
   ```
14. Install the driver package:
   ```
   pkg_add /mnt/aac9x-amd64.tgz
   ```
   **Note:** The distribution also includes driver packages for FreeBSD 8.
15. Reboot the computer.

### Installing with VMware ESX 4.1

**Note:** You will need your VMware Installation CD to complete this task. You must have root privileges to create and install the driver image.

To install the Adaptec RAID controller driver while installing VMware ESX 4.1:

1. Insert the VMware Installation CD.
2. Restart your computer.
3. Follow the on-screen instructions to begin the VMware installation.
4. Select **Yes** to install a custom driver, then click **Add**.
5. Insert the CD containing the driver, then click OK.

6. Select the driver from the displayed list, click OK, then follow the on-screen instructions to load the driver.

7. Complete the VMware installation, following the on-screen instructions.

8. Reboot your computer, then remove the VMware Installation CD.

   **Note:** You may see a warning that the controller driver is not certified by VMware (no signature attached). You can ignore this message.

### Installing with VMware ESXi 5.x

**Note:** You will need a writable CD to complete this task. You must have administrator privileges to create the driver disk and install the driver image.

To install the Adaptec RAID controller driver with VMware ESXi 5.x, you must create a custom boot image using the VMware Image Builder tool. The VMware Image Builder is distributed as a snap-in component for vSphere PowerCLI, a command-line and scripting tool from VMware based on Microsoft PowerShell.

You can download PowerCLI from the VMware Download Center at [www.vmware.com/downloads](http://www.vmware.com/downloads). To perform the installation, you will also need to download the VMware ESXi5.x Standard Software Depot from the VMware Download Center.

   **Note:** In the following instructions, perform Steps 1-7 on the Windows machine used to build the custom boot image, and Steps 8-11 on the machine where you want to install the custom image. Be sure to install the prerequisite software first, including Powershell and Microsoft .NET 2.0, before you install PowerCLI or create the custom boot image.

To install the Adaptec RAID controller driver while installing VMware ESXi 5.x:

1. Download Microsoft PowerShell and Microsoft .NET 2.0 (if not installed on your machine already) and install on your Windows build machine. You can download PowerShell and Microsoft .NET from the Microsoft Download Center at [www.microsoft.com/download](http://www.microsoft.com/download).

   **Note:** PowerShell is preinstalled on many Windows systems, including Windows Server 2012, Windows 7, and Windows 8.

2. Download and install vSphere PowerCLI on your Windows build machine. You can download PowerCLI from the VMware Download Center at [www.vmware.com/downloads](http://www.vmware.com/downloads) (for example, VMware-PowerCLI-5.0.0-374833.exe).

3. Run PowerShell as Administrator, then set the execution policy to Remote Signed:

   ```powershell
   # Set-ExecutionPolicy RemoteSigned
   ```

4. Download the VMware ESXi5.x Standard Software Depot (for example, vmware-ESXi-5.0.0-469512-depot.zip or vmware-ESXi-5.1.0-799733-depot.zip) and store in a temporary location on your Windows build machine. You can download the software depot from the VMware Download Center at [www.vmware.com/downloads](http://www.vmware.com/downloads). When you start the download, be sure to choose "ESXi Offline Bundle".

   **Note:** You may need to provide account credentials to download the software depot from the VMware Web site.

5. Insert the Adaptec Installation DVD, navigate to the Linux driver folder, then copy the Adaptec AACRAID driver binary to a temporary location on the Windows build machine:

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESXi 5.0</td>
<td>aacraid-esxi5.0-1.2.1.xxxxx.zip</td>
</tr>
<tr>
<td>ESXi 5.1</td>
<td>aacraid-esxi5.1-1.2.1.xxxxx.zip</td>
</tr>
</tbody>
</table>

   where xxxxx is the build number.
After you copy the file, remove the Adaptec Installation DVD.

6. Launch vSphere PowerCLI, then follow the steps below to create the custom boot image:
   a) At the PowerCLI prompt, add the VMware Image Builder snap-in by running the following cmdlet:

   ```powershell
   # Add-PSSnapIn VMware.ImageBuilder
   
   Note: You will see a message if the Image Builder snap-in is already installed. You can ignore this message.
   
   Note: Continue using PowerCLI in Steps 6.b through 6.j.
   ```

   b) Add the VMware ESXi 5.x Software Depots:

   VMware ESXi 5.0:

   ```powershell
   # Add-EsxSoftwareDepot
   C:\ESXi5.0-PMC-CustomISO\vmware-ESXi-5.0.0-469512-depot.zip
   ```

   VMware ESXi 5.1:

   ```powershell
   # Add-EsxSoftwareDepot
   C:\ESXi5.1-PMC-CustomISO\vmware-ESXi-5.1.0-799733-depot.zip
   ```

   where C:\ESXi5.x-PMC-CustomISO is the temporary folder on your build machine where the software depot is stored.

   c) Add the AACRAID driver binary as a software depot (where xxxxx is the build number):

   VMware ESXi 5.0:

   ```powershell
   # Add-EsxSoftwareDepot
   C:\ESXi5.0-PMC-CustomISO\aacraid-esxi5.0-1.2.1.xxxxx.zip
   ```

   VMware ESXi 5.1:

   ```powershell
   # Add-EsxSoftwareDepot
   C:\ESXi5.1-PMC-CustomISO\aacraid-esxi5.1-1.2.1.xxxxx.zip
   ```

   where C:\ESXi5.x-PMC-CustomISO is the temporary folder on your build machine where the software depot is stored.

   d) Verify that the software depots are added:

   ```powershell
   # $DefaultSoftwareDepots
   ```

   e) List ESX Image Profiles:

   ```powershell
   # Get-EsxImageProfile
   You should see a display similar to this:
   
   ESXi-5.1.0-799733-no-tools
   ESXi-5.1.0-799733-standard
   ```

   f) Create a copy of the standard image profile, using the -CloneProfile option:

   VMware ESXi 5.0:

   ```powershell
   # New-EsxImageProfile -CloneProfile ESXi-5.0.0-469512-standard -Name "ESXi 5.0 Adaptec Series 7"
   ```

   VMware ESXi 5.1:

   ```powershell
   # New-EsxImageProfile -CloneProfile ESXi-5.1.0-799733-standard -Name "ESXi 5.1 Adaptec Series 7"
   ```

   g) Change the vendor and acceptance level of the new image profile:
VMware ESXi 5.0:

```
# Set-EsxImageProfile -ImageProfile "ESXi 5.0 Adaptec Series 7" -vendor PMC-Sierra -AcceptanceLevel VMwareCertified
```

VMware ESXi 5.1:

```
# Set-EsxImageProfile -ImageProfile "ESXi 5.1 Adaptec Series 7" -vendor PMC-Sierra -AcceptanceLevel VMwareCertified
```

h) Check if the new driver package is available:

```
# Get-EsxSoftwarePackage
```

You should see a line like this:

```
scsi-aacraid 5.1.5.2.1.29900-1  Adaptec_Inc 7/24/201...
```

i) Add the scsi-aacraid software package to the new image profile:

VMware ESXi 5.0:

```
# Add-EsxSoftwarePackage -ImageProfile "ESXi 5.0 Adaptec Series 7" -SoftwarePackage scsi-aacraid
```

VMware ESXi 5.1:

```
# Add-EsxSoftwarePackage -ImageProfile "ESXi 5.1 Adaptec Series 7" -SoftwarePackage scsi-aacraid
```

j) Export the custom ISO image:

VMware ESXi 5.0:

```
# Export-EsxImageProfile -ImageProfile "ESXi 5.0 Adaptec Series 7" -FilePath C:\ESXi5.0-PMC-CustomISO\ESXi5.0-PMC-Sierra-Series-7.iso -NoSignatureCheck -ExportToISO
```

VMware ESXi 5.1:

