USER'S GUIDE

ServeRAID M5016 SAS/SATA Controller for IBM System x

IBM P/N: 81Y1011

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Preface

This book contains installation instructions and specifications for the ServeRAID M5016 SAS/SATA controller for IBM® System x®. In addition, it documents the transportable memory module, flash power backup module, and cables.

For details on how to configure this controller, refer to the *ServeRAID-M Software User's Guide*. For information about the operating system drivers, refer to the *ServeRAID-M Device Driver Installation User's Guide*.

Organization

This document has the following chapters and appendices:

- Chapter 1, **Overview**, provides a general overview of the ServeRAID M5016 SAS/SATA controller.
- Chapter 2, **ServeRAID M5016 SAS/SATA Controller Hardware Installation**, describes the procedures for installing the ServeRAID M5016 SAS/SATA controller.
- Chapter 3, **ServeRAID M5016 SAS/SATA Controller Characteristics**, provides the characteristics and technical specifications for the ServeRAID M5016 SAS/SATA controller.
- Appendix A, **Getting Help and Technical Assistance**, contains information about help and technical assistance with your controller.
- Appendix B, **Notices**, contains information about the warranty, patents, license inquiries, and trademarks.
- Appendix C, **Glossary of Terms and Abbreviations**, lists and explains the terms and abbreviations used in this manual.

Related Publications

ServeRAID-M Device Driver Installation User's Guide

This document explains how to install the ServeRAID-M device driver for your operating system. The information in this document is independent of the back-end bus and applies to the ServeRAID-M controllers.

ServeRAID MegaCLI User's Guide

This document explains how to use the MegaCLI® Command Tool, a command line interface (CLI) configuration utility, to configure, monitor, and maintain ServeRAID-M controllers and the storage-related devices connected to the controllers.

ServeRAID-M Software User's Guide

This document explains how to use the MegaRAID Storage Manager and WebBIOS configuration utilities to configure, monitor, and maintain the ServeRAID-M controllers and the storage-related devices connected to the controllers.

Safety Information

This document contains translated caution and danger statements. Each caution and danger statement that appears in the documentation has a number that you can use to locate the corresponding statement in your language in the *Safety Information* document.

Notices and Statements

The caution and danger statements in this document are also in the multilingual *Safety Information* document, which is on the IBM Documentation CD. Each statement is numbered for reference to the corresponding statement in your language in the *Safety Information* document.

The following notices and statements are used in this document:

Note: These notices provide important tips, guidance, or advice.

Important: These notices provide information or advice that might help you avoid inconvenient or problem situations.

Attention: These notices indicate potential damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage might occur.

CAUTION: These statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.

DANGER: These statements indicate situations that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure step or situation.

Safety

Use the following safety guidelines to help protect your computer system from potential damage and to ensure your own personal safety.

Note: Use your ServeRAID M5016 SAS/SATA controller with UL-listed Information Technology Equipment (ITE) products only.

Important:

Each caution and danger statement in this document is labeled with a number. This number is used to cross reference an English-language caution or danger statement with translated versions of the caution or danger statement in the *Safety Information* document.

For example, if a caution statement is labeled "Statement 1," translations for that caution statement are in the *Safety Information* document under "Statement 1."

Be sure to read all caution and danger statements in this document before you perform the procedures. Read any additional safety information that comes with the server or optional device before you install the device.

This device is intended for use with UL Listed IBM devices.

Statement 1:

DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **Connect all power cords to a properly wired and grounded electrical outlet.**
- **Connect to properly wired outlets any equipment that will be attached to this product.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.**

To Connect:	**To Disconnect:**
1. Turn everything OFF.	1. Turn everything OFF.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Protecting against Electrostatic Discharge – Static electricity can harm delicate components inside your computer. To prevent static damage, discharge static electricity from your body before you touch any of your computer's electronic components, such as the microprocessor. You can do so by touching an unpainted metal surface, such as the metal around the card-slot openings at the back of the computer.

As you continue to work inside the computer, periodically touch an unpainted metal surface to remove any static charge your body may have accumulated. In addition to the preceding precautions, you can also take the following steps to prevent damage from electrostatic discharge:

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component in your computer. Just before unwrapping the antistatic packaging, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads.

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Chapter 1
Overview

This chapter provides a general overview of the ServeRAID M5016 SAS/SATA controller and consists of the following sections:

1.1 Overview

The ServeRAID-M5016 Serial Attached SCSI (SAS)/Serial ATA (SATA) controller is a high-performance intelligent PCI Express®-to-SAS/SATA controller with RAID control capabilities. This controller provides reliability, high performance, and fault-tolerant disk subsystem management, and offers a cost-effective way to implement RAID in a server. It is an ideal RAID solution for the storage of workgroup, departmental, and enterprise systems.

Note: This controller supports SATA, SATA II, and SATA III drives.

The ServeRAID M5100 Series 1GB Flash/RAID 5 Upgrade for IBM System x comes installed on the controller and provides transportable memory storage. The ServeRAID M5100 Series Flash Power Module for

IBM System x provides backup power to the ServeRAID M5100 Series 1GB Flash/RAID 5 Upgrade unit in case of a power failure or outage.

1.1.1 SAS and SATA Technology

SAS technology brings a wealth of options and flexibility with the use of SAS devices and SATA devices within the same storage infrastructure. However, SAS devices and SATA devices bring individual characteristics that make each one a more suitable choice depending on your storage needs.

MegaRAID® gives you the flexibility to combine these two similar technologies on the same controller and within the same enclosure. Supporting both the SAS interface, and the SATA interface, this controller is a versatile product that provides the backbone of both server and high-end workstation environments.

> Note: You cannot mix SAS drives and SATA drives within the same *virtual disk(s)*.

The ServeRAID M5016 SAS/SATA controller is based on the MegaRAID first-to-market SAS IC technology and proven technology. As a second-generation PCI Express controller, it addresses the growing demand for increased data throughput and scalability requirements across midrange and enterprise-class server platforms. IBM offers a family of SAS controllers to address the needs for both internal solutions and external solutions.

1.1.2 SAS and SATA Protocols

The controller supports the SAS protocol as described in the *Serial Attached SCSI Standard*, *Version 2.0*. In addition, the controller supports the SATA II protocol defined by the *Serial ATA specification, Version 2.0*, and the SATA III protocol defined by the *Serial ATA Specification, Version 3.0*. SATA III is an extension to SATA II.

Each port on the controller supports SAS devices and/or SATA devices using the following:

- SAS Serial SCSI Protocol (SSP), which enables communication with other SAS devices
- SATA, which enables communication with other SATA devices

- Serial Management Protocol (SMP), which communicates topology management information directly with an attached SAS expander device
- Serial Tunneling Protocol (STP), which enables communication with a SATA device through an attached expander

1.1.3 Transportable Memory Module and Flash Power Module

The ServeRAID M5016 SAS/SATA controller comes with the ServeRAID M5100 Series 1GB Flash/RAID 5 Upgrade for IBM System x installed. (The flash upgrade device is referred to in this document as the transportable memory module). You can connect the transportable memory module by cable to a remote ServeRAID M5100 Series Flash Power Module for IBM System x, which provides backup power.

The transportable memory module enables better performance in RAID 5/RAID 50 configurations and can add RAID 6/RAID 60 capability. The module is mounted on the controller and provides a 1333-mega transfers per second (MT/s), double data rate 3 (DDR3) interface between the controller and the memory integrated circuits (ICs).

A remote ServeRAID M5100 Series Flash Power Module super-capacitor pack provides the power to offload cached data from the DRAM to the nonvolatile FLASH memory on the transportable memory module if a power failure or outage occurs. The DRAM contents are restored to the transportable memory module the next time the RAID controller is powered. Cached data can then be written to the storage devices.

