IBM ®

ServeRAID M5210 SAS/SATA Controller for IBM System x

User's Guide

Part Number: 00D2437

Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الآمنية

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 Safety Information (安全信息)。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφάλειας (safety information).

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się
z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

Youq mwngz yungh canjbinj neix gaxgonq, itdingh aeu doeg aen
canjbinj soengq cungj vahgangj ancien siusik.

مەزكۇر مەھسۇلاتنى ئورنتىشتىن بۇرۇن بخەتەرلىك ئۇچۇرلىرىنى ئوقۇپ چىقىڭ.

ཐོན་རྫས་འདི་བདེ་སྐྱོང་མ་བྱས་གོང་། སྐོར་གྱི་ཡིད་གཟབ་ བྱ་འདུ་མིན་ཡོད་པའི་ཐོད་སྟེར་བཙལ་དགོས།

Bu ürünü kurmadan önce güvenlik bilgilerini okuyun.

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.	

Statement 3:

CAUTION:
When laser products (such as CD-ROMs, DVD drives, fiber optic devices, or transmitters) are installed, note the following:

DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

Class 1 Laser Product
Laser Klasse 1
Laser Klass 1
Luokan 1 Laserlaite
Appareil À Laser de Classe 1

Statement 8:

CAUTION:
Never remove the cover on a power supply or any part that has the following label attached.

Hazardous voltage, current, and energy levels are present inside any component that has this label attached. There are no serviceable parts inside these components. If you suspect a problem with one of these parts, contact a service technician.

Statement 28:

CAUTION:
The battery is a lithium ion battery. To avoid possible explosion, do not burn the
battery. Exchange it only with the approved part. Recycle or discard the battery
as instructed by local regulations.

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Chapter 1: Overview

1.1　ServeRAID M5210 Controller Description

The ServeRAID M5210 SAS/SATA controller is a PCI-Express 3.0, half-size, half-height RAID controller based on the LSISAS3108 PCI Express-SAS/SATA I/O Processor chip.

The controller controls eight internal SAS/SATA ports through two SFF-8643 4i internal mini-SAS HD connectors. 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 12.0 Gb/s SAS link rates and 6.0 Gb/s SATA III link rates.

The controller brings 12.0 Gb/s SAS and 6.0 Gb/s SATA 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 LSISAS3108 ROC device increases system performance and provides fault-tolerant data storage. The LSISAS3108 supports data striping across multiple disks, which reduces disk access time because multiple disks simultaneously read or write data. In addition, the LSISAS3108 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 SAS protocol as described in the Serial Attached SCSI Standard, version 3.0, and the SATA III protocol defined by the Serial ATA Revision 3.0 Specification.

> **NOTE** You cannot mix SAS drives and SATA drives within the same virtual drive.

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

1.1.1　Controller Guidelines

before you install the controller, read the following guidelines:

- You can connect only one device per SAS PHY unless you use an expander
- Cables have to meet the SAS specification
- You cannot mix SAS drives and SATA drives in the same virtual drive
- You cannot mix SAS Solid State Drives (SSDs) or SATA SSDs and existing mechanical drives (SAS or SATA) in the same virtual drive
- You cannot mix Solid State SAS drives and Solid State SATA drives in the same virtual drive

See Section 3.2.4, "Power Supply Requirements for the ServeRAID M5210 SAS/SATA Controller" for information about the power requirements, and Section 3.2.5, "Operating and Non-operating Conditions"for information about the minimum and the maximum temperature ranges.

1.2 Integrated MegaRAID Mode and MegaRAID mode

The ServeRAID M5210 controller can run in either integrated MegaRAID (iMR) mode natively or in MegaRAID (MR) mode with the addition of a transportable memory module.

iMR is a highly integrated, low-cost RAID solution made possible by Fusion-MPT architecture. Integrated MegaRAID is a processor-based, hardware RAID solution designed for system environments requiring redundancy and high availability where a full-featured RAID implementation is not required or might be cost prohibitive.

The major advantage of iMR is that it provides RAID at the processor level, so it does not burden the CPU, which allows for more efficient operation. iMR mode is native to the ServeRAID M5210 controller and does not require a transportable memory module.