```
# Export-EsxImageProfile -ImageProfile "ESXi 5.1 Adaptec Series 7" -FilePath C:\ESXi5.1-PMC-CustomISO\ESXi5.1-PMC-Sierra-Series-7.iso -NoSignatureCheck -ExportToISO
```

where -FilePath specifies the path to the custom iso image.

7. Burn the custom ISO image to a writable CD.

   **Note:** Use whatever tool you prefer to burn the CD, such as an interactive (GUI-based) tool or a command line tool.

   Remove the CD after you finish burning the image.

8. On the VMware ESXi machine, insert the custom boot CD, then restart your computer.

9. Follow the on-screen instructions to begin the VMware installation.

10. Complete the VMware installation, following the on-screen instructions.

11. Remove the custom boot CD, then reboot your computer.
Installing with Citrix XenServer

**Note:** You will need the Adaptec Installation DVD, your XenServer installation CD, and a writable CD to complete this task. You must have administrator privileges to install the driver image.

To install the Adaptec RAID controller driver with Citrix XenServer, you must copy the XenServer driver iso image from the installation DVD, and burn it to a writeable CD. You will be prompted to insert the XenServer driver CD twice.

To install the Adaptec RAID controller driver while installing Citrix XenServer:

1. On a Windows machine, insert the Adaptec Installation DVD, navigate to the Linux driver folder, then copy the XenServer driver iso image to a temporary location:

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XenServer 6.1</td>
<td>citrix-aacraid-1.2.1-xxxxx.xen-6.1.iso</td>
</tr>
</tbody>
</table>

   where xxxxx is the build number.

   After you copy the file, remove the Adaptec Installation DVD.

2. Burn the XenServer driver iso image to a writable CD.

   **Note:** Use whatever tool you prefer to burn the CD, such as an interactive, GUI-based, tool or a command line tool.

   Remove the CD after you finish burning the image.

3. On the machine where you want to install the OS and RAID controller driver, insert the XenServer installation CD, then restart your computer.


5. Remove the XenServer installation CD and insert the driver CD.

6. When the driver update is complete, remove the driver CD and insert the XenServer installation CD.

7. Continue the XenServer installation, following the on-screen instructions.

8. When prompted to add a driver (at the end of the OS installation), remove the XenServer installation CD and insert the driver CD.

9. Complete the XenServer installation, following the on-screen instructions.

10. Remove the driver CD, then reboot your computer.
Installing the Driver on an Existing Operating System

This chapter explains how to install your Adaptec RAID controller driver on an existing operating system.

Note: To install the driver while you’re installing an operating system, see Installing the Driver and an Operating System on page 40.

Before You Begin

Before you begin, install and connect your Adaptec RAID controller and internal disk drives (see Installing the Controller and Disk Drives on page 29).

You must also create a driver disk before you begin installing the controller driver.

Note: For up-to-date operating system version support, visit the Adaptec Web Site at www.adaptec.com. From the main menu select Support>Knowledgebase>Find Answers. Select your controller type and OS support to generate a list of supported operating systems and to download the latest drivers.

Creating a Driver Disk

This section describes how to create a driver disk for operating systems that require one. You will need a USB flash drive to complete this task.

- Windows operating systems do not require a driver disk; see Installing on Windows on page 52.
- For Debian Linux, the driver is loaded directly from the OS installation DVD; see Installing on Debian Linux on page 53.
- For FreeBSD, VMware, and Citrix XenServer, you must copy the driver from the installation DVD and install it from the local system; see Installing on FreeBSD on page 54, Installing on VMware on page 55, and Installing on Citrix XenServer on page 56.
- For all other OSs, create the driver disk using the Create Diskette menu on the Adaptec Installation DVD.

To create a driver disk using the Create Diskette menu:

1. Set your system BIOS so that your computer boots from the DVD drive.
2. Turn on your computer, then insert the Adaptec Installation DVD.
3. Click Create Diskette, then select your operating system and version.
4. When prompted, insert a USB flash drive, then click OK. The system creates the driver disk on the USB drive.
5. Remove and label the driver disk.
6. Continue with the instructions for your operating system:
   - For Red Hat, Cent OS, SuSE, or Fedora Linux, see Installing on Red Hat, Cent OS, SuSE, or Fedora Linux on page 53.
   - For Ubuntu Linux, see Installing on Ubuntu Linux on page 53.
   - For Solaris, see Installing on Solaris on page 54.

Installing on Windows

Note: The following instructions apply to all supported Windows operating systems.

To install the driver on Windows:

1. Start or restart Windows. The Found New Hardware Wizard opens and searches for the driver.
2. Insert the driver disk, then select Locate and Install Driver Software.... and Don’t Search Online.
3. Click Next, then click Close.
4. When the installation is complete, remove the driver disk and restart your computer.
5. Continue with *Managing Your Storage Space* on page 57.

### Installing on Red Hat, Cent OS, SuSE, or Fedora Linux

To install the driver on Red Hat Linux, Cent OS, SuSE Linux, or Fedora Linux:

1. Insert and mount the Adaptec Installation DVD:

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat, Cent OS</td>
<td><code>mount /dev/cdrom /mnt/cdrom</code></td>
</tr>
<tr>
<td>SuSE</td>
<td><code>mount /dev/cdrom /media/cdrom</code></td>
</tr>
<tr>
<td>Fedora</td>
<td><code>mount /dev/hdc /mnt/cdrom</code></td>
</tr>
</tbody>
</table>

2. Install the module RPM:

   ```bash
   rpm -ivh mount-point/xxx/yyy.rpm
   ```

   where `mount-point` is the mount point on the Linux system, `xxx` is the driver path, and `yyy.rpm` is the rpm file.

3. Reboot your computer to ensure the driver loaded correctly.

4. Continue with *Managing Your Storage Space* on page 57.

### Installing on Debian Linux

**Note:** You must have root privileges to install the driver image. For Debian Linux, the `su` command is sufficient.

To install the driver on Debian Linux:

1. Insert and mount the Debian Installation DVD:

   ```bash
   mount /dev/cdrom /mnt/cdrom
   ```

2. Load the Debian unpacking tools:

   ```bash
   apt-get install build-essential
   ```

3. Install the DEB driver package (where `xxxxx` is the build number):

   ```bash
   dpkg -i aacraid-1.2.1-xxxxx-Debian6.0-all.deb
   ```

4. Reboot your computer to ensure the driver loaded correctly.

5. Continue with *Managing Your Storage Space* on page 57.

### Installing on Ubuntu Linux

**Note:** For driver installation on Ubuntu Linux, you may need to create the root account and password. Enter these commands: `sudo bash; sudo passwd root`. You must have root privileges to install the driver image.

To install the driver on Ubuntu Linux:

1. Update the Ubuntu package index:

   ```bash
   sudo apt-get update
   ```

2. Load the Ubuntu unpacking tools:

   ```bash
   sudo apt-get install build-essential
   ```

3. Install the DEB driver package (where `xxxxx` is the build number):

   ```bash
   dpkg -i aacraid-1.2.1-xxxxx-Debian6.0-all.deb
   ```

   Ubuntu 10.x:
sudo dpkg -i aacraid-1.2.1-xxxxx-Debian+Ubuntu-all.deb

Ubuntu 11.x and Ubuntu 12.x:
sudo dpkg -i aacraid-1.2.1-xxxxx-Ubuntu11.04+11.10+12.04-all.deb

4. Reboot your computer to ensure the driver loaded correctly.
5. Continue with *Managing Your Storage Space* on page 57.

**Installing on Solaris**

To install the driver on Solaris:

1. Start your computer.
2. *(Solaris 10 only)* Check for any pre-existing Adaptec driver by running `pkginfo SUNWaac` in a terminal window. If there is no pre-existing Adaptec driver on your computer, continue with Step 3. If an Adaptec driver is already installed on your computer, run `pkgrm SUNWaac` to remove it.
   
   **Caution:** If your operating system currently boots from the Adaptec controller, do not reset your computer after you remove the pre-existing Adaptec driver. Instead, follow the steps in this section to install a new driver before rebooting your computer.

3. Insert and mount the driver disk:

   `volcheck`

4. Change to the driver installer directory:
   
   Solaris 10:
   
   `cd /rmdisk/aacraid/DU/sol_210/i86pc/Tools`

   Solaris 11:
   
   `cd /rmdisk/aacraid/DU/sol_211/i86pc/Tools`

5. Start the driver installer:
   
   `./install.sh -i`

6. Remove the driver disk, then reboot your computer.
7. Continue with *Managing Your Storage Space* on page 57.

**Installing on FreeBSD**

To install the driver on FreeBSD:

1. Start your computer.
2. Insert and mount the driver disk:

   `mount -t msdos /dev/fd1 /mnt`

3. Copy the driver package to the /tmp directory:

   `cp /mnt/aac8x-i386.tgz /tmp`

4. Install the driver package:

   `pkg_add /tmp/aac8x-i386.tgz`

5. Remove the driver disk, then reboot your computer.
6. Continue with *Managing Your Storage Space* on page 57.
Installing on VMware

Note: You must remove the old driver before you can install the new one. You must have root privilege to install the new driver.

Note: To copy the driver VIB file to the VMware ESX/ESXi server (in Step 2 below), you must have access to a remote copy utility, such as WinSCP, putty, or Linux scp.

To install the driver on VMware:

1. At the VMware console screen, type these commands to remove the old driver:
   
   **VMware ESX 4.1:**
   
   ```
   esxupdate query --vib-view | grep -i aacraid (list driver packages)
   esxupdate -b <vibID> --maintenancemode remove (remove package)
   ```
   
   where `vibID` is the full name of the driver package.
   
   Note: For VMware 4.0 or earlier, use the `rpm -e` command to remove the driver.

   **VMware ESXi 5.x:**
   
   ```
   esxcli software vib list | grep -i aacraid (list driver packages)
   esxcli software vib remove --vibname=scsi-aacraid --maintenance-mode (remove package)
   ```

2. Using a remote copy utility, copy the driver VIB file for your operating system version from the Linux driver folder on the installation DVD to a local directory on the ESX server. This example uses Linux scp to copy the driver to `/tmp/aacraid` (where `xxxxx` is the build number):
   
   **VMware ESX 4.1:**
   
   ```
   scp
   /mnt/cdrom/linux/driver/vmware-esx-drivers-scsi-aacraid-400.4.2.1.xxxxx-1.0.4.260247.x86_64.vib
   root@<esx-server-ip>:./tmp/aacraid
   ```

   **VMware ESXi 5.0:**
   
   ```
   scp
   /mnt/cdrom/linux/driver/vmware-esxi-drivers-scsi-aacraid-500.5.2.1.xxxxx-1.0.5.472560.x86_64.vib
   root@<esx-server-ip>:./tmp/aacraid
   ```

   **VMware ESXi 5.1:**
   
   ```
   scp
   /mnt/cdrom/linux/driver/vmware-esxi-drivers-scsi-aacraid-510.5.2.1.xxxxx-1.1.5.799733.x86_64.vib
   root@<esx-server-ip>:./tmp/aacraid
   ```
   
   Note: Due to file name limits on the installation DVD, the “_64.vib” portion of the file name may be truncated and not visible.

3. Install the VIB module (where `xxxxx` is the build number):
   
   **VMware ESX 4.1:**
   
   ```
   esxupdate -b
   /tmp/aacraid/vmware-esx-drivers-scsi-aacraid-400.4.2.1.xxxxx-1.0.4.260247.x86_64.vib
   --nodeps --nosigcheck --maintenancemode update
   ```

   **VMware ESXi 5.0:**
   
   ```
   esxcli software vib install -f -v
   file:/tmp/aacraid/vmware-esxi-drivers-scsi-aacraid-500.5.2.1.xxxxx-1.0.5.472560.x86_64.vib
   ```

   **VMware ESXi 5.1:**
esxcli software vib install -f -v
file:/tmp/aacraid/vmware-esxi-drivers-scsi-aacraid-510.5.2.1.xxxxx..-1.1.5.799733.x86_64.vib

4. Reboot your computer.

**Installing on Citrix XenServer**

**Note:** To copy the driver RPM file to XenServer (in Step 1 below), you must have access to a remote copy utility, such as WinSCP, putty, or Linux scp. You must have root privilege to install the driver.

To install the driver on XenServer:

1. Using a remote copy utility, copy the driver RPM file from the Linux driver folder on the Adaptec installation DVD to a local directory on XenServer. This example uses Linux scp to copy the driver to /tmp/aacraid (where xxxxx is the build number):

   ```
   scp /mnt/cdrom/linux/driver/citrix-aacraid-1.2.1-xxxxx.xen-6.1.rpm
   root@<xen-server-ip>:/tmp/aacraid
   ```

2. Install the driver module rpm (where xxxxx is the build number):

   ```
   rpm -ivh /tmp/aacraid/citrix-aacraid-1.2.1-xxxxx.xen-6.1.rpm
   ```

3. Reboot your computer.
Managing Your Storage Space

Once you have installed your Adaptec RAID controller, disk drives (or other devices), and device driver, you can begin to build and manage your storage space. This chapter introduces maxView Storage Manager, and describes the other utilities included with your Adaptec RAID controller.

About maxView Storage Manager

maxView Storage Manager is a browser-based software application that helps you build a storage space for your online data, using Adaptec RAID controllers and disk drives. With maxView Storage Manager, you can group disk drives into logical drives and build in redundancy to protect your data and improve system performance.

From a single workstation, you can use maxView Storage Manager to monitor and manage all the controllers and disk drives in your storage space.

When maxView Storage Manager is installed on a computer, the maxView Storage Manager Agent (and other related services) is also installed automatically. The Agent is designed to run in the background, without user intervention. Its job is to monitor system health, manage event notifications, task schedules, and other on-going processes on a system. It sends notices when tasks are completed successfully, and notifies you when errors or failures occur on that system.

If your storage space includes systems that won't be connected to monitors (and therefore won't require the graphical user interface), you can choose to run the Agent only on those systems instead of the full application. For more information, refer to the maxView Storage Manager User's Guide on the Adaptec Installation DVD.

Installing maxView Storage Manager

maxView Storage Manager is included on the Adaptec Installation DVD. For installation instructions, refer to the maxView Storage Manager User's Guide, in the books folder on the installation DVD.

About the Adaptec RAID Controller Configuration Utility