1.2 ServeRAID M5016 SAS/SATA Controller Limitations

The ServeRAID M5016 SAS/SATA controller has the following limitations:

- You can connect only one device per SAS PHY unless you use an expander
- You can use a maximum cable length of six feet (using shorter cables is preferred)
- Cables have to meet the SAS specification
- You cannot mix SAS drives and SATA drives in the same virtual disk

- You cannot mix SAS or SATA Solid State Drives (SSDs) and legacy mechanical drives (SAS or SATA) in the same virtual disk
- You cannot mix Solid State SAS drives and Solid State SATA drives in the same virtual disk
- See Section 3.3.4, “Power Supply Requirements for the ServeRAID M5016 Controller,” for information about the power requirements
- See Section 3.3.5, “Operating and Non-operating Conditions” for information about the minimum and maximum temperature ranges

1.3 Technical Description

The ServeRAID M5016 controller brings 6.0 Gb/s Serial Attached SCSI and 6.0 Gb/s Serial ATA performance to host controller, workstation, and server designs. The controller supports internal storage devices, which allows you to use a system that supports enterprise-class SAS drives, and desktop-class SATA drives. The controller can connect to drives directly. Simplified cabling between devices is an additional benefit.

The controller has one LSISAS2208 ROC (RAID-on-chip) processor that controls eight internal SAS/SATA ports through two x4 SAS internal connectors. This device is compliant with the Fusion-MPT architecture and provides a PCI Express x8 interface.

The controller integrates eight high-performance SAS/SATA PHYs and a PCI Express bus master DMA core. Each of the eight PHYs is capable of 6.0 Gb/s SAS link rates and 6.0 Gb/s SATA III link rates.

The LSISAS2208 ROC device provides an eight-lane, 5-Gb/s PCI Express host interface, eight 6.0 Gb/s SAS or 6.0 Gb/s SATA ports, and a full-featured, hardware-based RAID implementation. The LSISAS2208 ROC device integrates a high-speed DDR3 SDRAM interface with a hardware RAID assist engine for parity calculations. The LSISAS2208 ROC device provides the maximum benefits of a RAID system and enables you to configure the system to satisfy your system requirements.

The LSISAS2208 ROC device increases system performance and provides fault-tolerant data storage. In addition, the device supports data striping across multiple disks, which reduces disk access time because multiple disks simultaneously read or write data. The LSISAS2208 ROC

device backs up data with either data mirroring or a parity block. Either backup method enables you to recover lost data in the event of a disk failure. You can select the data backup method that best suits your needs. A hardware RAID assist exclusive-OR (XOR) engine speeds parity generation and checking and reduces system-access times.

The controller supports the following SATA features:

- 3 Gb/s SATA II performance
- 6 Gb/s SATA III performance
- Compatibility with SAS 6 Gb/s
- Staggered spin-up
- Hot plug
- Native command queuing
- Activity and fault indicators for each PHY
- Port Selector (for dual-port drives)

Each port on the ServeRAID M5016 controller supports SAS devices, SATA devices, or both using SSP, SMP, STP, and SATA. SSP enables communication with other SAS devices. SATA enables the controller to communicate with other SATA devices.

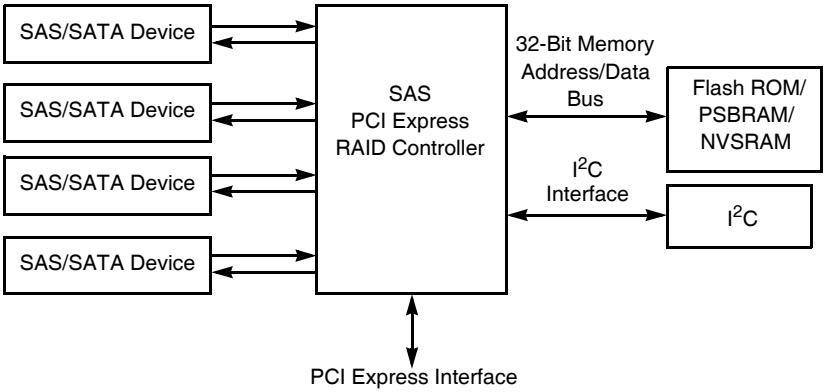
1.4 Configuration Scenarios

There are two main scenarios in which you can use this ServeRAID controller:

- **Low-end, internal SATA configuration:** In this configuration, use the ServeRAID controller as a high-end SATA compatible controller that connects up to eight disks. This configuration is mostly for low-end or entry servers. Enclosure management is provided through out-of-band I^2C bus. Side bands of both types of internal SAS connectors support the SFF-8485 (SGPIO) interface.
- **Midrange, internal SAS configuration:** This configuration is like the internal SATA configuration, but with high-end disks. This configuration is more suitable for low-range to midrange servers.

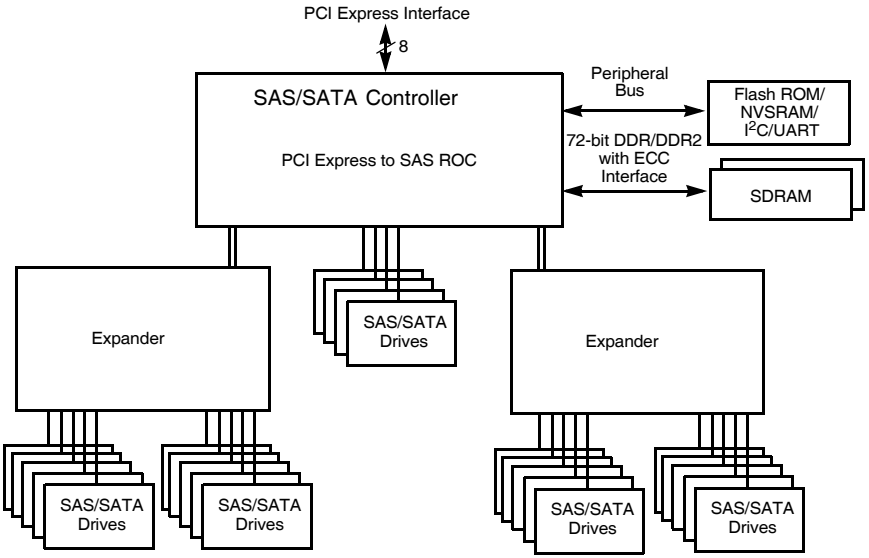
The following figure shows a direct-connect configuration. The Inter-IC (I^2C) interface communicates with peripherals. The external memory bus provides a 32-bit memory bus, parity checking, and chip select signals for pipelined synchronous burst static random access memory (PSBRAM), nonvolatile static random access memory (NVSRAM), and Flash ROM.

Figure 1.1 Example of a SAS Direct-Connect Application



The following figure shows an example of a ServeRAID controller configured with an expander that is connected to SAS disks, SATA II disks, or both.

Figure 1.2 Example of a ServeRAID SAS/SATA Controller Configured with an Expander



1.4.1 Number of Physical Disks Supported

Your configuration planning for your ServeRAID controller depends in part on the number of physical disks that you want to use in a RAID array. The number of drives in an array determines the RAID levels that can be supported by this controller. Only one RAID level can be assigned to each virtual disk. RAID 1 supports an even number of drives from two to 32.

Table 1.1 shows the minimum number and the maximum number of drives required for each RAID level.

Table 1.1 Physical Devices Required for Each RAID Level

RAID Level	Minimum # of Physical Devices	Maximum # of Physical Devices
0	1	32
1	2	32
5	3	32

Table 1.1 Physical Devices Required for Each RAID Level (Cont.)

RAID Level	Minimum # of Physical Devices	Maximum # of Physical Devices
6	4	32
10	4	32
50	6	32
60	8	32

1.5 Benefits of the SAS Interface

SAS is a serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. SAS combines the advantages of SATA, SCSI, and Fibre Channel, and is the future mainstay of the enterprise and high-end workstation storage markets. SAS offers a higher bandwidth per pin than parallel SCSI, and it improves signal and data integrity.

The SAS interface uses the proven SCSI command set to ensure reliable data transfers, while providing the connectivity and flexibility of point-to-point serial data transfers. The serial transmission of SCSI commands eliminates clock-skew challenges. The SAS interface provides improved performance, simplified cabling, smaller connectors, lower pin count, and lower power requirements when compared to parallel SCSI.

The ServeRAID M5016 controller leverages a common electrical and physical connection interface that is compatible with Serial ATA technology. The SAS protocols and the SATA protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 26-wire ATA cable. The SAS/SATA connector and cable are easier to manipulate, allow connections to smaller devices, and do not inhibit airflow. The point-to-point SATA architecture eliminates inherent difficulties created by the legacy ATA master-slave architecture, while maintaining compatibility with existing ATA firmware.