The major advantage of MR mode is that the it supports more RAID levels than iMR mode. iMR mode supports RAID levels 0, 1, 5, 10, and 50 and supports 64k stripe size only. MR mode supports RAID levels 0, 1, 5, 6, 10, 50, and 60 and supports 64k to 1M stripe size.

> **NOTE** iMR mode RAID 5 requires purchase of the Feature on Demand upgrade.

> **NOTE** MR mode RAID 5/50 requires a transportable memory module (4 options).

> **NOTE** MegaRAID RAID 6/60 requires a transportable memory module (4 options) and the Feature on Demand upgrade.

See Section 1.2.1, "Supported RAID Level Upgrades" for information about these upgrades.

See Section 1.2.2, "Summary of RAID Levels" for information about the supported RAID levels.

1.2.1 Supported RAID Level Upgrades

To use RAID levels 5, 6, 50, or 60 with this controller, you need to install a Feature on Demand upgrade and/or a transportable memory module, depending on the RAID level.

This controller supports iMR RAID levels 5 and 50 with the following installed Feature on Demand upgrade:

■ ServeRAID M5200 Series Zero Cache/RAID 5 Upgrade for IBM System x

This controller supports MegaRAID RAID levels 5 and 50, with any of the following installed transportable memory modules:

■ ServeRAID M5200 Series 1GB Cache/RAID 5 Upgrade for IBM System x
■ ServeRAID M5200 Series 1GB Flash/RAID 5 Upgrade for IBM System x
■ ServeRAID M5200 Series 2GB Flash/RAID 5 Upgrade for IBM System x
■ ServeRAID M5200 Series 4GB Flash/RAID 5 Upgrade for IBM System x

This controller supports MegaRAID RAID levels 6 and 60 with the ServeRAID M5200 Series RAID 6 Upgrade for IBM System x

1.2.2 Summary of RAID Levels

RAID levels describe a system for ensuring the availability and redundancy of data stored on large disk subsystems.

RAID 0 uses striping to provide high data throughput, especially for large files in an environment that does not require fault tolerance.

RAID 1 uses mirroring so that data written to one drive is simultaneously written to another drive. This is good for small databases or other applications that require small capacity but complete data redundancy.

RAID 5 uses disk striping and parity data across all drives (distributed parity) to provide high data throughput, especially for small random access.

RAID 6 uses distributed parity, with two independent parity blocks per stripe, and disk striping. A RAID 6 virtual drive can survive the loss of two drives without losing data. A RAID 6 drive group, which requires a minimum of three drives, is similar to a RAID 5 drive group. Blocks of data and parity information are written across all drives. The parity information is used to recover the data if one or two drives fail in the drive group.

RAID 10, a combination of RAID 0 and RAID 1, consists of striped data across mirrored spans. A RAID 10 drive group is a spanned drive group that creates a striped set from a series of mirrored drives. RAID 10 allows a maximum of eight spans. You must use an even number of drives in each RAID virtual drive in the span. The RAID 1 virtual drives must have the same stripe size. RAID 10 provides high data throughput and complete data redundancy but uses a larger number of spans.

RAID 50, a combination of RAID 0 and RAID 5, uses distributed parity and disk striping. A RAID 50 drive group is a spanned drive group in which data is striped across multiple RAID 5 drive groups. RAID 50 works best with data that requires high reliability, high request rates, high data transfers, and medium-to-large capacity.

RAID 60, a combination of RAID 0 and RAID 6, uses distributed parity, with two independent parity blocks per stripe in each RAID set, and disk striping. A RAID 60 virtual drive can survive the loss of two drives in each of the RAID 6 sets without losing data. It works best with data that requires high reliability, high request rates, high data transfers, and medium-to-large capacity.

> **NOTE** Having virtual drives of different RAID levels, such as RAID 0 and RAID 5, in the same drive group is not allowed. For example, if an existing RAID 5 virtual drive is created out of partial space in an array, the next virtual drive in the array has to be RAID 5 only.