The Adaptec RAID Controller Configuration (ARCCONF) is a command line utility that you can use to perform basic array and configuration management functions. With ARCCONF, you can:

- Create and delete logical drives
- Modify and copy configuration settings
- Recover from disk drive failures and troubleshoot your system

ARCCONF is described in the Adaptec RAID Controller Command Line Utility User's Guide, which is included on the Adaptec Installation DVD.

About the Adaptec RAID Configuration Utility

The Adaptec RAID Configuration (ARC) utility is a BIOS-based utility that you can use to create and manage controllers, disk drives and other devices, and arrays. The ARC utility comprises these tools:

- Logical Device Configuration—For creating and managing arrays, and initializing and rescanning disk drives.
- Controller Settings—For modifying your controller and disk drive settings.
- Disk Utilities—For formatting or verifying disk drives.

The ARC utility is included in your controller's BIOS. For more information, see Using the Adaptec RAID Configuration Utility on page 74.
Note: The ARC utility is primarily intended for pre-operating system installation configuration.

About the Adaptec Flash Utility

The Adaptec Flash Utility (AFU) is a text-based DOS utility that you can use to update, save, or verify your RAID controller's firmware.

Caution: Although the AFU contains safeguards to prevent you from accidentally damaging your RAID controller's flash contents, it is still important to use the AFU carefully and correctly to avoid rendering your RAID controller inoperable. We recommend that only advanced users familiar with working in DOS use the AFU. You can also use maxView Storage Manager to update the controller firmware. See the maxView Storage Manager User’s Guide for more information.

Which Utility Should I Use?

To create a bootable array, we recommend that you use the BIOS-based ARC utility (See Using the Adaptec RAID Configuration Utility on page 74).

For subsequent storage management tasks on most supported operating systems, including VMware Guest OSs, we recommend that you install and use maxView Storage Manager (see About maxView Storage Manager on page 57). As a full-featured software application with a graphical user interface, it is the easiest to use and offers the widest range of management functions. For operating systems that do not support the maxView Storage Manager GUI, such as FreeBSD, use the ARCCONF command line utility to configure and manage arrays.
10 Solving Problems
This chapter provides basic troubleshooting information and solutions for solving controller problems.

Troubleshooting Checklist
If you encounter difficulties installing or using your Adaptec RAID controller, check these items first:
- With your computer powered off, check the connections to each disk drive, power supply, LED connector, and so on. Try disconnecting and reconnecting disk drives from the Adaptec RAID controller.
- Check that your Adaptec RAID controller is installed in a compatible PCIe expansion slot. To double-check the bus compatibility of your controller, see About Your RAID Controller on page 17.
- Ensure that your Adaptec RAID controller is firmly seated and secured in the PCIe expansion slot.
- If your Adaptec RAID controller is not detected during system boot, try installing it in a different compatible expansion slot. (See Installing the Controller on page 29 for instructions.)
- Did the driver install correctly?
- If you have external disk drives (or other devices), are they powered on?
- Check the Readme on the installation DVD for compatibility issues and known problems.

If you are still unable to resolve a problem, you can find additional troubleshooting information and direction on the Adaptec Web site at www.adaptec.com or the Support Knowledgebase at ask.adaptec.com.

Monitoring Disk Drives Status
You can use the 'blink' feature in maxView Storage Manager to monitor the status of your SAS and SATA disk drives. When you blink a specific disk drive or set of disk drives, the LED(s) on the selected disk drives flash.

This table describes the LED flash states:

<table>
<thead>
<tr>
<th>Controller Device State</th>
<th>Slot State</th>
<th>LED Flash State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed</td>
<td>Device is faulty</td>
<td>On</td>
</tr>
<tr>
<td>Rebuilding</td>
<td>Device is rebuilding</td>
<td>Slow flash</td>
</tr>
<tr>
<td>Blink</td>
<td>Identify the device</td>
<td>Fast flash</td>
</tr>
<tr>
<td>Other</td>
<td>No error</td>
<td>Off</td>
</tr>
</tbody>
</table>

For more information about using maxView Storage Manager to monitor your disk drives, refer to the maxView Storage Manager User’s Guide or the online Help.

Silencing the Alarm
If your Adaptec RAID controller includes an alarm, the alarm will sound when an error occurs. To silence the alarm, use maxView Storage Manager (see Managing Your Storage Space on page 57.) OR the ARC utility (see Modifying Your Controller’s Configuration on page 78.)

Recovering from a Disk Drive Failure
This section explains how to recover when a disk drive or SSD fails:
- If the array was protected by a hot spare, see Failed Disk Drive Protected by a Hot Spare on page 60.
- If the array was not protected by a hot spare, see Failed Disk Drive Not Protected by a Hot Spare on page 60.
- If there is a disk drive failure in more than one array simultaneously, see Failure in Multiple Arrays Simultaneously on page 60.
- If it is a RAID 0 array, see Disk Drive Failure in a RAID 0 Array on page 60.
- If multiple disk drives fail within the same array, see Multiple Failures in the Same Array on page 60.
- If the drive is part of the maxCache Container, see Failed SSD in maxCache Container on page 61.

**Note:** maxView Storage Manager uses the term logical drives or logical devices when referring to arrays (see Terminology Used in this Guide on page 14).

**Failed Disk Drive Protected by a Hot Spare**

When an array is protected by a hot spare, if a disk drive in that array fails the hot spare is automatically incorporated into the array and takes over for the failed drive.

To recover from the failure:

1. Remove and replace the failed disk drive.
2. **If copyback is not enabled**—In maxView Storage Manager, remove the ‘hot spare’ designation from the original hot spare (the disk drive that was built into the array). Then, designate a new hot spare to protect the arrays on that controller.

   **If copyback is enabled**—Data is automatically moved back to its original location once the controller detects that the failed drive has been replaced. No action is required.

**Failed Disk Drive Not Protected by a Hot Spare**

When an array is not protected by a hot spare, if a disk drive in that array fails, remove and replace the failed disk drive. The controller detects the new disk drive and begins to rebuild the array.

If the controller fails to rebuild the array, check that the cables, disk drives, and controllers are properly installed and connected. Make sure that the new disk drive is equal or greater in size than the failed disk drive. Then, if necessary, use maxView Storage Manager to rebuild the array. For instructions, refer to the maxView Storage Manager User’s Guide or online Help.

**Failure in Multiple Arrays Simultaneously**

If there’s a disk drive failure in more than one array at the same time (one failure per array), and the arrays have hot spares protecting them, the controller rebuilds the arrays with these limitations:

- A hot spare must be of equal or greater size than the failed disk drive it’s replacing.
- Failed disk drives are replaced with hot spares in the order in which they failed. (The array that includes the disk drive that failed first is rebuilt first, assuming an appropriate hot spare is available—see bullet above.)

If there are more disk drive failures than hot spares, see Failed Disk Drive Not Protected by a Hot Spare on page 60.

If copyback is enabled, data is moved back to its original location once the controller detects that the failed drive has been replaced.

**Disk Drive Failure in a RAID 0 Array**

Because RAID 0 volumes do not include redundancy, if a disk drive fails in a RAID 0 array, the data can’t be recovered.

Correct the cause of the failure or replace the failed disk drives. Then, restore your data (if available).

**Multiple Failures in the Same Array**

Except in RAID 6 and RAID 60 arrays (see Understanding RAID on page 67), if more than one disk drive fails at the same time in the same array, the data normally can’t be recovered.

You may be able to recover the data by forcing the logical drive online or by recreating the logical drive without the initialization step. You can use the BIOS utility, ARC (see About the Adaptec RAID Configuration Utility on page 57), the command-line utility, ARCCONF, or maxView Storage Manager. For more information, refer to the Adaptec RAID Controller Command Line Interface User’s Guide and the maxView Storage Manager User’s Guide.
Note: In some instances, RAID 10 and RAID 50 arrays may survive multiple disk drive failures, depending on which disk drives fail.

Failed SSD in maxCache Container

Because the maxCache Container is a redundant logical device, comprised of SSDs only, it is rebuilt automatically when a failed SSD is replaced, just like an ordinary array. Once you identify the failed SSD, for example, by using maxView Storage Manager’s rapid fault isolation feature, replace it with a new one (see Connecting Solid State Drives (SSDs) on page 33). The controller detects the new SSD and begins rebuilding the maxCache Container.

Resetting the Controller

You may need to reset, or flash, your Adaptec RAID controller if it becomes inoperable or if a firmware upgrade is unsuccessful. Adaptec RAID controllers support a reset protocol called HDA mode flash. For information about HDA mode, see the Readme on the installation DVD or contact your support representative. To locate the flash jumper on your RAID controller board, see the illustrations in About Your RAID Controller on page 17.
A Introduction to SAS
This section provides a basic overview of the main features of SAS, introduces some common SAS terms, and explains how SAS differs from parallel SCSI.

Note: For technical articles and tutorials about SAS, refer to the SCSI Trade Association (STA™) Web site at www.scsita.org.

Terminology Used in This Appendix
For convenience, SAS HBAs and SAS RAID controllers are referred to generically in this chapter as SAS cards. HBAs, RAID controllers, disk drives, and external disk drive enclosures are referred to as end devices and expanders are referred to as expander devices.
For convenience, this chapter refers to end devices and expander devices collectively as SAS devices.

What is SAS?
Legacy parallel SCSI is an interface that lets devices such as computers and disk drives communicate with each other. Parallel SCSI moves multiple bits of data in parallel (at the same time), using the SCSI command set.
SAS is an evolution of parallel SCSI to a point-to-point serial interface. SAS also uses the SCSI command set, but moves multiple bits of data one at a time. SAS links end devices through direct-attach connections, or through expander devices.
SAS cards can typically support up to 128 end devices and can communicate with both SAS and SATA devices. (You can add 128 end devices—or even more—with the use of SAS expanders. See SAS Expander Connections on page 65.)

Note: Although you can use both SAS and SATA disk drives in the same SAS domain (see SAS Expander Connections on page 65), we recommend that you do not combine SAS and SATA disk drives within the same array or logical drive. The difference in performance between the two types of disk drives may adversely affect the performance of the array.

Data can move in both directions simultaneously across a SAS connection (called a link—see How Do SAS Devices Communicate? on page 62). Link speed is 300 MB/sec in half-duplex mode. Therefore, a SAS card with eight links has a bandwidth of 2400 MB/sec.
Although they share the SCSI command set, SAS is conceptually different from parallel SCSI physically, and has its own types of connectors, cables, connection options, and terminology, as described in the rest of this chapter.
To compare SAS to parallel SCSI, see How is SAS Different from Parallel SCSI? on page 66.

How Do SAS Devices Communicate?
SAS devices communicate with each other through links. A link is a physical connection between two phys.
As shown in the following figure, SAS devices contain ports (see What’s a SAS Port? on page 63), ports contain phys, and each phy contains one transmitter and one receiver—one transceiver. A phy can belong to one port only.
What’s a Phy?

Phys are part of the physical communication connection between SAS devices. Each phy contains a transceiver that sends data back and forth between SAS devices.

When a connection is formed between two end devices, a link is established from a phy in one port to a phy in the other port. As shown in the figure above, a wide port can support multiple independent links simultaneously.

Phys are internal, within SAS connectors (see What’s a SAS Connector? on page 64).

SAS cables physically connect one or more phys on one SAS device to one or more phys on another SAS device.

What’s a SAS Port?

Note: Because the physical link between SAS devices is from phy to phy, rather than port to port, a “port” is more of a virtual concept, different from what is normally considered a port on other types of RAID controllers and storage devices.

A port is one or more phys. A narrow port contains one phy. A wide port typically contains four phys.

Each port has its own unique SAS address (see How are Disk Drives Identified in SAS? on page 64), and all the phys in a port share that same SAS address.

SAS card port options vary. A SAS card with four phys could be configured with one wide port, with two wide ports that comprise two phys, or with four narrow ports each containing one phy. (A wide port with four phys is referred to as a 4-wide or 4x port.)

What’s a SAS Address?

Each SAS port is identified with a unique SAS address, which is shared by all phys on that port.

For example, a SAS disk drive might have two narrow ports. Each port has one unique SAS address. The single phy in each port uses its port’s SAS address.

In another example, a SAS device might have one 4-wide port. That port has one SAS address, which is shared by all four phys in the port.