1.5.1 PCI Express Architecture

PCI Express is a local bus system designed to increase data transfers without slowing down the central processing unit (CPU). You can install your ServeRAID M5016 controller in PCI Express computer systems with a standard bracket type. With these controllers in your system, you can connect SCSI devices and SATA devices over the bus.

PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

1.5.2 Operating System Support

To check for the latest list of supported operating systems and to download the drivers for those operating systems, see http://www.ibm.com/systems/support/.

The ServeRAID M5016 controller uses Fusion-MPT™ architecture for all major operating systems, thinner drivers, and better performance.

1.6 Benefits of the ServeRAID M5016 Controller

This section provides a summary of the features and benefits of the ServeRAID M5016 controller. It contains information on SAS features, SATA features, PCI performance, integration, usability, and flexibility.

The ServeRAID M5016 controller offers the following features:

- PCI Express x8 lane width
- PCI Express performance up to 5 Gb/s per lane
- 1 GB Double Data Rate III (DDR3) at 667 MHz custom module with iBBU support or with USB cache offload
- Two internal connectors
- Support for RAID levels 0, 1, 5, 6, 10, 50, and 60
- Advanced array configuration and management utilities
- Online RAID level migration
- Drive migration

- Drive roaming
- Media scan
- No reboot necessary after expansion
- More than 200 Qtags per array
- User-specified rebuild rate
- 32-Kbyte nonvolatile random access memory (NVRAM) for storing RAID system configuration information; the MegaRAID SAS firmware is stored in flash ROM for easy upgrade.

1.6.1 SAS Features

The following list describes the SAS features of the ServeRAID M5016 controller:

- Provides eight fully independent PHYs
- Supports 6.0 Gb/s SAS data transfers per PHY
- Supports SSP to enable communication with other SAS devices
- Supports SMP to communicate topology management information
- Provides a serial, point-to-point, enterprise-level storage interface
- Simplifies cabling between devices
- Provides a scalable interface that supports up to 240 devices through the use of expanders
- Supports wide ports consisting of 2, 3, or 4 PHYs within a single quad port
- Supports narrow ports consisting of a single PHY
- Transfers data using SCSI information units

1.6.2 SAS Array Limitations

This section describes the array limitations of the controller. These include limitations such as the number of physical disks supported, the maximum number of disks per controller, and the maximum number of virtual disks allowed per controller.

Table 1.2 lists the array limitations for the ServeRAID M5016 controller.

Table 1.2 ServeRAID M5016 SAS/SATA Controller Array Limitations

Specification	ServeRAID M5016 SAS/SATA Controller
Maximum virtual disks per controller	64
Maximum arrays per controller	128
Maximum virtual disks per array	16
Maximum physical devices per array	32
Maximum physical devices per controller	128
Maximum hot spares	128
Maximum spans per virtual disk	8
Maximum ports	2

Note: The maximum number of hot spares per array is equal to the maximum number of physical drives per array.

The controller supports 64-bit logical block addressing (LBA), which makes it possible to connect a large number of drives to the RAID controller, directly and through expanders. However, the actual number of drives that you can attach depends on the limits listed in Table 1.2 rather than by the actual RAID volume capacity.

The maximum numbers in Table 1.2 depend on how many physical devices you have connected to the controller. For example, the maximum number of arrays per controller is equal to the number of physical disks supported by the controller up to the limit of 128 arrays per controller. In addition, though you can have up to 16 virtual disks per array, and up to 128 arrays per controller, there is a limit of 64 virtual disks per controller.

1.6.3 SATA Features

The following list describes the SATA features of the ServeRAID M5016 controller:

- Supports SATA II data transfers of 3.0 Gbs/s
- Supports SATA III data transfers of 6.0 Gbs/s
- Supports STP data transfers of 3.0 Gbs/s
- Provides a serial, point-to-point storage interface
- Simplifies cabling between devices
- Eliminates the master-slave construction used in parallel ATA
- Allows addressing of multiple SATA targets through an expander
- Allows multiple initiators to address a single target (in a fail-over configuration) through an expander

1.6.4 PCI Express Performance

The following list describes the PCI Express performance features of the ServeRAID M5016 controller:

- Provides a PCI Express interface that:
  - Supports a dedicated PCI Express bus
  - Supports x8 lane configuration
  - Supports transfer rates of up to 8 Gb/s per lane
  - Complies with the *PCI Express Specification*, *Revision 3.0*
- Provides unequaled performance through the Fusion-MPT architecture
- Provides high throughput and low CPU utilization to offload the host processor

1.6.5 Usability Features

The following list describes the usability features of the ServeRAID M5016 controller:

- Simplifies cabling with point-to-point, serial architecture
- Supports smaller, thinner cables that do not restrict airflow
- Provides drive spin-up sequencing control
- Provides up to two LED signals for each PHY to indicate link activity and faults
- Provides an I^2C interface for enclosure management
- Supports the external SAS Sideband signal SFF-8485 (SGPIO) interface

1.6.6 Flexibility Features

These features increase the flexibility of the ServeRAID M5016 controller:

- Supports a Flash ROM interface, a nonvolatile static RAM (NVSRAM) interface, and a pipelined synchronous burst SRAM (PSBRAM) interface
- Offers a flexible programming interface to tune I/O performance
- Allows mixed connections to SAS targets or SATA targets
- Leverages compatible connectors for SAS connections and SATA connections
- Allows grouping of up to four PHYs in a single quad port to form a wide port
- Allows programming of the World Wide Name

1.6.7 Drive Roaming

Drive roaming occurs when the physical disks are changed to different ports on the same controller. When the drives are placed on different channels, the controller detects the RAID configuration from the configuration data on the drives.

Note: In a clustering environment, drive roaming is supported within the same channel only.

Configuration data is saved in both the NVRAM on the RAID controller and on the drives attached to the controller. This action maintains the integrity of the data on each drive, even if the drives have changed their target ID.

Note: If you move a drive that is being rebuilt, the rebuild operation will restart, not resume.

Follow these steps to use drive roaming:

Step 1. Turn off the power to the server and all physical disks, enclosures, and system components. Disconnect the power cords from the system.

Step 2. Open the host system by following the instructions in the host system technical documentation.

Step 3. Move the drives to different positions on the backplane to change the targets.

Step 4. Determine the SAS target requirements.

Step 5. Perform a safety check.

a. Make sure that the drives are inserted correctly.

b. Close the cabinet of the host system.

Step 6. Reconnect the power cords to the system.

Step 7. Turn on the power to the system.

The controller then detects the RAID configuration from the configuration data on the drives.

1.6.8 Drive Migration

Drive migration is the transfer of a set of drives in an existing configuration from one controller to another. The drives must remain on the same channel and must be reinstalled in the same order as in the original configuration. The controller to which you migrate the drives cannot have an existing configuration.

Note: Only complete configurations can be migrated; individual virtual disks cannot be migrated.

Note: Drive roaming and drive migration cannot be supported at the same time.

Follow these steps to migrate drives:

Step 1. Make sure that you clear the configuration on the system to which you migrate the drives, to prevent a configuration data mismatch between the drives and the NVRAM.

Note: When you migrate drives, move only the disks that make up the virtual disk (not all of the physical disks in an array), so that you do not have an NVRAM mismatch error (providing a configuration is on the destination controller). The NVRAM mismatch error appears only if you move all of the drives to the other controller.

Step 2. Turn off the power to the server and all physical disks, enclosures, and system components. Disconnect the power cords from the systems.

Step 3. Open the host system, following the instructions in the host system technical documentation.

Step 4. Remove the SAS cable connectors from the internal drives that you want to migrate.

a. Make sure that pin 1 on the cable matches pin 1 on the connector.

b. Make sure that the SAS cables conform to all SAS specifications.

Step 5. Remove the physical disks from the first system, and insert them into drive bays on the second system.

Step 6. Connect the SAS cables to the physical disks in the second system.

Step 7. Determine the SAS target requirements.