1.3 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 to several SATA disks. This type of configuration is mostly for low-end or entry level servers. Enclosure management is provided through out-of-band I2C bus. Side bands of both types of internal SAS connectors support the SFF-8485 and SFF-8448 (SGPIO) interface.
- Midrange, internal SAS configuration: This configuration is like the internal SATA configuration, but with high-end disks. This type of configuration is more suitable for low-range to midrange servers.

The following figure shows a direct-connect configuration. The Inter-IC (I2C) 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 Example of a SAS Direct Connect Application
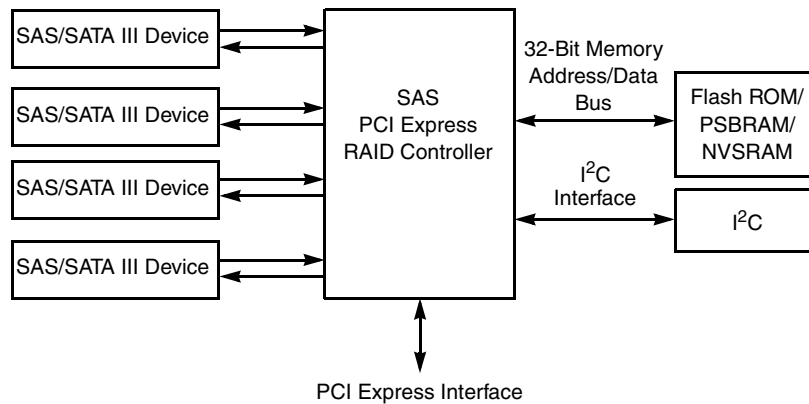
The following figure shows an example of a ServeRAID controller configured with an expander that is connected to SAS disks, SATA disks, or both.

Figure 2 Example of a ServeRAID Controller Configured with an Expander
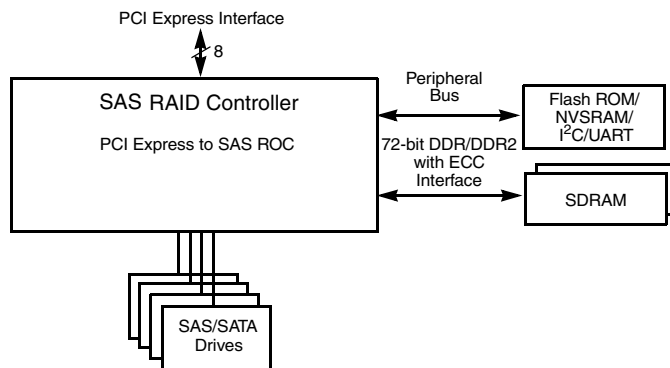
1.3.1   Number of Physical Disks Supported

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. Table 1 shows the minimum number and the maximum number of drives required for each RAID level.

Table 1 Physical Devices Required for each RAID Level

Raid Level	Minimum # of Physical Devices	Maximum # of Physical Devices
0	1	32
1	2	2
5	3	32
6	3	32
10	4	32
50	6	32
60	6	32

1.4   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 M5210 SAS/SATA controller leverages a common electrical and physical connection interface that is compatible with Serial ATA technology. The SAS protocols and SATA protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 26-wire ATA cable. The SAS/SATA III connector and cable are easier to manipulate, allow connections to smaller devices, and do not inhibit airflow. The point-to-point SATA III architecture eliminates inherent difficulties created by the legacy ATA master-slave architecture, while maintaining compatibility with existing ATA firmware.

1.4.1   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 M5210SAS/SATA controller in PCI Express computer systems with a standard bracket type. With this controller 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.

1.4.2   Operating System Support

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

The ServeRAID M5210 controller uses Fusion-MPT architecture for all major operating systems, thinner device drivers, and better performance.

1.5   Benefits of the ServeRAID M5210 SAS/SATA Controller

This section provides a summary of the features and the benefits of the ServeRAID M5210 SAS/SATA controller. It contains information on SAS features, SATA features, PCI performance, integration, usability, and flexibility.

The controller offers the following features:

- PCI Express x8 lane width
- PCI Express performance up to 8 GT/s (1 GB/s) per lane
- Two internal connectors
- Support for RAID levels 0, 1, 5, 10, and 50 in iMR mode
- Support for RAID levels 0, 1, 5, 6, 10, 50, and 60 in MR mode

To use RAID levels 5/50/6/60 with this controller, you need to install a Feature on Demand upgrade and/or a transportable memory module. See Section 1.2.1, "Supported RAID Level Upgrades" for information about these upgrades.