Unlike SCSI devices and SCSI IDs, SAS devices self-configure their SAS addresses. User intervention is not required to set SAS addresses, and SAS addresses cannot be modified.
What's a SAS Connector?

A SAS or mini-SAS connector is the physical plug or receptacle that you see on a SAS device. It's what you plug a SAS cable into, or the end of the SAS cable that's being plugged in. (See Cables on page 25.)

A connector is what forms physical links between phys. Some SAS connectors can support multiple links. The number of links a SAS connector can support is referred to as its width. Narrow connectors support a single link; wide connectors supports more than 1 link.

A single SAS device may have one or more connectors. A single SAS connector may help form links between more than two SAS devices. (For instance, as shown in the figure in Connecting Drives Directly to the Controller on page 33, the 4-wide internal SAS connector forms links with four independent disk drives.)

What do SAS Cables Look Like?

Internal standard SAS cables are narrower than internal parallel SCSI cables. The connectors vary in size depending on the number of links they support, from single link connectors to 4-wide (or larger) connectors. Internal fan-out cables let you attach four disk drives to a single 4-wide connector.

Mini-SAS connectors support both internal and external SAS connections. The mini-SAS connectors are smaller than the standard SAS internal and external connectors. Mini-SAS connectors support single and multilinks with the ability to scale to future speed needs.

For examples of some internal SAS/mini-SAS cables and an external SAS/mini-SAS cables, see Cables on page 25.

How are Disk Drives Identified in SAS?

In the BIOS and in the management utilities (see Identifying Disk Drives on page 81), disk drives are identified in the following formats:

- CNX:DevY = Device Y is attached to Connector X (see Direct-attach Connections on page 64 for more information)
- BoxX:SlotX = Enclosure X is attached to a disk drive in Slot X (see Backplane Connections on page 65 for more information)
- ExpX:PhyX = Expander X is attached to Phy X (see SAS Expander Connections on page 65 for more information)

where X is the count number.

Note: Devices other than disk drives (CDROM, tape drives, etc...) are listed in order after your system disk drives.

In parallel SCSI, XX is the disk drive's channel number, YY is the target number, and ZZ is the logical unit number (LUN).

What are the SAS Connection Options?

You can connect end devices to each other through direct cable connections and through backplane connections. When you use one or more expander devices (see SAS Expander Connections on page 65), you can create large configurations.

Direct-attach Connections

In a direct-attach connection, SAS or SATA disk drives are connected directly to a SAS card with SAS or mini-SAS cables. One disk drive is attached to one SAS/mini-SAS connector with one SAS/mini-SAS cable (or multiple disk drives are attached to one SAS/mini-SAS connector with one fan-out cable). The figure in Connecting Drives Directly to the Controller on page 33 shows an example of direct-attach connections.
The number of direct-attached disk drives is limited to the number of *phys* supported by the SAS card. (Note that there may be multiple phys within a single connector. See *SAS Expander Connections* on page 65.)

**Backplane Connections**

In a backplane connection, disk drives and SAS cards are attached to and communicate with each other through a system backplane.

There are two types of backplane connections, *passive* and *active*. When connecting to either backplane, it’s important to properly connect your disk drive LEDs in order to identify disk drive conditions. See *About Your RAID Controller* on page 17 for your RAID controller Activity LED connections and locations.

Once you have connected to a backplane, use maxView Storage Manager to manage your disk drives. For more information, refer to the *maxView Storage Manager User’s Guide* on the Adaptec Installation DVD.

The number of end devices is limited to the number of slots available on the backplane. For example, the Adaptec S50 enclosure, which contains an expander, is a backplane connection that supports up to 12 SAS or SATA disk drives.

Some backplanes support daisy-chain expansion to other backplanes. For example, you can daisy-chain (connect one to the next) up to nine Adaptec S50 enclosures to a single SAS card in a host system.

**SAS Expander Connections**

A SAS expander device literally expands the number of end devices that you can connect together. Expander devices, typically embedded into a system backplane (see *Backplane Connections* on page 65), support large configurations of SAS end devices, including SAS cards and SAS and SATA disk drives.

With expander devices, you can build large and complex storage topologies.

There are two types of SAS expanders: *fanout expanders* and *edge expanders*. Each performs a different role in a storage system. (For more information about how SAS expanders work, refer to the STA Web site at www.scsita.org.)

You can connect up to 128 SAS ports to an edge expander. (A single edge expander can therefore support up to 128 SAS addresses.)

You can connect up to 128 edge expanders to a fanout expander.

You can use only one fanout expander in any single SAS *domain* (a topology of SAS—and possibly SATA—end devices and expander devices). A single SAS domain can therefore comprise up to 16,384 SAS ports (and therefore up to 16,384 SAS addresses including the fanout expander).

The next figure illustrates (in very basic terms) a SAS domain and shows how SAS cards, SAS and SATA disk drives, and expander devices can fit together in a large data storage topology.
How is SAS Different from Parallel SCSI?

In summary, although SAS and parallel SCSI both use the SCSI command set, how they move data from one place to another is very different. To support point-to-point serial data transport, SAS introduces new types of connectors, cables, connection options, and terminology.

Generally speaking, SAS is faster and more flexible than parallel SCSI, and provides more options for building your storage space. SAS lets you mix SAS and SATA disk drives together, and lets you connect many, many more devices.

This table describes many of the main differences between the two interfaces.

<table>
<thead>
<tr>
<th>Parallel SCSI</th>
<th>Serial Attached SCSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel interface</td>
<td>Serial interface</td>
</tr>
<tr>
<td>Maximum speed 320 MB/sec shared by all devices on the bus</td>
<td>Maximum speed 300 MB/sec per phy when in half-duplex mode</td>
</tr>
<tr>
<td>Supports SCSI devices only</td>
<td>Supports SATA and SAS disk drives simultaneously</td>
</tr>
<tr>
<td>Up to 16 devices per SCSI channel</td>
<td>More than 100 disk drives per SAS card, using an expander (see SAS Expander Connections on page 65) or 50 SATAII disk drives.</td>
</tr>
<tr>
<td>Supports single-port devices only</td>
<td>Supports single- and dual-port devices</td>
</tr>
<tr>
<td>Uses SCSI IDs to differentiate between devices connected to the same adapter</td>
<td>Uses unique SAS addresses to differentiate between devices</td>
</tr>
<tr>
<td>User intervention required to set SCSI IDs</td>
<td>SAS addresses self-configured by SAS devices</td>
</tr>
<tr>
<td>Requires bus termination</td>
<td>Requires no bus termination</td>
</tr>
<tr>
<td>Standard SCSI connectors</td>
<td>SAS connectors (see Cables on page 25)</td>
</tr>
</tbody>
</table>
Understanding RAID

When you create arrays (or logical drives), you can assign a RAID level to protect your data. Each RAID level offers a unique combination of performance and redundancy. RAID levels also vary by the number of disk drives they support.

This appendix describes the RAID levels supported by your Adaptec RAID controller, and provides a basic overview of each to help you select the best level of protection for your data storage.

Understanding Drive Segments

A drive segment is a disk drive or portion of a disk drive that is used to create an array. A disk drive can include both RAID segments (segments that are part of an array) and available segments. Each segment can be part of only one logical device at a time. If a disk drive is not part of any logical device, the entire disk is an available segment.

Non-redundant Arrays (RAID 0)

An array with RAID 0 includes two or more disk drives and provides data striping, where data is distributed evenly across the disk drives in equal-sized sections. However, RAID 0 arrays do not maintain redundant data, so they offer no data protection.

Compared to an equal-sized group of independent disks, a RAID 0 array provides improved I/O performance.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can create a RAID 0 drive segment of 250 GB, for a total of 1000 GB for the volume, as shown in this figure.

![Diagram showing RAID 0 configuration with disk drives and segment sizes.]
**RAID 1 Arrays**

A RAID 1 array is built from two disk drives, where one disk drive is a mirror of the other (the same data is stored on each disk drive). Compared to independent disk drives, RAID 1 arrays provide improved performance, with twice the read rate and an equal write rate of single disks. However, capacity is only 50 percent of independent disk drives.

If the RAID 1 array is built from different-sized disk drives, the free space, drive segment size is the size of the smaller disk drive, as shown in this figure.

**RAID 1 Enhanced Arrays**

A RAID 1 Enhanced (RAID 1E) array—also known as a striped mirror—is similar to a RAID 1 array except that data is both mirrored and striped, and more disk drives can be included. A RAID 1E array can be built from three or more disk drives.

In this example, the large bold numbers represent the striped data, and the smaller, non-bold numbers represent the mirrored data stripes.
**RAID 10 Arrays**

A RAID 10 array is built from two or more equal-sized RAID 1 arrays. Data in a RAID 10 array is both striped and mirrored. Mirroring provides data protection, and striping improves performance.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can create two mirrored drive segments of 250 GB, for a total of 500 GB for the array, as shown in this figure.
RAID 5 Arrays

A RAID 5 array is built from a minimum of three disk drives, and uses data striping and parity data to provide redundancy. Parity data provides data protection, and striping improves performance.

Parity data is an error-correcting redundancy that’s used to re-create data if a disk drive fails. In RAID 5 arrays, parity data (represented by Ps in the next figure) is striped evenly across the disk drives with the stored data.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can contain 750 GB of stored data and 250 GB of parity data, as shown in this figure.
RAID 50 Arrays

A RAID 50 array is built from six to forty-eight disk drives configured as two or more RAID 5 arrays, and stripes stored data and parity data across all disk drives in both RAID 5 arrays. (For more information, see RAID 5 Arrays on page 70.)

The parity data provides data protection, and striping improves performance. RAID 50 arrays also provide high data transfer speeds.

Drive segment size is limited to the size of the smallest disk drive in the array. For example, three 250 GB disk drives and three 400 GB disk drives comprise two equal-sized RAID 5 arrays with 500 GB of stored data and 250 GB of parity data. The RAID 50 array can therefore contain 1000 GB (2 x 500 GB) of stored data and 500 GB of parity data.

In this figure, P represents the distributed parity data.
RAID 6 Arrays

A RAID 6 array—also known as dual drive failure protection—is similar to a RAID 5 array because it uses data striping and parity data to provide redundancy. However, RAID 6 arrays include two independent sets of parity data instead of one. Both sets of parity data are striped separately across all disk drives in the array.

RAID 6 arrays provide extra protection for your data because they can recover from two simultaneous disk drive failures. However, the extra parity calculation slows performance (compared to RAID 5 arrays). RAID 6 arrays must be built from at least four disk drives. Maximum stripe size depends on the number of disk drives in the array.

RAID 60 Arrays

Similar to a RAID 50 array (see RAID 50 Arrays on page 71), a RAID 60 array—also known as dual drive failure protection—is built from eight disk drives configured as two or more RAID 6 arrays, and stripes stored data and two sets of parity data across all disk drives in both RAID 6 arrays.

Two sets of parity data provide enhanced data protection, and striping improves performance. RAID 60 arrays also provide high data transfer speeds.
Comparing RAID Levels

Use this table to select the RAID levels that are most appropriate for the logical drives on your storage space, based on the number of available disk drives and your requirements for performance and reliability.

<table>
<thead>
<tr>
<th>RAID Level</th>
<th>Redundancy</th>
<th>Disk Drive Usage</th>
<th>Read Performance</th>
<th>Write Performance</th>
<th>Built-in Hot Spare</th>
<th>Minimum Disk Drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAID 0</td>
<td>No</td>
<td>100%</td>
<td>***</td>
<td>***</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td>RAID 1</td>
<td>Yes</td>
<td>50%</td>
<td>**</td>
<td>**</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td>RAID 1E</td>
<td>Yes</td>
<td>50%</td>
<td>**</td>
<td>**</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>RAID 10</td>
<td>Yes</td>
<td>50%</td>
<td>**</td>
<td>**</td>
<td>No</td>
<td>4</td>
</tr>
<tr>
<td>RAID 5</td>
<td>Yes</td>
<td>67 – 94%</td>
<td>***</td>
<td>*</td>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>RAID 5EE</td>
<td>Yes</td>
<td>50 – 88%</td>
<td>***</td>
<td>*</td>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td>RAID 50</td>
<td>Yes</td>
<td>67 – 94%</td>
<td>***</td>
<td>*</td>
<td>No</td>
<td>6</td>
</tr>
<tr>
<td>RAID 6</td>
<td>Yes</td>
<td>50 – 88%</td>
<td>**</td>
<td>*</td>
<td>No</td>
<td>4</td>
</tr>
<tr>
<td>RAID 60</td>
<td>Yes</td>
<td>50 – 88%</td>
<td>**</td>
<td>*</td>
<td>No</td>
<td>8</td>
</tr>
</tbody>
</table>

Disk drive usage, read performance, and write performance depend on the number of drives in the logical drive. In general, the more drives, the better the performance.