Step 8. Perform a safety check.

a. Make sure that all of the cables are attached correctly.

b. Make sure that the RAID controller is installed correctly.

c. Close the cabinet of the host system.

Step 9. Reconnect the power cords to the system.

Step 10. Turn on the power to the system.

The controller detects the RAID configuration from the configuration data on the drives.

1.7 Hardware Specifications

You can install your ServeRAID M5016 controller in a computer with a mainboard that has a PCI Express slot. Table 1.3 describes the hardware configuration features of the controller.

Table 1.3 ServeRAID M5016 SAS/SATA Controller Specifications

Specification	ServeRAID M5016 SAS/SATA Controller
RAID Levels	0, 1, 5, 6, 10, 50, and 60
Devices Supported per Port	Up to 122 SAS devices or SATA devices (such as drives and expanders)
Ports	Eight internal
Data Transfer Rate	Up to 6 Gb/s per phy
Bus	PCI Express 2.0
Cache Function	Write-back, write-through, adaptive read ahead, non-read ahead, read ahead, cache I/O, direct I/O
Multiple Virtual Disks/ Arrays per Controller	Up to 40 virtual disks per controller or per logical array
Online Capacity Expansion	Yes
Dedicated and Global Hot Spares	Yes
Hot Swap Devices Supported	Yes

Table 1.3 ServeRAID M5016 SAS/SATA Controller Specifications

Specification	ServeRAID M5016 SAS/SATA Controller
Non-Disk Devices Supported	Yes
Mixed Capacity Physical Disks Supported	Yes
Number of Internal Connectors	Two (x4 SAS Port) SFF-8087 Mini SAS 8i connectors
Hardware Exclusive OR (XOR) Assistance	Yes
Direct I/O	Yes
Architecture	Fusion-MPT

1.8 Technical Support

See the *Warranty and Support Information* document for information about the technical support available for this product.

Chapter 2 ServeRAID M5016 SAS/SATA Controller Hardware Installation

This chapter describes the procedures used to install the ServeRAID M5016 SAS/SATA controller and mount the ServeRAID M5100 Series Flash Power Module for IBM System x in the server. It consists of the following sections:

2.1 Requirements

The following items are required for installation:

- A ServeRAID M5016 SAS/SATA controller
- A host system with an available PCI Express expansion slot
- The *ServeRAID-M Documentation* CD containing the documentation
- The necessary cables
- A backplane and an enclosure for SAS drives and SATA drives (Mechanical or Solid State Devices, SSDs)
- ServeRAID M5100 Series 1GB Flash/RAID 5 Upgrade for IBM System x (comes installed on the controller)
- ServeRAID M5100 Series Flash Power Module for IBM System x

Note: ServeRAID M5100 Series Flash Power Module

Note: For optimal performance, use an uninterruptible power supply.

2.2 Quick Installation

The following steps are for quick installation of your controller. These steps are for experienced computer users/installers. Section 2.3, "Detailed Installation," contains the steps for all others to follow.

Step 1. Review all safety information provided with the server; then, turn off the power to the server and all of the attached devices, and unplug the server and the device power cords.

Step 2. Open the cabinet of the host system by following the instructions in the host system technical documentation.

Step 3. Install the controller in the server and connect the SAS devices or the SATA devices to it. Make sure that the cables you use conform to all specifications.

Step 4. Perform a safety check.

a. Make sure that all cables are properly attached

b. Make sure that the controller is installed correctly

c. Close the cabinet of the host system

Step 5. Reconnect the power cords to the system and to all attached devices.

Step 6. Turn on the power to the system after you complete the safety check.

2.3 Detailed Installation

This section provides detailed instructions for installing the ServeRAID M5016 controller.

Step 1. Unpack the Controller

Unpack and remove the controller. Inspect it for damage. If it appears damaged, or if any of the following items are missing, contact your place of purchase. The controller is shipped with the following items:

- The *ServeRAID-M Documentation* CD containing an electronic version of this *User's Guide* and other related documentation
- Warranty information

Step 2. Turn off the Power to the System

Review all safety information provided with the computer; then, turn off the power to the computer, unplug the power cords from the power supplies, disconnect the computer from the network, and remove the computer cover. See the documentation provided with the computer for instructions. Before you install the controller, make sure that the computer is disconnected from the power and from any networks.

Step 3. Review the Controller Connectors

Refer to Chapter 3, "ServeRAID M5016 SAS/SATA Controller Characteristics" for a diagram of the ServeRAID M5016 controller with its connectors.

Step 4. Review the Controller Limitations

Review Section 1.2, "ServeRAID M5016 SAS/SATA Controller Limitations" before you install the controller in the system.

Step 5. Install the Controller

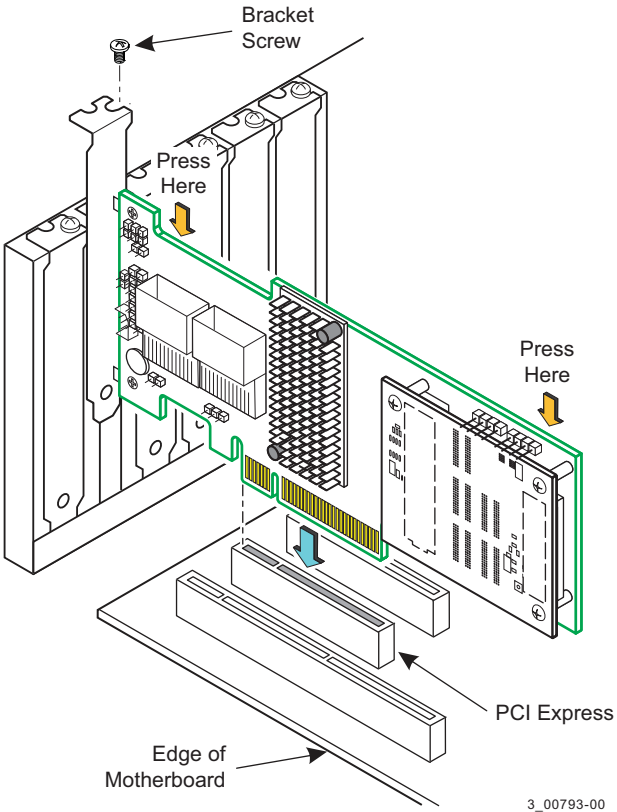
Select a PCI Express slot and align the controller's PCI Express bus connector to the slot. Press down gently but firmly to ensure that the card is properly seated in the slot. Secure the bracket to the computer chassis.

The following figure shows the installation of the ServeRAID M5016 controller in a PCI Express slot.

Note: Some PCI Express slots support PCI Express graphics cards only. If a controller is installed one of those slots, the controller will not function.

Attention: To avoid damage to the computer, always remove the controller from the PCI Express slot before you relocate or ship the computer.

Figure 2.1 Installing the ServeRAID M5016 Controller in a PCI Express Slot



Step 6. Configure and Install the SAS Devices, the SATA Devices, or Both in the Host Computer Case

Configure the SAS devices, SATA devices, or both, and install them in the external enclosure.

Note: See the documentation for the external devices for pre-installation configuration requirements.

Step 7. Connect the SAS Devices, the SATA Devices, or Both to the Controller

Use SAS cables to connect SAS devices, SATA devices, or both to the controller.

Refer to Section 2.5, "Connecting a ServeRAID-M5016 SAS/SATA Controller to a Drive Backplane on an Enclosure" for information about connecting the controller to the backplane on an expander containing SAS drives and SATA drives.

The maximum cable length is six meters. You can connect one device per SAS PHY unless you use an expander.

System throughput problems can occur if the SAS cables are not the correct type. To minimize the potential for problems:

a. Use cables no longer than six meters (using shorter cables is preferred)

b. Use cables that meet the SAS specification

c. Route the SAS cables carefully

Step 8. Turn on the Power to the System

Reinstall the computer cover and reconnect the AC power cords; then, turn on the power to the computer.

Make sure that the power is turned on to the SAS devices and the SATA III devices before or at the same time as the host computer. If the power is turned on to the computer before it is turned on to the devices, the computer might not recognize the devices.

For the United Extensible Firmware Interface (uEFI), no BIOS message displays. Press F1 to enter System Setup. Refer to your system user's guide for specific configuration information.

Under other interfaces or operating systems, a BIOS message appears during boot. The firmware takes several seconds to initialize. The configuration utility prompt times out after several seconds. The second portion of the BIOS message displays the controller number, firmware version, and cache SDRAM size. The numbering of the controller follows the PCI slot scanning order used by the host mainboard.

Step 9. Run the WebBIOS Configuration Utility

Run the WebBIOS Configuration Utility to configure the physical arrays and the logical drives. When the message `Press <Ctrl><H> for WebBIOS` appears on the screen, press CTRL-H immediately to run the utility.

Step 10. Install the Operating System Driver

The controller can operate under various operating systems. To operate under these operating systems, you must install the software drivers. You can find and download the latest drivers at http://www.ibm.com/support/. For updates, click **Downloads and drivers**.

Device driver updates are made available periodically. To ensure that you have the current version of the driver, download the latest driver at http://www.ibm.com/support/. See the readme file that accompanies the driver for any updated information.

For details on installing the driver, refer to the *ServeRAID-M Device Driver Installation User's Guide* on the *ServeRAID-M Documentation* CD. Be sure to use the latest Service Packs provided by the operating system manufacturer and to review the `readme` file that accompanies the driver.

2.4 After Installing the Controller

After the you install the controller, you must configure it and install the operating system driver. The *ServeRAID-M Software User's Guide* instructs you on the configuration options and how to set them on your controller. The *ServeRAID-M Device Driver Installation User's Guide* provides detailed installation instructions for operating system drivers.

2.5 Connecting a ServeRAID-M5016 SAS/SATA Controller to a Drive Backplane on an Enclosure

This section describes how to connect the ServeRAID M5016 controller by cable to the drive backplane on an enclosure. The enclosure can contain SAS drives and SATA drives.

Both the SAS protocols and the SATA protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 26-wire ATA cable. An iPass™ cable with a SFF-8087 mini-SAS 4i internal connector at each end is used to connect the controller to the drive backplane of an enclosure containing SAS drives and/or SATA drives.

Note: Use only straight SAS cables, not cross-over SAS cables.

Follow these steps to connect the SFF-8087 mini-SAS 4i internal connectors on the cable to the controller and the drive backplane.

Step 1. Read the safety information that comes with the controller

Step 2. Turn off the server and peripheral devices and disconnect the power cords.

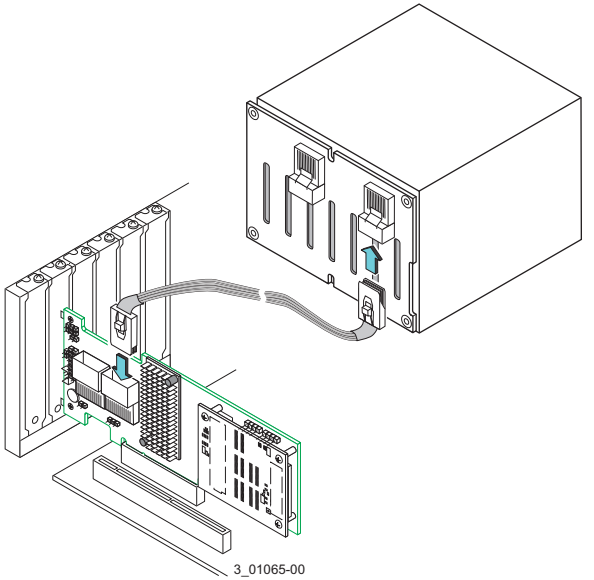
Step 3. Remove the server cover.

Step 4. Plug the SFF-8087 mini-SAS 4i internal connector on one end of the cable into the x4 SAS port 0-3 connector on the controller, as shown in the following figure.

Step 5. Plug the SFF-8087 mini-SAS 4i internal connector on the other end of the cable into the port connector on the drive backplane.

You can use another SFF-8087 mini-SAS 4i internal cable to connect the other port connector on the controller to the other port connector on the drive backplane.

Figure 2.2 Connecting a ServeRAID M5016 Controller Internal Connector to a Drive Backplane



Step 6. Replace the server cover.

Step 7. Slide the server into the rack.

Step 8. Reconnect the power cords and any cables that you removed.

Step 9. Turn on the peripheral devices and the server.

2.6 Mounting and Connecting a ServeRAID M5100 Series Flash Power Module

In the event of a power failure, the super capacitor in the flash power module has enough power to copy the cache memory contents on to a non-volatile USB device on the battery backup unit.

The remote ServeRAID M5100 Series Flash Power Module super-capacitor pack protects the integrity of the cached data on the controller by providing backup power if there is a complete ac power failure or a brief power outage. It provides the power to offload cached data from the DRAM to the nonvolatile FLASH memory on the transportable memory module if a power failure or outage occurs. The DRAM contents are

restored to the transportable memory module the next time the controller is powered. Cached data can then be written to the storage devices.

Attention: To avoid the loss of data, back up your data before you change your system configuration.

To mount the flash power module inside the server, complete the following steps:

Step 1. Read the safety information that comes with the server.

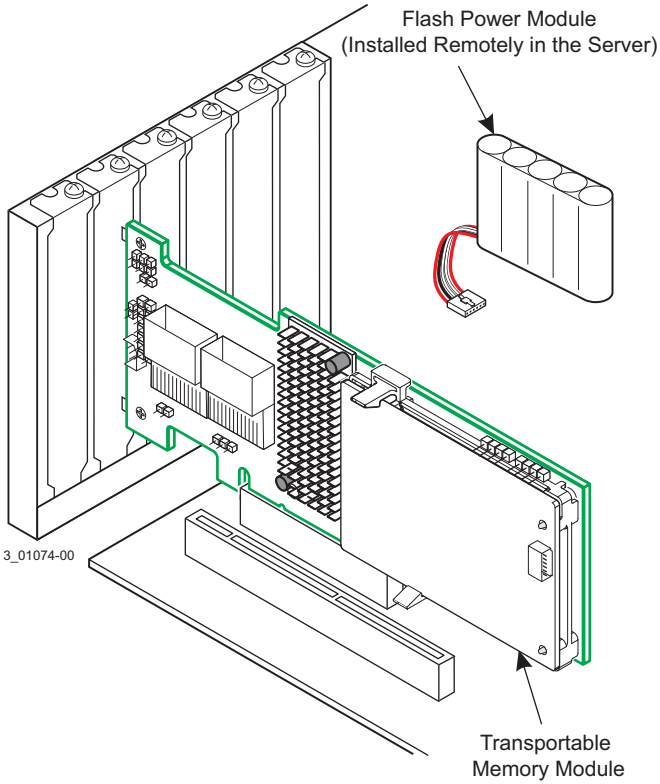
Step 2. Turn off the server and peripheral devices and disconnect the power cords. Remove the server cover. For more information, see the installation instructions that come with the server.

Step 3. In a static-free environment, carefully remove the flash power module from the antistatic bag and inspect it for damage. If it appears to be damaged, contacty our place of purchase.

Step 4. Mount the flash power module in a suitable location inside the server, observing the following guidelines:

- No standard method exists to mount the flash power module inside the server. The correct mounting location and procedure depends on the server configuration.
- You must connect a remote-mount cable to the flash power module that is installed remotely in the server and to the transportable memory module mounted on the controller. Make sure that one of the remote-mount cables that comes with the transportable memory module is long enough to make this connection when the controller is installed in the server.