Using the Adaptec RAID Configuration Utility

The Adaptec RAID Configuration (ARC) utility is a BIOS-based utility that you can use to create arrays and manage controllers, disk drives and other devices.

Introduction to the ARC Utility

The ARC utility comprises these tools:

- Logical Device Configuration—For creating and managing arrays, and initializing and rescanning disk drives (see Using the ARC Utility to Create and Manage Arrays on page 75).
- Controller Settings—For modifying your controller and disk drive settings (see Using the ARC Utility to Modify Controller Settings on page 78).
- Disk Utilities—For formatting or verifying disk drives (see Formatting and Verifying Disk Drives on page 80).

Ctrl-A or uEFI/HII?

Your Adaptec RAID controller supports two interfaces to the BIOS-level RAID configuration options of the ARC utility: Ctrl-A and uEFI/HII. On servers that support the Unified Extensible Firmware Interface, or uEFI (version 2.10 or higher), the BIOS-level RAID configuration options are presented with a HII interface, or Human Interaction Infrastructure, rather than the Adaptec Ctrl-A interface described in this chapter. uEFI/HII provides an architecture-independent mechanism for initializing add-in cards, like the Adaptec RAID controller, and rendering contents to the screen in a uniform way.

In the HII interface, access to the RAID configuration options is provided through the server’s standard BIOS. How you access the BIOS varies, depending on the manufacturer, but typically it’s started by simply pressing DEL. Once you enter setup, navigate to the "PMC maxView Storage Manager" option, typically on the BIOS’ "Advanced" menu, then scan for and select a controller.

From that point on, the HII menus and the Ctrl-A menus for configuring your RAID controller are almost identical. For example, the top-most menu contains the same three choices: Logical Device Configuration, Controller Settings, Disk Utilities (described above). Options in the lower-level menus are also similar.

In both interfaces, all the tools are menu-based and instructions for completing tasks appear on-screen. Menus can be navigated using the arrows, Enter, Esc, and other keys on your keyboard.

This chapter provides instructions for navigating and completing tasks with the Ctrl-A interface. To complete tasks with the HII interface:

- Refer to the on-screen instructions for keyboard navigation and selection options.
- Refer to the option descriptions in this chapter for details about individual RAID configuration settings and tasks.

Running the ARC Utility

If your Adaptec controller is connected to a RAID enclosure, power on your enclosure (or enclosures) before you power on your computer.

Start or restart your computer. When prompted, press Ctrl+A.

During boot up, if your system has insufficient memory this message displays:

"Adaptec RAID Configuration Utility will load after, system initialization. Please wait... Or press <Enter> Key to attempt loading the utility forcibly [Generally, not recommended]"

Note: The first time you power on your computer after you install a new controller, the BIOS may display a configuration that doesn’t match your system’s configuration. This is normal.
Using the ARC Utility to Create and Manage Arrays

To use the ARC utility to create and manage arrays, start the ARC utility (see `Running the ARC Utility` on page 74), select your controller (if you have more than one), then press `Enter`. Select `Logical Device Configuration` from the ARC main menu, then press `Enter`.

Follow the on-screen instructions to create and manage arrays, and initialize, rescan, and erase disk drives.

Creating a New Array

To begin creating an array, select `Create Arrays` from the Logical Device Configuration menu.

Only disk drives that can be used in a new array are available for selection. (Disk drives must be initialized before they can be used in an array. See `Initializing Disk Drives` on page 77 for more information.)

**Note:**
- To create a hybrid array that leverages the performance benefits of the SSDs in your system, you must select an equal number SSDs and HDDs. You can create a hybrid RAID1 or hybrid RAID10 only.
- When you create an all SSD array, we recommend disabling all caching, including maxCache caching. If any caching is enabled when you create the array, you will be prompted to turn caching off.

Use the Array Properties menu to modify the array's RAID level, size, name, stripe size, cache settings, and maxCache settings.

**Note:** For more information about RAID levels and using disk drives to create arrays, see `Choosing a RAID Level` on page 25. For more information about maxCache, see `Modifying Cache Settings` on page 76.

Managing Existing Arrays

To view or modify existing arrays, select `Manage Arrays` from the Logical Device Configuration menu.

From the Manage Arrays menu, you can:
- View the properties of an array.  
  **Note:** Failed drives are displayed in a different text color.
- Make an array bootable (see `Creating Bootable Arrays` on page 75).
- Assign or remove hot spares.
- Modify power management settings.
- Change the cache settings for an array.
- Delete an array.

  **Caution:** Before deleting an array, back up the data to avoid permanently losing it.

Creating Bootable Arrays

**Note:** You may need to change the system BIOS to modify the boot order. For more information, refer to your computer documentation.

The controller always uses the lowest numbered array as its bootable array.

To make an array bootable:

1. Select `Manage Arrays` from the Logical Device Configuration menu.
2. Select the array that you want to make bootable, then press `Ctrl+B`.

  **Note:** You cannot make an array bootable while it's building, verifying, or rebuilding.

  The array's number changes to Array 00, which makes this array the controller's boot array.

3. Restart your computer.
Modifying Power Management Settings

Power management settings switch the array to low power state when it is inactive for a specific time. To modify power management settings:

1. Select Manage Arrays from the Logical Device Configuration menu.
2. Select the array, then press Ctrl+W.

In the power management console, enter these details:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Management</td>
<td>When enabled, switches the array to low power state, when the array/drive is inactive.</td>
</tr>
<tr>
<td>Slow Down Drive After</td>
<td>The duration of inactive state of the array/drive after which it is slowed down to low power mode. This is an optional setting.</td>
</tr>
<tr>
<td></td>
<td>Note: The disk drive should support low power mode.</td>
</tr>
<tr>
<td>Power Off Drive After</td>
<td>The duration of inactive state of the array/drive after which it is powered off. This is an optional setting.</td>
</tr>
<tr>
<td></td>
<td>Note: Power Off Drive After duration should be greater than Slow Down Drive After Duration.</td>
</tr>
<tr>
<td>Verify Drive After</td>
<td>The regular time interval at which the system performs a health check of the array/drive.</td>
</tr>
</tbody>
</table>

Modifying Cache Settings

You can modify the read and write cache settings for an array. You can also modify the maxCache settings. Adaptec maxCache uses the compatible Solid State Drives (SSDs) in your system as fast cache memory to improve performance for both read and write operations in I/O-intensive applications with mixed workloads.

Note: maxCache SSD Caching is supported on Adaptec Series Q controllers only.

To modify the cache settings for an array:

1. Select Manage Arrays from the Logical Device Configuration menu.
2. Select the array, then press Ctrl+C.
   The Modify Cache Settings window opens.
3. Enable or disable read caching.
4. Press Tab.
5. Enable or disable write caching:
   - Select Enable always for “write-back” caching
   - Select Enable with ZMM if your controller has battery backup or a zero-maintenance cache protection module
   - Select Disable for “write-through” caching
6. Press Tab.
7. Select the maxCache Read Cache setting (Enable/Disable).
8. Select the maxCache Write Cache setting (Enable/Disable).
9. Press Enter to accept the values.
Initializing Disk Drives

If a disk drive appears grayed-out (unavailable for use in a new array), it may need to be initialized. To begin initializing a disk drive, select **Initialize Drives** from the Logical Device Configuration menu. You can initialize one drive or multiple drives. If an error occurs during initialization, the message "Initializing drives...FAILED x of n" is displayed. Press Enter to see a list of drives that failed to initialize. Press Esc to continue.

**Caution:** Do not initialize a disk drive that is part of an array. Initializing a disk drive that’s part of an array may make the array unusable. Back up all data from your disk drive before you initialize it.

Rescanning Disk Drives

To begin rescanning a disk drive, select **Rescan Drives** from the Logical Device Configuration menu.

Secure Erasing Disk Drives

When you perform a secure erase on a disk drive, all data on that disk drive is completely and irretrievably eradicated. Secure erase performs three distinct writing passes to the disk drive being erased—it does not just write zeros.

Performing a secure erase takes up to six times longer than clearing (or zeroing) a disk drive; on a 2TB or 3TB drive, often it takes hours, possibly as long as a day! You may want to perform a secure erase only on disk drives that contain confidential or classified information.

**Note:** To erase (or zero) a disk drive with non-classified information, you may choose to format it (see **Formatting and Verifying Disk Drives** on page 80) instead, or initialize it using maxView Storage Manager—both options take much less time than the secure erase option.

To begin a secure erase, select **Secure Erase** from the Logical Device Configuration menu, then select Y (yes). To return to the main Logical Device Configuration menu once the secure erase has begun, press Esc.

**Note:** For newer SATA drives, you can choose to perform a Secure ATA Erase, which implements the secure erase feature at the drive firmware level. To start a Secure ATA Erase, select a SATA drive, then type Ctrl-S to open the Secure ATA Erase dialog. You will see this dialog only if the drive supports Secure ATA Erase.

The selected disk drive(s) cannot be used until the erase is complete.

Stopping a Secure Erase

To stop a secure erase in progress:

1. In the Logical Device Configuration menu, select **Secure Erase**.
2. Select the disk drive being secure erased, then press Ctrl+Q.
   
   The secure erase stops and you return to the main Logical Device Configuration menu.

Uninitializing Disk Drives

Uninitializes one or more physical drives. This option clears Adaptec meta-data and reserved space and any OS partitions from a drive; any existing data on the drive is destroyed. Drives can uninitialized only if they are not part of any array.

**Note:** Uninitialized drives are surfaced to the OS as RAW Pass Through Devices. Typically, they are used with the controller in HBA mode. Uninitialized drives are also compatible with any HBA and can be exchanged with drives on the motherboard’s SATA interface. For more information about uninitialized devices and controller modes, see **General Controller Settings** on page 78.

To begin uninitializing a disk drive, select **Uninitialize Drives** from the Logical Device Configuration menu, then type Y to continue.
Using the ARC Utility to Modify Controller Settings

The ARC Controller Settings tool allows you to modify the settings of your controller and the disk drives connected to it.

Opening the Controller Settings Tool

To open the ARC Controller Settings tool, start the ARC utility (see Running the ARC Utility on page 74), select Controller Settings from the ARC main menu, then press Enter.

Follow the on-screen instructions to modify the settings of your controller and connected disk drives, as needed.

Applying Changes and Exiting

1. To exit the Controller Settings tool, press Esc until you are prompted to exit.
   If you modified any settings, you are prompted to save the changes before you exit.
2. Select Yes to exit, then press any key to restart your computer.
   Any changes you made take effect after the computer restarts.

Modifying Your Controller’s Configuration

Note: Default controller settings are suitable for most computers. We recommend that you do not change the default setting.

To modify your controller's basic settings, select Controller Configuration from the main Controller Settings menu.

To modify your controller’s power management settings, select Advanced Configuration.

Some options may not be available for your controller.

General Controller Settings

Note: Default settings are shown in bold type.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
</table>
| Drive’s Write Cache           | When set to Enable All, write cache is enabled on all disk drives on the controller. (Enabling the write cache overrides any individual drive settings in maxView Storage Manager.) When set to Disable All, write cache is not used on the disk drives. When set to Drive Specific, write cache is enabled/disabled on a per-drive basis in maxView Storage Manager.  
  Caution: When write cache is enabled, there is a slight possibility of data loss or corruption during a power failure. |
<p>| Runtime BIOS                  | When enabled, the controller BIOS allows the controller to act as a bootable device. Disabling the BIOS allows another controller to act as a bootable device. |
| Automatic Failover            | When enabled, the controller automatically rebuilds an array when a failed disk drive is replaced. When disabled, the array must be rebuilt manually. |
| Array Background Consistency Check | When enabled, the controller constantly verifies a redundant array. Note that there may be a significant performance reduction. Default is disabled. |
| Array-based BBS Support       | When enabled in systems that support BBS, the controller presents attached bootable devices up to the BIOS for boot device selection. This is relevant for logical arrays. Default is disabled. |
| SATA Native Command Queuing (NCQ) | When enabled, NCQ is enabled. Disable this feature if you want to attach more than 48 SATA II disk drives. Only available with SATA II disk drives. |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Drives Display During POST</td>