Figure 2.3 Flash Power Module Installed Remotely inside the Server



Step 5. Connect the transportable memory module to the flash power module:

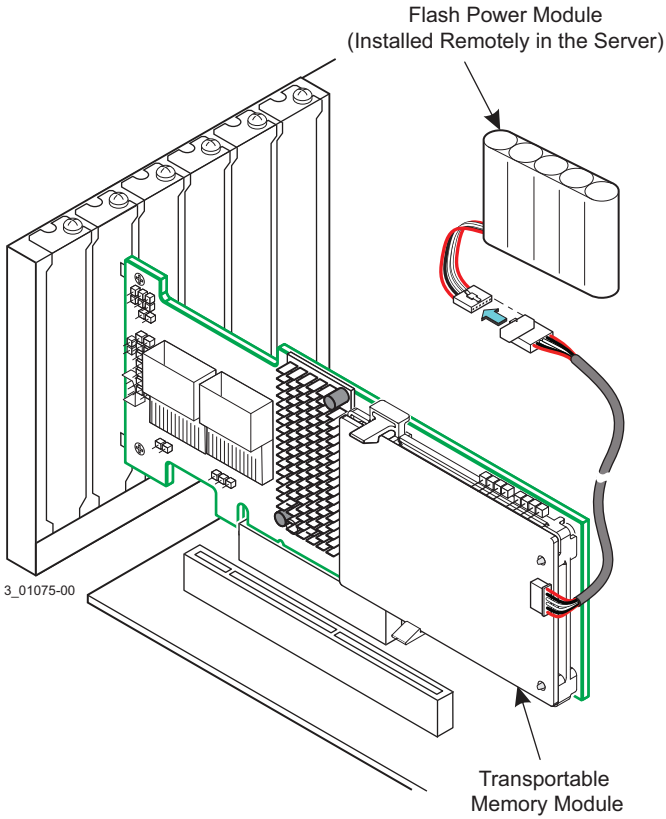
a. Select the correct remote-mount cable length for your configuration.

   The transportable memory module comes with a 42.5cm (16.7in.) remote-mount cable and a 87.5cm (34.5in.) remote-mount cable.

b. Connect one connector on the remote-mount cable to the flash power module (remotely mounted in the server) cable, as shown in the following figure.

c. Connect the other connector on the remote-mount cable to the cable connector on the top side of the transportable memory module that is mounted on the controller.

Figure 2.4 Connecting the Remote Flash Power Module to the Transportable Memory Module on the Controller



Step 6. Replace the server cover, reconnect the power cords, and turn on the server.

Chapter 3
ServeRAID M5016 SAS/SATA Controller Characteristics

This chapter describes the characteristics of the ServeRAID M5016 SAS/SATA controller. It consists of the following sections:

3.1 ServeRAID M5016 SAS/SATA Controller Description

The ServeRAID M5016 SAS/SATA controller is a dual PHY, SAS PCI Express controller and is used in systems with a PCI Express slot. PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

The ServeRAID M5016 controller has one LSISAS2208 ROC (RAID-on-chip) processor that controls eight external SAS/SATA ports through two x4 SAS internal connectors.

3.1.1 Controller Layout and Connector Information

This subsection provides the controller layout and connector information for the controller. The following subsections provide graphics and connector information for the controller.

The controller has eight internal SAS/SATA connectors. The following figure displays the connectors on the controller, while are described in Table 3.1.

Figure 3.1 Card Layout for the ServeRAID M5016 Controller

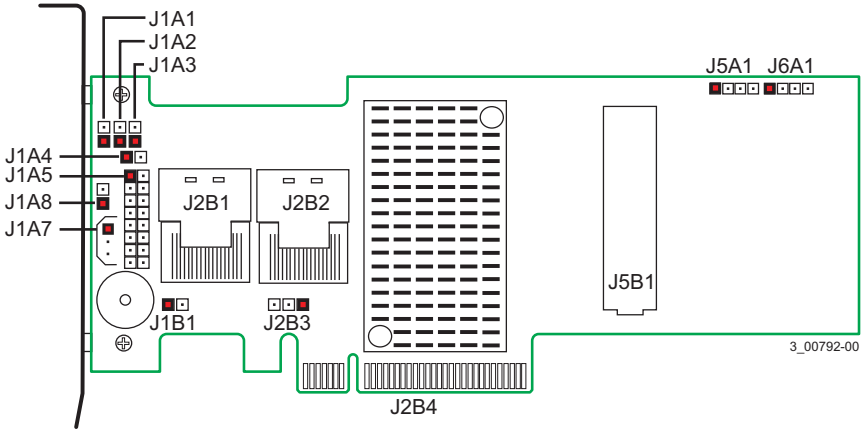


Table 3.1 ServeRAID M5016 Controller Connectors

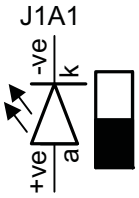
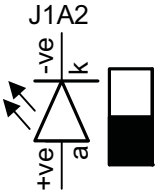
Connector	Description	Type	Comments
J1A1	Global drive fault LED header 	2-pin connector	Connects to an LED that indicates whether a drive is in a fault condition.
J1A2	Write pending LED header 	2-pin connector	Connects to an LED that indicates when the data in the cache has yet to be written to the storage devices. Used when the write-back feature is enabled.
J1A3	LSI test header	2-pin connector	Reserved for internal use.

Table 3.1 ServeRAID M5016 Controller Connectors (Cont.)

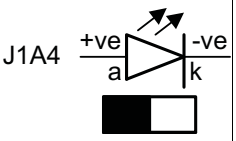
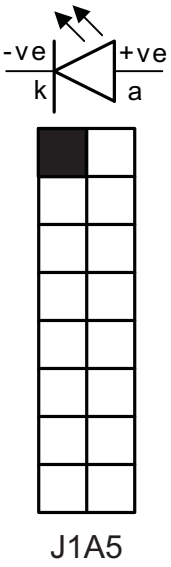
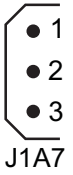
Connector	Description	Type	Comments
J1A4	Activity LED header 	2-pin connector	Connects to an LED that indicates activity on the drives connected to the controller.
J1A5	Individual PHY and Drive Fault Indication header Ports 3-0 Ports 7-4 	2x8-pin header	Connects to an LED that indicates whether a drive is in a fault condition. There is one LED per port. When lit, each LED indicates the corresponding drive has failed or is in the Unconfigured-Bad state. The LEDs function in a direct-attach configuration (there are no SAS expanders). Direct attach is defined as a maximum of one drive connected directly to each port.
J1A7	I^2C Enclosure Management connector 	3-pin connector	Supports SES (SCSI enclosure services) over I^2C through an internal I^2C backplane cable.

Table 3.1 ServeRAID M5016 Controller Connectors (Cont.)

Connector	Description	Type	Comments
J1A8	I^2O Mode Selection	2-pin header	Installing this jumper causes the RAID controller to run in I2O Mode. The default mode of operation is without the shunt. The MegaRAID firmware does not require this connector to be installed in order to function.
J1B1	Serial EEPROM (SBR)	2-pin connector	Provides controller information, such as the serial number, revision, and manufacturing date. The default is no shunt installed.
J2B1	x4 SAS Ports 0 through Port 3 internal connector	SFF-8087 mini-SAS 4i internal connector	Connects the controller by cable to SAS drives or SATA drives.
J2B2	x4 SAS Ports 4 through Port 7 internal connector	SFF-8087 mini-SAS 4i internal connector	Connects the controller by cable to SAS drives or SATA drives.
J2B3	Advanced Software Options Hardware Key header	3-pin header	Enables support for selected advanced features, such as recovery, CacheCade, FastPath, and SafeStore disk encryption.
J2B4	PCI Express Standard edge card connector	Standard edge card interface with the host system	This interface provides power to the board and an I^2C interface connected to the I^2C bus for IPMI.

Table 3.1 ServeRAID M5016 Controller Connectors (Cont.)

Connector	Description	Type	Comments
J5A1	Serial Universal Asynchronous Receiver/Transmitter (UART) connector for the Expander	4-pin connector	Reserved for LSI use.
J5B1	CVFM03 DDR3 connector	240-pin connector	Connects the controller to the CVFM03 CacheVault Flash Module. The CVFM03 module connects to a remote CVPM02 CacheVault Power Module.
J6A1	Serial Universal Asynchronous Receiver/Transmitter (UART) connector for the Expander	4-pin connector	Reserved for LSI use.

3.2 Characteristics of the ServeRAID M5016 SAS/SATA Controller

Table 3.2 shows the general characteristics of the ServeRAID M5016 SAS/SATA controller.

Table 3.2 ServeRAID M5016 SAS/SATA Controller Characteristics

Flash ROM[1]	Serial EEPROM[2]	SAS Data Transfers	SCSI Features	SCSI Termination
Yes	Yes	Up to 6 Gb/s per port	Plug and Play Scatter/Gather Activity LED	Active

1. For boot code and firmware.
2. For BIOS configuration storage.

The controller ensures data integrity by intelligently validating the compatibility of the SAS domain. The controller uses Fusion-MPT architecture, which allows for thinner drivers and better performance.

3.3 Technical Specifications

The design and implementation of the ServeRAID M5016 SAS/SATA controller minimize electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The controller carries the following marks and certifications:

- CE mark
- C-Tick mark
- FCC Self-Certification logo
- Canadian Compliance Statement
- Korean MIC
- Taiwan BSMI
- Japan VCCI

In addition, the controller meets the requirements of CISPR Class B.

3.3.1 Controller Specifications

Table 3.3 lists the specifications for the ServeRAID M5016 SAS/SATA controller.

Table 3.3 ServeRAID M5016 SAS/SATA Controller Specifications

Specification	ServeRAID M5016 SAS/SATA Controller
Processor (PCI Express Host Controller to PCI Secondary I/O Controller)	LSISAS2208 ROC device with Integrated PowerPC processor
Operating Voltage	+3.3 V, +12 V
Card Size	Low profile PCI Express controller card size (68.90 mm x 167.65 mm)
Array Interface to Host	PCI Express Rev 2.0
Type of Drives Supported	Serial Attached SCSI (SAS), Serial ATA II (SATA II), and SATA III

Table 3.3 ServeRAID M5016 SAS/SATA Controller Specifications

Specification	ServeRAID M5016 SAS/SATA Controller
PCI Express Bus Data Transfer Rate	• Up to 85 Gb/s per lane • x8 lane width • Up to 2 Gbytes/s per direction for SAS x4 cards (4 Gbytes/s total)
Serial Port	3-pin RS232-compatible connector (for manufacturing use only)
SAS Controller(s)	One LSISAS 2208 Single SAS controller
SAS Bus Speed	6 Gb/s
SAS Ports	Two SAS connectors with four SAS ports each
Cache Configuration	SAS 2208 DDR3 667 MHz memory interface (64-bit with ECC error correcting)
Size of Flash ROM for Firmware	8 Mbytes
Nonvolatile Random Access Memory (NVRAM)	32 Kbytes for storing RAID configuration

3.3.2 Array Performance Features

Table 3.4 shows the array performance features for the ServeRAID M5016 SAS/SATA controller.

Table 3.4 Array Performance Features

Specification	ServeRAID M5016 Controller
PCI Express Host Data Transfer Rate	8 Gb/s per lane
Drive Data Transfer Rate	6.0 Gb/s per lane
Maximum Scatter/Gathers	26 elements
Maximum Size of I/O Requests	6.4 Mbytes in 64 Kbyte stripes
Maximum Queue Tags per Drive	As many as the drive can accept
Stripe Sizes	8, 16, 32, 64, 128, 256, and 512 Kbyte
Maximum Number of Concurrent Commands	255

3.3.3 Fault Tolerance

Table 3.5 shows the fault tolerance features of the ServeRAID M5016 SAS/SATA controller.

Table 3.5 Fault Tolerance Features

Specification	ServeRAID M5016 SAS/SATA Controller
Support for SMART[1]	Yes
Flash Power Module for Cache Memory	Connect the ServeRAID M5100 Series Flash Power Module for IBM System x by cable to the ServeRAID M5100 Series 1GB Cache/RAID 5 Upgrade for IBM System x, which is a transportable memory module that comes installed on this ServeRAID controller. 1. See Section 2.6, "Mounting and Connecting a ServeRAID M5100 Series Flash Power Module" for installation instructions.
Drive Failure Detection	Automatic
Drive Rebuild Using Hot Spares	Automatic
Parity Generation and Checking	Yes

1. The Self Monitoring Analysis and Reporting Technology (SMART) detects up to 70 percent of all predictable drive failures. In addition, SMART monitors the internal performance of all motors, heads, and drive electronics.

3.3.4 Power Supply Requirements for the ServeRAID M5016 Controller

All power is supplied to the controllers through the PCI Express 3.3V rails and the 12V rail. Onboard switching regulator circuitry operating from the 3.3V rails and the 12V rail provide the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: During a hard reset
- State 2: During a disk stress test
- State 3: While sitting idle at the DOS prompt

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± - 9 percent (from PCI edge connector only). Table 3.6 lists the power supply for the controller for each of the three states at the different voltages.

Table 3.6 Power Supply for the ServeRAID M5016 Controller

PCI Edge Connector	State 1	State 2	State 3
3.3V supply	0.1A	0.94762905A	0.94232971A
+12V supply	0.84A	0.53350067A	0.53209699A
3.3V auxiliary supply	0.76A	0.007135698A	0.0035464705A

3.3.5 Operating and Non-operating Conditions

The operating (thermal and atmospheric) conditions for the ServeRAID M5016 SAS/SATA controller are:

- Relative humidity range is 20% to 80% noncondensing
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the LSISAS2208 ROC processor above the maximum ambient temperature
- Temperature range: +10 °C to +40 °C

The parameter for the non-operating (such as storage and transit) environment for the controller is:

- Relative humidity range is 5 percent to 90 percent noncondensing
- Temperature range: –30 °C to +80 °C

Appendix AGetting Help and Technical Assistance

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you. This section contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your system, and whom to call for service, if it is necessary.

A.1 Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system and any optional devices are turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system.
- Go to the IBM support website at http://www.ibm.com/supportportal/ to check for technical information, hints, tips, and new device drivers or to submit a request for information.

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the documentation that is provided with your IBM product. The documentation that comes with IBM systems also describes the diagnostic tests that you can perform. Most systems, operating systems, and programs come with documentation that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the documentation for the operating system or program.

A.2 Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, readme files, and help files. See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.ibm.com/supportportal/ and follow the instructions.

A.3 Getting help and information from the World Wide Web

On the World Wide Web, the IBM website has up-to-date information about IBM systems, optional devices, services, and support. You can find service information for IBM systems and optional devices at http://www.ibm.com/supportportal/.

A.4 Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems. For information about which products are supported by Support Line in your country or region, see http://www.ibm.com/services/supline/products/.

For more information about Support Line and other IBM services, see http://www.ibm.com/services/, or see http://www.ibm.com/planetwide/ for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

A.5 Hardware service and support

You can receive hardware service through your IBM reseller or IBM Services. To locate a reseller authorized by IBM to provide warranty service, go to http://www.ibm.com/partnerworld/ and click **Find Business Partners** on the right side of the page. For IBM support telephone numbers, see http://www.ibm.com/planetwide/. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

A.6 IBM Taiwan product service

台灣 IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路 7 號 3 樓
電話：0800-016-888

IBM Taiwan product service contact information:
IBM Taiwan Corporation
3F, No 7, Song Ren Rd.
Taipei, Taiwan
Telephone: 0800-016-888

Appendix B Notices

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B.2 Important Notes

When referring to hard disk drive capacity or communications volume, MB stands for 1 000 000 bytes, and GB stands for 1 000 000 000 bytes. Total user-accessible capacity can vary depending on operating environments.

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Some software might differ from its retail version (if available) and might not include user manuals or all program functionality.

This product is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications networks, nor is it intended to be used in a public services network.

B.3 Documentation format

The publications for this product are in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when you use the PDF files and want to request a web-based format or accessible PDF document for a publication, direct your mail to the following address:

Information Development
IBM Corporation
205/A015
3039 E. Cornwallis Road
P.O. Box 12195
Research Triangle Park, North Carolina 27709-2195
U.S.A.

In the request, be sure to include the publication part number and title.

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B.4 Electronic emission notices

Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. 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. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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.

Industry Canada Class A emission compliance statement

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

Avis de conformité à la réglementation d'Industrie Canada

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

Australia and New Zealand Class A statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

Attention: This is an EN 55022 Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Responsible manufacturer:
International Business Machines Corp.
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Armonk, New York 10504
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Germany Class A statement

Deutschsprachiger EU Hinweis:

Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2004/108/EG zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55022 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung der IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung der IBM gesteckt/eingebaut werden.

EN 55022 Klasse A Geräte müssen mit folgendem Warnhinweis versehen werden: "Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen zu ergreifen und dafür aufzukommen."