<td>When enabled, connected disk drives are displayed during system Power On Self Test (POST). Displaying the disk drives adds a few seconds to the overall POST time. Default is disabled.</td>
</tr>
<tr>
<td>DVD/CD-ROM Boot Support</td>
<td>When enabled, the system can be booted from a bootable DVD/CD. (This setting is not available on all RAID controller models.)</td>
</tr>
<tr>
<td>Removable Media Devices Boot Support</td>
<td>When enabled, removable media devices, such as CD drives, are supported. (This setting is not available on all RAID controller models.)</td>
</tr>
<tr>
<td>Alarm Control</td>
<td>When enabled, the alarm sounds. Default is enabled. Note: When the alarm is turned off (disabled), it will remain off after a reboot.</td>
</tr>
<tr>
<td>Default Background Task Priority</td>
<td>Sets the default priority for background tasks on the controller (such as logical drive creation) to High, Medium, or Low. Default is High. Note: This setting applies to new tasks. It does not affect currently running tasks.</td>
</tr>
<tr>
<td>LED Indication Mode</td>
<td>When set to Activity and Fault, the drive activity LEDs blink to indicate I/O activity (randomly depending on I/O load) and fault (steady 1Hz). When set to Fault Only, the drive activity LEDs blink to indicate fault state only. For Series 6/6E controllers, default is Fault Only.</td>
</tr>
<tr>
<td>Backplane Mode</td>
<td>When set to Default, controller automatically sets the backplane mode to IBPI. To set the backplane mode explicitly, select IBPI, SGPIO, or Disabled. Default is IBPI. Note: With the default IBPI setting, the firmware sends a SGPIO &quot;Backplane_TYPE&quot; signal if it recognizes that a SGPIO Backplane is connected. If any connected SGPIO backplane does not support the &quot;Backplane_TYPE&quot; signal, or it does not support the IBPI protocol, you can manually set the Backplane Mode to &quot;SGPIO&quot;.</td>
</tr>
<tr>
<td>Selectable Performance Mode</td>
<td>When set to Dynamic, performance criteria adjusts automatically based on controller usage, RAID level, and disk drive type. When set to OLTP/Db, performance criteria is optimized for transaction-oriented applications, such as data entry and retrieval. When set to User Defined, you are prompted to use the OS tools to set individual parameters (contact Adaptec support for more information). Default is Dynamic.</td>
</tr>
<tr>
<td>Controller Mode</td>
<td>• When set to RAID Mode, all RAID functions of the controller are enabled. • When set to Auto Volume Mode, RAID functions of the controller are enabled. Attached drives without Adaptec meta-data, but with an OS partition, are surfaced to the host operating system as RAW Pass Through devices (similar to JBODs on legacy Adaptec controllers), where the RAID layer of the controller firmware is bypassed when the host issues commands to the device. Attached drives without Adaptec meta-data and without OS partitions, are automatically configured as Simple Volumes (single drives with Adaptec meta-data). Auto Volume Mode enables DRAM caching on rotating media to help reduce latency and accelerate performance. • When set to HBA Mode, attached drives are surfaced as RAW devices. The intent of this mode is to allow the RAID controller to act and be used as an HBA. Changing into HBA mode is allowed only if there are no drives with Adaptec meta-data attached to the controller (see Uninitializing Disk Drives on page 77 for more information). Uninitialized drives are</td>
</tr>
</tbody>
</table>
Option | Description
--- | ---
compatible with any HBA and can be exchanged with drives on the motherboard’s SATA interface. Default is RAID Mode.

**Power Management Settings**

*Note:* When power management is disabled, no related options will be displayed.

*Note:* Make sure the operating system driver supports power management.

*Note:* Default settings are shown in **bold** type.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Management Settings</td>
<td>When enabled, switches the system to low power state, based on the specified settings.</td>
</tr>
<tr>
<td>Time Zone</td>
<td>The time zone of the place in which the system is located. Time specific power management settings are implemented based on the set time zone. By default, it is set to 00:00. The valid range for the time zone settings is -12:00 to +12:00.</td>
</tr>
<tr>
<td>Stay Awake Start</td>
<td>The time from which the system should operate in the full power mode, irrespective of other power management settings, daily. By default it is set to <strong>00:00</strong>. The valid range is 00:00 to 23:59.</td>
</tr>
<tr>
<td>Stay Awake End</td>
<td>The time until which the system should operate in the full power mode, irrespective of other power management settings, daily. By default it is set to <strong>00:00</strong>. The valid range is 00:00 to 23:59.</td>
</tr>
<tr>
<td>Spin Up Limit (Internal)</td>
<td>The number of internal drives to be spun up at any given moment. By default it is set to 0. In the default setting, all the internal drives will spin up.</td>
</tr>
<tr>
<td>Spin Up Limit (External)</td>
<td>The number of external drives to be spun up at any given moment. By default it is set to 0. In the default setting, all the external drives will spin up.</td>
</tr>
</tbody>
</table>

**Checking Backup Unit Status**

To check the status of the controller’s flash backup unit, select **Backup Unit Status** from the Controller Settings menu. This option is available only if the controller is configured with a flash backup unit.

**Formatting and Verifying Disk Drives**

You can use the ARC Disk Utilities tool to low-level format or verify your disk drives. (New disk drives are low-level formatted at the factory and do not need to be low-level formatted again.)

*Caution:* Before you format a disk drive, back up all data. Formatting destroys all data on a disk drive.

To format or verify a disk drive:

1. Start the ARC utility (see **Running the ARC Utility** on page 74).
2. Select the controller you want, then press Enter.
3. Select **Disk Utilities**.
4. Select the disk drive you want, then press Enter.
5. Select **Format Disk** or **Verify Disk Media**.
Locating Disk Drives

You can use the Identify Drive feature to physically locate a disk drive by blinking the LED.

**Note:** This feature is only available with disk drives that have an activity LED.

To locate a disk drive:

1. Start the ARC utility (see *Running the ARC Utility* on page 74).
2. Select the controller you want, then press Enter.
4. Select the disk drive you want, then press Enter.
5. Select Identify Drive, then press Enter.
6. When you have finished locating your disk drive, press any key to stop the blinking.

Identifying Disk Drives

You can identify disk drives by viewing the list of disk drives on your system. Only physical drives that display during POST are shown.

To identify a disk drive:

1. Start the ARC utility (see *Running the ARC Utility* on page 74).
2. Select the controller you want, then press Enter.

The Disk Utilities view provides you with the following information:

<table>
<thead>
<tr>
<th>Location</th>
<th>Model</th>
<th>Rev#</th>
<th>Speed</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1=DEV1</td>
<td>The manufacturer</td>
<td>The revision number of the disk drive.</td>
<td>The speed of the disk drive.</td>
<td>The size of the disk drive.</td>
</tr>
<tr>
<td>Box0=Slot0</td>
<td>information.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exp0=phy0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The location information of a disk drive is determined by three types of connections:

- Direct attached drives—The connection is determined by the cable connected to a device, for example CN1 (connector 1) is connected to DEV1 (device 1). For more information, see *Direct-attach Connections* on page 64.
- Storage Enclosure Processor (SEP) managed devices—The connection is determined by an active backplane. Box0 (enclosure 0) is connected to slot0 (disk drive slot 0 in the enclosure). For more information, see *Backplane Connections* on page 65.
- Expanders—The connections is determined by an expander. Exp0 (expander 0) is connected to phy0 (phy 0 within a connector). For more information, see *SAS Expander Connections* on page 65.

**Note:** Devices other than disk drives (CDROM, tape drives, etc...) are listed in order after your system disk drives.

Viewing the Event Log

The BIOS-based event log records all firmware events, such as configuration changes, array creation, and boot activity.

Some events are not stored indefinitely—the event log is cleared of any non-persistent events each time you restart your computer; additionally, once the log is full, new events overwrite old events.

To view the event log:

1. Start the ARC utility (see *Running the ARC Utility* on page 74).
2. Select the controller you want, then press Enter.
3. When the ARC utility menu appears, press Ctrl+P.

4. Select **Controller Log Information**, then press **Enter**.
   The current event log opens.
Using the Adaptec Flash Utility

This chapter describes how to use the Adaptec Flash Utility (AFU), a text-based DOS utility that you can use to update, save, or verify the RAID controller’s firmware.

**Caution:** Although the AFU contains safeguards to prevent you from accidentally damaging your RAID controller’s flash contents, it is still important to use the AFU carefully and correctly to avoid rendering your RAID controller inoperable. We recommend that only advanced users familiar with working in DOS use the AFU. For more information, see *Managing Your Storage Space* on page 57.

**System Requirements**

- **DOS version 5.0 or later.**
  
  **Note:** You can’t run the AFU from a DOS command prompt window under any version of Windows.

- At least 8 MB of extended memory.

**Compatibility Notes**

- Supports HIMEM.SYS; compatible with other DOS drivers running under HIMEM.SYS (for example, SMARTDRV.SYS and SETVER.SYS).

- *Does not* support DOS extenders installed in memory, such as EMM386.SYS and DOS4GW.

**Before You Begin**

1. Obtain the firmware (see the following section).
2. Create firmware disk (see *Creating the Firmware Update Disk* on page 83).

There are two ways to run the AFU:

1. Using the AFU menus (see *Running the Menu-based AFU* on page 84)
2. From the command line (see *Running the AFU from the Command Line* on page 84)

**Obtaining the Firmware**

To obtain RAID controller firmware, go to:

- Adaptec Installation DVD—Includes the AFU executable (AFU.exe) and a separate flash image. The flash image comprises a single User Flash Image (UFI) file.
- Adaptec Web site—Download a new firmware file to get the most recent version of firmware/BIOS and AFU.

See [www.adaptec.com](http://www.adaptec.com) for more information.

**Creating the Firmware Update Disk**

To create the firmware update disks:

1. Copy these files to a USB flash drive or writable CD:
   - AFU.exe
   - Axxxx01.ufi
   
   where xxx is the model number of your controller.
   
   **Note:** Most controller model numbers have a suffix (for example, Adaptec RAID 6405). Check that the .ufi file is the correct file for your controller before copying.

2. To use a menu-based AFU, see the following section.

   To run the AFU from the command line, see *Running the AFU from the Command Line* on page 84.
Running the Menu-based AFU

To run the menu-based AFU:

1. Shut down your operating system and reboot to DOS from a bootable DOS floppy disk or from a DOS partition on a bootable drive. (You can use a disk drive connected to the controller you are updating.) If your computer isn’t set up to boot from the bootable floppy disk, enter the system setup utility and change the setting.

2. Insert the firmware update disk (created using the steps above) containing AFU.exe

3. At the DOS command prompt, type `AFU` with no arguments. The AFU’s main menu is displayed.

4. Select **Select Controllers**, then select the Adaptec RAID controller(s) to be flashed.
   
   To update multiple RAID controllers in the same system, update the boot controller’s flash first, restart the computer, then update the flash for the remaining controllers.

5. Select **Select an Operation**.

6. Choose the operation you want, then follow the on-screen instructions to complete the task:

   - **Update flash image**—Updates all the flash components on a RAID controller with the flash image data from the UFI file.
   - **Save flash image**—Reads the contents of a RAID controller’s flash components and saves the data to a UFI file, which you can use to restore a RAID controller’s flash if required.
   - **Verify flash image**—Reads the contents of a RAID controller’s flash components and compares it to the contents of the specified UFI file.
   - **Display flash information**—Displays version information about a RAID controller’s flash components.

7. Complete the flash operation and restart your computer before trying to use the RAID controller again. (You can not use your RAID controller while you are updating its flash.) The AFU processes the selected command and reports either success or an error message code.

Running the AFU from the Command Line

*Note:* You can also run a menu-based AFU (see Running the Menu-based AFU on page 84).

To run the AFU from the command line:

1. Shut down your operating system and reboot to DOS from a bootable DOS floppy disk or from a DOS partition on a bootable drive. (You can use a disk connected to the controller you’re updating.) If your computer isn’t set up to boot from the bootable floppy disk, enter the system setup utility to change the setting.

2. Insert the firmware update disk containing AFU.exe.

3. At the DOS command, type AFU followed by a command (see **AFU Commands** on page 84) and any switches you want.
   
   *Note:* To find a controller number, type `AFU LIST`, then press Enter.

   The AFU processes the command and reports either success or an error message code.

To update a RAID controller’s flash using the command line utility ARCCONF, see Updating the Flash Using the AFU Command Line on page 87.

AFU Commands

This section lists the available AFU commands.
List
Displays the AFU-supported RAID controllers installed on your computer. Also displays the ID numbers assigned to each controller.
You don’t have to restart the computer after completing this command.

This example shows a typical system response to a LIST command:

```
A:\> AFU LIST
Adaptec Flash Utility V4.0-0 B5749 (c)Adaptec Inc. 1999-2005.
All Rights Reserved.
Controllers Detected and Recognized:
Controller #0 (03:05:00) Adaptec RAID 51645
```

Save
Saves the contents of a RAID controller’s flash in a UFI file. The name of the UFI file is based on the controller type and can’t be changed.
You must restart the computer following a SAVE command.
The command syntax for the SAVE command is:
AFU SAVE [/C<Controller ID>] [/D <UFI File Path>]
These switches are available:
• /C <Controller ID>—One or more RAID controller IDs representing the set of RAID controllers on which to perform the specified command. The default is 0; if the computer has multiple RAID controllers, the AFU defaults to controller 0 unless you specify otherwise.
  For example:
  To specify a single RAID controller ID: /C 0
  To specify multiple IDs separated by commas: /C 0,2
  To indicate all RAID controllers: ALL
  If you are using multiple RAID controllers, you must specify the controller you want by using the /C switch; otherwise, the AFU displays an error message and exits.
• /D <UFI File Path>—Specifies the path where the UFI files are located. If you do not specify the /D switch, the AFU looks for (or creates) its UFI files in the default location.
  You cannot specify the name of a UFI file, only its path. UFI filenames are predefined, based on the RAID controller type.
  In this example, the AFU saves flash contents from RAID controller 0 to a UFI file in the current default drive and directory:

```
A:\> AFU SAVE /C 0
In this example, the AFU saves flash contents from Controller 1 to a UFI file in C:\UFI_FILES:
```

```
A:\> AFU SAVE /C 1 /D C:\UFI_FILES
```

Update
Updates the flash components of one or more RAID controllers on your computer from the flash image data in a UFI file. You must restart the computer following an UPDATE command.
The command syntax for the UPDATE command is:
AFU UPDATE [/C<Controller ID>] [/D <UFI File Path>]
This example shows a typical system response after an update.

```
A:\> AFU UPDATE /C 0
Adaptec Flash Utility V4.0-0 B5749
(c)Adaptec Inc. 1999-2005. All Rights Reserved.
Updating Controller 0 (Adaptec RAID 31205)
Reading flash image file (Build 5749)
```
AFU is about to update firmware on controllers Adaptec RAID 51645
***PLEASE DO NOT REBOOT THE SYSTEM DURING THE UPDATE***
This might take a few minutes.
Writing Adaptec RAID 51645 (4MB) Flash Image to controller 0...OK.
Verifying...OK
Please restart the computer to allow firmware changes to take effect.

Verify
Compares the contents of each of the flash components on a RAID controller to the corresponding image in a UFI file, and indicates whether they match. After using the VERIFY command, you must restart the computer.
The command syntax for the VERIFY command is as follows:
AFU VERIFY [/C<Controller ID>] [/D <UFI File Path>]

This example shows a typical system response after a VERIFY command.
A:\> AFU VERIFY /C 0
Adaptec Flash Utility V4.0-0 B5749 (c)Adaptec Inc. 1999-2005.
All Rights Reserved.
Reading flash image file (Build 5748) Controller #0: Adaptec RAID 51645
ROM: Checksum: 797B [VALID] (Build 5748)
File: Checksum: 797B [VALID] (Build 5748)
Image Compares Correctly

Version
Displays version information about the flash components on a RAID controller. After using the VERSION command, restart your computer.
The command syntax for the VERSION command is:
AFU VERSION [/C<Controller ID>]

This example displays version information about all supported RAID controllers.
A:\> AFU VERSION /C 0
Adaptec Flash Utility V4.0-0 B5749 (c)Adaptec Inc. 1999-2005.
All Rights Reserved.
Version Information for Controller #0 (Adaptec RAID 51645)
A:\> AFU VERSION /C ALL

Help
Displays a summary of AFU functions and command switches.
For example:
A:\> AFU HELP
A:\> AFU /?
Updating the Flash Using the AFU Command Line

1. Create the firmware update disk (see Creating the Firmware Update Disk on page 83).
2. Shut down your operating system and reboot to DOS from a bootable DOS floppy disk or from a DOS partition on a bootable drive. (You can use a disk connected to the controller you’re updating.) If your computer isn’t set up to boot from the bootable floppy disk or a bootable device other than a disk drive, enter the system setup utility to change the setting.
3. Insert the firmware update disk containing AFU.exe
4. At the DOS command, if you have multiple controllers and you don’t know the number of the controller you want to update, type AFU LIST, then press Enter. Otherwise, skip to the next step.
5. At the DOS command, type AFU followed by a command (see AFU Commands on page 84) and any switches you want.
6. Update the flash using the instructions suitable for your requirements:
   - To update a single RAID controller:
     \[
     \text{AFU UPDATE /C <cont_number>}
     \]
     Where <cont_number> is the number of the RAID controller whose firmware you are updating. For example, to upgrade Controller 0, type AFU UPDATE /C 0
   - To update multiple RAID controllers:
     \[
     \text{AFU UPDATE /C <controller_number_a>,<controller_number_b>}
     \]
     Where <controller_number_a> and <controller_number_b> are the numbers of the Adaptec RAID controllers whose firmware you are updating. For example, to upgrade controllers 0, 2, and 3, type AFU UPDATE /C 0, 2, 3
   - To update all RAID controllers simultaneously:
     \[
     \text{AFU UPDATE /C all}
     \]
     Note: The UFI file identifies the RAID controllers, so you don’t have to worry about flashing the wrong controller.
7. When prompted, insert the firmware disk.
   The AFU processes the command and reports either success or an error message code.
Controller Alarm Connector Quick Reference

This appendix provides a reference guide for Adaptec RAID controller external alarm connectors.

Adaptec RAID 7805/7805Q/71605/71605Q/71605E Alarm Connector Specification

<table>
<thead>
<tr>
<th>2274100-R</th>
<th>ASR-7805 SGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2274200-R</td>
<td>ASR-7805 Kit</td>
</tr>
<tr>
<td>2274300-R</td>
<td>ASR-7805Q SGL</td>
</tr>
<tr>
<td>2274400-R</td>
<td>ASR-71605 SGL</td>
</tr>
<tr>
<td>2274500-R</td>
<td>ASR-71605E SGL</td>
</tr>
<tr>
<td>2274600-R</td>
<td>ASR-71605Q SGL</td>
</tr>
</tbody>
</table>

- Adaptec RAID 7805/7805Q/71605/71605Q/71605E External Alarm Connector: Molex 22-28-4023 or equivalent
- Alarm Mating Cable Connector: Molex 50-57-9002 or equivalent

J6:

<table>
<thead>
<tr>
<th>J6 Pin Number</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>~2kHz Square Wave</td>
<td>Open collector transistor</td>
</tr>
<tr>
<td>1</td>
<td>+3.3V</td>
<td>—</td>
</tr>
</tbody>
</table>

Adaptec RAID 71685/72405/78165 Alarm Connector Specification

<table>
<thead>
<tr>
<th>2274700-R</th>
<th>ASR-71685 SGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2274900-R</td>
<td>ASR-72405 SGL</td>
</tr>
<tr>
<td>2280900-R</td>
<td>ASR-78165 SGL</td>
</tr>
</tbody>
</table>

- Adaptec RAID 71685/72405/78165 External Alarm Connector: Molex 22-28-4023 or equivalent
- Alarm Mating Cable Connector: Molex 50-57-9002 or equivalent

J6:

<table>
<thead>
<tr>
<th>J6 Pin Number</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>~2kHz Square Wave</td>
<td>Open collector transistor</td>
</tr>
<tr>
<td>1</td>
<td>+3.3V</td>
<td>—</td>
</tr>
</tbody>
</table>
Safety Information
To ensure your personal safety and the safety of your equipment:

• Keep your work area and the computer clean and clear of debris.
• Before opening the system cabinet, unplug the power cord.

Electrostatic Discharge (ESD)

Caution: ESD can damage electronic components when they are improperly handled, and can result in total or intermittent failures. Always follow ESD-prevention procedures when removing and replacing components.

To prevent ESD damage:

• Use an ESD wrist or ankle strap and ensure that it makes skin contact. Connect the equipment end of the strap to an unpainted metal surface on the chassis.

• Avoid touching the controller against your clothing. The wrist strap protects components from ESD on the body only.

• Handle the controller by its bracket or edges only. Avoid touching the printed circuit board or the connectors.

• Put the controller down only on an antistatic surface such as the bag supplied in your kit.

• If you are returning the controller to Adaptec by PMC Product Support, put it back in its antistatic bag immediately.

If a wrist strap is not available, ground yourself by touching the metal chassis before handling the controller or any other part of the computer.
Technical Specifications

Environmental Specifications

Note: Adaptec RAID controllers require adequate airflow to operate reliably. The recommended airflow is 200 LFM (linear feet per minute), minimum. Forced airflow is required.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature with forced airflow</td>
<td>0 °C to 55 °C</td>
</tr>
<tr>
<td>Ambient temperature with Flash Backup Unit</td>
<td>0 °C to 50 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>10% to 90%, non-condensing</td>
</tr>
<tr>
<td>Altitude</td>
<td>Up to 3,000 meters</td>
</tr>
</tbody>
</table>

Note: Ambient temperature is measured 1” from the RAID processor.

DC Power Requirements

<table>
<thead>
<tr>
<th>Bus Type</th>
<th>Description</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCIe</td>
<td>Ripple and noise</td>
<td>50 mV peak-to-peak (max)</td>
</tr>
<tr>
<td>PCIe</td>
<td>DC Voltage</td>
<td>3.3 V ± 9%, 12 V ± 8%</td>
</tr>
</tbody>
</table>

Current Requirements

<table>
<thead>
<tr>
<th>Adaptec Model</th>
<th>Typical Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptec RAID 7805/7805Q</td>
<td>0.1A @ 3.3 VDC; 1.5A @ 12.0 VDC</td>
</tr>
<tr>
<td>Adaptec RAID 71605/71605Q</td>
<td>0.1A @ 3.3 VDC; 1.6A @ 12.0 VDC</td>
</tr>
<tr>
<td>Adaptec RAID 71605E</td>
<td>0.1A @ 3.3 VDC; 1.5A @ 12.0 VDC</td>
</tr>
<tr>
<td>Adaptec RAID 71685</td>
<td>0.1A @ 3.3 VDC; 1.8A @ 12.0 VDC</td>
</tr>
<tr>
<td>Adaptec RAID 72405</td>
<td>0.1A @ 3.3 VDC; 1.8A @ 12.0 VDC</td>
</tr>
<tr>
<td>Adaptec RAID 78165</td>
<td>1.1A @ 3.3 VDC; 1.3A @ 12.0 VDC</td>
</tr>
</tbody>
</table>
Index

A
activity LED connector specifications 88
Adaptec Flash Utility, See AFU
Adaptec RAID Configuration utility 57
Adaptec RAID Controller Configuration utility, See ARCCONF
adapters, See controllers
advanced data protection 17
AFU 58, 83
Alarm Control setting 79
ARC 17, 36, 39, 59, 75, 76, 77, 78, 79, 80
checking flash backup unit 80
creating arrays 36, 75
creating bootable arrays 17, 39, 75, 76
HII interface 36
initializing disk drives 75, 77
managing arrays 75
modifying controller settings 59, 78
opening Controller Settings tool 78
rescanning disk drives 77
secure erasing disk drives 77
stopping a secure erase 77
uninitializing disk drives 77, 79
ARC Controller Settings 78
applying changes 78
exiting 78
ARCCONF 17, 57
Array Background Consistency Check setting 78, 80
array migration 17
Array-based BBS Support setting 78
arrays 17, 25, 36, 37, 39, 67, 68, 69, 70, 71, 72, 75, 76
creating (ARC) 36, 75
creating (maxView Storage Manager) 37
creating bootable arrays 17, 39, 75, 76
making an array bootable 37, 39
managing with ARC 75
non-redundant 25, 67
RAID 1 25, 68
RAID 10 25, 69
RAID 1E 25, 68
RAID 5 25, 70, 71
RAID 50 25, 71, 72
RAID 6 25, 72
RAID 60 25, 72
arrays (bootable) 35, 36, 40
audible alarm 59
automatic failover 17
Automatic Failover setting 78

B
backplane connections 33, 64, 65, 81
batteryless backup 29, 30
boards, See controllers
boot controller 28, 36
bootable arrays 17, 35, 36, 37, 39, 40, 75, 76
creating 17, 35, 36, 39, 40, 75, 76
C
cards, See controllers
CD-ROM Boot Support setting 79
checking flash backup unit 80
command line interface (flash utility) 83, 84
command line utility 57
concept 14, 15, 36, 57, 58, 60
connectors 64, 81
contents of controller kit 16
controllers 14, 16, 17, 18, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 39, 59, 61, 64, 65, 66, 67, 74, 75, 77, 78, 79, 80, 81, 83, 88, 90
alarm connector specifications 88
Alarm Control setting 79
Array Background Consistency Check setting 78, 80
Array-based BBS Support setting 78
array-level features 17
Automatic Failover setting 78
CD-ROM Boot Support setting 79
connecting disk drives 30, 32, 33
connecting external devices 30, 32, 33, 34
data protection 17
descriptions 14, 16, 17, 29, 31, 33, 59, 61, 65
disk drives 25, 29
Drive's Write Cache setting 78
event log 81
figures 14, 16, 17, 29, 31, 33, 59, 61, 65
firmware 83
flashing 18, 61
installation options 27
installing 29, 59
modifying general settings 77, 78
modifying settings with ARC 74, 78
Physical Drives Display During POST setting 79
RAID levels 25, 33, 75
Removable Media Devices Boot Support setting 79
resetting 18, 61
Runtime BIOS setting 78
SAS cables 16, 25, 35, 64, 66
setting boot controller 28, 36
specifications 90
standard features 17, 25, 29
troubleshooting 59
updating firmware 83
upgrading firmware 18
D

direct-attach connections 33, 64, 81
disk drives 17, 25, 29, 30, 32, 33, 34, 59, 60, 63, 64, 74, 75, 77, 79, 80, 81
connecting to controllers 30, 32, 33
connections 81
external 30, 32, 33, 34
failure recovery 59, 60
multiple arrays 59, 60
multiple disk drives 60
RAID 0 arrays 60
with hot spare 59, 60
without hot spare 59, 60
formatting 74, 77, 80
identifying 64, 81
initializing 75, 77
recovering from failure 59
rescanning 77
SAS identifiers 33, 63, 64
secure erasing 77
stopping a secure erase 77
solid state 17, 25, 33
types of connections 81
uninitializing 77, 79
verifying 74, 77, 80
DKMS 40, 42
drive requirements 25
Drive’s Write Cache setting 78
driver and operating system installation 28, 39, 40, 52
driver disk 40
driver installation 28, 35, 36, 40, 52
drivers 40, 41, 42, 44, 47, 48, 51, 52, 54
installing on FreeBSD 52, 54
installing on Solaris 52, 54
installing on Windows 52
installing with FreeBSD 40, 47
installing with Linux 40, 41, 42, 44
installing with VMware 40, 41, 47, 48
installing with VMware 4.1 41
installing with Windows 40, 42
installing with XenServer 40, 51
drivers Debian 41
installing with Linux 40, 41, 42, 44
drivers Ubuntu 41
installing with Linux 40, 41, 42, 44
Dynamic Kernel Module Support 40, 42

E

electrostatic discharge 89
end devices 62
event log 81
expander connections 62, 64, 65, 66, 81
expander devices 62
external devices 30, 32, 33, 34

F

failed disk drives 59, 60
multiple arrays 59, 60
multiple disk drives 60
RAID 0 arrays 60
without hot spare 59, 60
firmware 83, 87
creating floppy disks 83, 87
firmware upgrades 18
flashing controllers 18, 61
floppy disks for firmware update 83, 87
formatting disk drives 74, 77, 80
FreeBSD 40, 47, 52, 54
driver installation 52, 54
OS installation 40, 47

H

hard disk 14
hard disk drive 14
hard drive, See disk drive
HBA mode 77, 79
HDA mode 61
HDA mode jumper 61
HII interface 36, 74
hot spares 17
Human Interaction Infrastructure Interface (HII) 36, 74
hybrid RAID 17, 33

I

initializing disk drives 75, 77
installation 27, 28, 29, 30, 32, 33, 34, 35, 36, 39, 40, 41, 42, 44, 47, 48, 51, 52, 59, 61, 64
backplane 33
controllers 29, 59
creating a driver disk 40
direct-attach 33, 64
disk drives 30, 32, 33
driver 28, 35, 36, 40, 52
driver and FreeBSD 40, 47
driver and Linux 40, 42, 44
driver and operating system 28, 39, 40, 52
driver and VMware 40, 41, 47, 48
driver and Windows 40, 42
driver and XenServer 40, 51
existing operating system 28
external devices 30, 32, 33, 34
installation options 27
solid state drives 33, 61
with operating system 28

K

kit contents 16
L

LED Indication Mode 79
Linux 40, 44
  OS installation 40, 44
Linux installation 40, 42
low-profile bracket 16, 27
  installing 27
low-profile computer cabinet 25

M

maxCache cache settings 75
maxCache Solid State Drive 33, 60, 61
  failed 60, 61
  installing 33, 61
maxView Storage Manager 37, 57
  creating arrays 37
  installing 57
mini-SAS 33, 64
  direct connection 33
  overview 64
mirroring 25

N

NCQ 17
non-redundant arrays 25, 67

O

online expansion 17
operating system installation 28, 39, 40, 52
operating systems 16

P

parity 25
phys 63
Physical Drives Display During POST setting 79

R

RAID 14, 17, 25, 67, 68, 69, 70, 71, 72
  non-redundant arrays 25, 67
  RAID 0 25, 67
  RAID 1 25, 68
  RAID 10 25, 69
  RAID 1E 17, 25, 68
  RAID 5 25, 70, 71
  RAID 50 25, 71, 72
  RAID 6 17, 25, 72
  RAID 60 17, 25, 72
RAID controllers, See controllers
RAID levels 25, 33, 75
recovering from disk drive failure 59
Red Hat 40, 42
  OS installation 40, 42
Redundant Array of Independent Disks, See RAID
Removable Media Devices Boot Support setting 79
replacing failed disk drives 59
  requirements 16, 25
  drive 25
rescanning disk drives 77
resetting controllers 18, 61
Runtime BIOS setting 78

S

safety information 29, 89
SAS 14, 16, 25, 33, 35, 36, 62, 63, 64, 65, 66, 81
  4-wide ports 63
  backplane connections 64, 65, 81
  cables 16, 25, 35, 64, 66
  comparison to parallel SCSI 62, 66
  connectors 63, 64
  description 33, 36, 62
  direct-attach connections 64, 81
  disk drives 33, 63, 64
  edge expanders 65
  end devices 62
  expander connections 62, 64, 65, 66, 81
  expander devices 62
  fanout expanders 65
  link speed 62
  links 62
  narrow connectors 64
  narrow ports 63
  phys 63
  ports 62, 63
  SAS address 63
  SAS cards 62
  SAS devices 62
  SAS domain 65
  terminology 62
  transceivers 62
  wide connectors 64
  wide ports 63
SAS devices 62
SAS disk drive identifiers 33, 63, 64
secure ATA erase 77
secure erasing disk drives 77
stopping a secure erase 77
Selectable Performance Mode 79
Serial Attached SCSI, See SAS
software 57
Solaris 52, 54
  driver installation 52, 54
Solid State Drive (SSD) 17, 25, 33, 61
  installing 33, 61
specifications 90
storage management 57, 58
  Adaptec RAID Configuration utility 57
  AFU 58
  ARCCONF 57
  maxView Storage Manager 57
storage space 14
SUSE installation 40, 44
system requirements 16

T

technical specifications 90
terminology 14, 38, 60, 62
SAS 62
tools 57, 58
Adaptec RAID Configuration utility 57
AFU 58
ARCCONF 57
maxView Storage Manager 57
topic 14, 17, 28, 42, 43, 44, 45, 46, 53, 54, 57, 59, 62, 83
troubleshooting tips 59

U

uEFI 36, 74
Unified Extensible Firmware Interface (uEFI) 36, 74
uninitializing disk drives 77, 79
updating firmware 83
upgrading firmware 18
utilities 57, 58
Adaptec RAID Controller utility 57

utilities (continued)
AFU 58
ARCCONF 57

V

verifying disk drives 74, 77, 80
VMware 40, 41, 47, 48
OS installation 40, 41, 47, 48

W

Windows 40, 42, 52
driver installation 52
OS installation 40, 42

X

XenServer 40, 51
OS installation 40, 51

Z

zero maintenance cache protection 17, 29, 30