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten

Dieses Produkt entspricht dem "Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)". Dies ist die Umsetzung der EU-Richtlinie 2004/108/EG in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC EG Richtlinie 2004/108/EG) für Geräte der Klasse A

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:
International Business Machines Corp.
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Der verantwortliche Ansprechpartner des Herstellers in der EU ist:
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E-mail: tjahn@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

Japan VCCI Class A statement

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI-A

This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

Korea Communications Commission (KCC) statement

이 기기는 업무용(A급)으로 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

This is electromagnetic wave compatibility equipment for business (Type A). Sellers and users need to pay attention to it. This is for any areas other than home.

Russia Electromagnetic Interference (EMI) Class A statement

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать радиопомехи, для снижения которых необходимы дополнительные меры

People's Republic of China Class A electronic emission statement

中华人民共和国“A类”警告声明

声 明

此为A级产品，在生活环境中，该产品可能会造成无线电干扰。在这种情况下，可能需要用户对其干扰采取切实可行的措施。

Taiwan Class A compliance statement

警告使用者:
這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

Appendix C
Glossary of Terms and Abbreviations

active termination	The electrical connection required at each end of the SCSI bus, composed of active voltage regulation and a set of termination resistors.
array	A group of drives that combines the storage space on the drives into a single segment of storage space. A hot spare drive does not actively participate in an array.
BIOS	Acronym for Basic Input/Output System. Software that provides basic read/write capability. Usually kept as firmware (ROM-based). The system BIOS on the mainboard of a computer boots and controls the system. The BIOS on your host controller acts as an extension of the system BIOS.
configuration	Refers to the way a computer is set up, the combined hardware components (computer, monitor, keyboard, and peripheral devices) that make up a computer system, or the software settings that allow the hardware components to communicate with each other.
device driver	A program that allows a microprocessor (through the operating system) to direct the operation of a peripheral device.
domain validation	Domain Validation is a software procedure in which a host queries a device to determine its ability to communicate at the negotiated data rate.
EEPROM	Acronym for Electronically Erasable Programmable Read-Only Memory. It is a memory chip that typically stores configuration information, as it provides stable storage for long periods without electricity and can be reprogrammed. Refer to NVRAM.
external SAS device	A SAS device installed outside the computer cabinet. These devices are connected using specific types of shielded cables.
Fusion-MPT architecture	Fusion-MPT (Message Passing Technology) architecture consists of several main elements: Fusion-MPT firmware, the Fibre Channel and

SCSI hardware, and the operating system level drivers that support these architectures. Fusion-MPT architecture offers a single binary, operating system driver that supports both Fibre Channel and SCSI devices.

host The computer system in which a storage controller is installed. It uses the storage controller to transfer information to and from devices attached to the SCSI bus.

host controller board A circuit board or integrated circuit that provides a device connection to the computer system.

hot spare An idle, powered on, standby drive ready for immediate use in case of disk failure. It does not contain any user data. A hot spare can be dedicated to a single redundant array or it can be part of the global hot-spare pool for all arrays managed by the controller.

When a disk fails, the controller firmware automatically replaces and rebuilds the data from the failed drive to the hot spare. Data can be rebuilt only from virtual disks with redundancy (RAID levels 1, 5, 10, and 50; not RAID level 0), and the hot spare must have sufficient capacity.

internal SAS device A SAS device installed inside the computer cabinet. These devices are connected by using a shielded cable.

main memory The part of a computer's memory which is directly accessible by the CPU (usually synonymous with RAM).

NVRAM Acronym for Nonvolatile Random Access Memory. An EEPROM (Electronically Erasable Read-Only Memory chip) that stores configuration information. Refer to EEPROM.

PCI Acronym for Peripheral Component Interconnect. A high-performance, local bus specification that allows the connection of devices directly to computer memory. The PCI Local Bus allows transparent upgrades from 32-bit data path at 33 MHz to 64-bit data path at 33 MHz, and from 32-bit data path at 66 MHz to 64-bit data path at 66 MHz.

PCI Express Acronym for Peripheral Component Interconnect Express. A high-performance, local bus specification that allows the connection of devices directly to computer memory. PCI Express is a two-way, serial connection that transfers data on two pairs of point-to-point data lines. PCI Express goes beyond the PCI specification in that it is intended as

a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

peripheral devices A piece of hardware (such as a video monitor, drive, printer, or CD-ROM) used with a computer and under the control of the computer. SCSI peripherals are controlled through a ServeRAID SAS/SATA M5016 controller (host controller).

PHY The interface required to transmit and receive data packets transferred across the serial bus.

Each PHY can form one side of the physical link in a connection with a PHY on a different SATA device. The physical link contains four wires that form two differential signal pairs. One differential pair transmits signals, while the other differential pair receives signals. Both differential pairs operate simultaneously and allow concurrent data transmission in both the receive and the transmit directions.

RAID Acronym for Redundant Array of Independent Disks (originally Redundant Array of Inexpensive Disks). An array of multiple independent physical disks managed together to yield higher reliability and/or performance exceeding that of a single physical disk. The RAID array appears to the controller as a single storage unit. I/O is expedited because several disks can be accessed simultaneously. Redundant RAID levels (RAID levels 1, 5, 6, 10, 50, and 60) provide data protection.

RAID levels A set of techniques applied to disk groups to deliver higher data availability, and/or performance characteristics to host environments. Each virtual disk must have a RAID level assigned to it.

SAS Acronym for Serial Attached SCSI. A serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. The SAS interface provides improved performance, simplified cabling, smaller connections, lower pin count, and lower power requirements when compared to parallel SCSI. The SAS controller leverages a common electrical and physical connection interface that is compatible with Serial ATA.

The ServeRAID SAS/SATA M5016 controller supports the SAS protocol as described in the *Serial Attached SCSI Standard*, *version 2.0*.

The ServeRAID M5016 SAS/SATA controller is a versatile controller that provides the backbone of both server and high-end workstation

environments. Each port on the RAID controller supports SAS devices and SATA devices.

SAS device Any device that conforms to the SAS standard and is attached to the SAS bus by a SAS cable. This includes SAS storage controllers (host controllers) and SAS peripherals.

SATA Acronym for Serial Advanced Technology Attachment. A physical storage interface standard, SATA is a serial link that provides point-to-point connections between devices. The thinner serial cables allow for better airflow within the system and permit smaller chassis designs.

The controller supports the SATA II protocol defined by the *Serial ATA specification, Version 2.0*, and the SATA III protocol defined by the *Serial ATA Specification, Version 3.0*. SATA III is an extension to SATA 2.0.

SMP Acronym for Serial Management Protocol. SMP enables communicates topology management information directly with an attached SAS expander device. Each PHY on the controller can function as an SMP initiator.

SSD Acronym for Solid State Devices. A Solid State Device uses solid-state memory to store data. They have no moving parts and are faster and more reliable than hard disk drives (HDDs).

SSP Acronym for Serial SCSI Protocol. SSP enables communication with other SAS devices. Each PHY on the SAS controller can function as an SSP initiator or SSP target.

STP Acronym for Serial Tunneling Protocol. STP enables communication with a SATA device through an attached expander. Each PHY on the SAS controller can function as an STP initiator.

stripe size The total disk space consumed by a stripe not including a parity disk. For example, consider a stripe that contains 64 Kbytes of disk space and has 16 Kbytes of data residing on each disk in the stripe. In this case, the stripe size is 64 Kbytes and the stripe element size is 16 Kbytes. The stripe depth is four (four physical disks in the stripe). You can specify stripe sizes of 8 Kbytes, 16 Kbytes, 32 Kbytes, 64 Kbytes, 128 Kbytes, 256 Kbytes, or 512 Kbytes for each virtual disk. A larger stripe size produces improved read performance, especially if most of the reads are sequential. For mostly random reads, select a smaller stripe size.

striping Disk striping writes data across two or more disks. Each stripe spans two or more disks but consumes only a portion of each disk. Each disk, therefore, may have several stripes. The amount of space consumed by a stripe is the same on each disk included in the stripe. The portion of a stripe that resides on a single disk is a stripe element. Striping by itself does not provide data redundancy; striping in combination with parity provides data redundancy.

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