- ■ 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.

1.5.1   SAS Features

The following list describes the SAS features of the ServeRAID M5210 controller:

- ■ Provides eight fully independent PHYs
- ■ Supports 12.0 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
- ■ 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

1.5.2   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 2 lists the array limitations for the ServeRAID M5210 controller.

Table 2 ServeRAID M5210 SAS/SATA Controller Array

Specification	ServeRAID M5210 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
	NOTE Can support up to 64 devices, but only 16 can be used in a RAID configuration.

Table 2 ServeRAID M5210 SAS/SATA Controller Array

Specification	ServeRAID M5210 SAS/SATA Controller
Maximum hot spares per controller	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 device drivers 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 rather than by the actual RAID volume capacity.

The maximum drive numbers in Table 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.

1.5.3   SATA III Features

The following list describes the SATA III features of the ServeRAID M5210 controller:

- Supports SATA III data transfers of 6.0 Gb/s
- Supports STP data transfers of 3.0 Gb/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 III targets through an expander
- Allows multiple initiators to address a single target (in a fail-over configuration) through an expander
- Displays activity and fault indicators for each PHY
- Supports Port Selector (for dual-port drives)
- Each port on the controller supports SAS devices, SATA devices, or both using SSP, SMP, STP, and SATA. SSP enables communication with other SAS devices.
- Enables the controller to communicate with other SATA devices.
- Supports staggered spin-up
- Supports hot plug

1.5.4   PCI Express Performance

The following list describes the PCI Express performance features of the ServeRAID M5210 Controller:

- Provides a PCI Express 3.0 interface that:
  — Supports a dedicated PCI Express bus
  — Supports x8 lane configuration
  — Supports transfer rates of up to 8 GT/s (1 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 off load the host processor

1.5.5   Usability Features

The following list describes the usability features of the ServeRAID M5210 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 I2C interface for enclosure management
- Supports the external SAS Sideband signal SFF-8485 and SFF-8448 (SGPIO) standards.

1.5.6   Flexibility Features

These features increase the flexibility of the ServeRAID M5210 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 III targets
- Leverages compatible connectors for SAS connections and SATA III 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

1.5.7   CacheCade

CacheCade is an advanced software option that is designed to accelerate the performance of hard disk drive (HDD) arrays with only an incremental investment in SSD technology. The MegaRAID CacheCade software utilizes SSDs as a dedicated pool of high-performance cache in front of HDDs to maximize I/O performance for transaction intensive applications. The key benefits of this software option include:

- Accelerated performance of existing HDD arrays with a small up-front investment
- Read and Write caching of hot spot data for significant reduction in I/O latency
- Optimized for real-world workloads of transaction-intensive applicaitons
- Simple, intuitive management tools to assign and manage CacheCade SSD pool

These features help reduce latency bottlenecks for server-based HDD volumes. Applications are often constrained by the performance limitations of their existing HDDs. With this type of storage infrastructure already in place, a switch to a new array based purely on SSDs is cost prohibitive. Although SSDs are capable of many more transactions per second than HDDs, SSDs have a very high cost per gigabyte and are not suited for heavy, large file workloads. You can accelerate the performance of existing HDD arrays without making substantial investments in new hardware by deploying LSI MegaRAID CacheCade software, which leverages SSDs in front of HDD volumes to create high-capacity, high-performance controller cache pools.

1.5.8   Protection Information (T10-DIF)

The T10 Technical Committee of the INCITS standardized the basic requirements to implement a data protection model for end-to-end data protection. This model protects your data within a storage system from various sources of corruption that historically have gone undetected. Examples of corruption sources include hardware data path errors (such as FIFO overruns and underruns), firmware errors (such as arithmetic overflow or incorrect pointer usage), and external agents overwriting the data in memory.

A fundamental component of the T10 data protection model is the addition of 8 bytes of extra protection information transferred with each block of user data in the storage system, as shown in the following figure. Although not specifically named in the T10 standards, this collection of 8 bytes is commonly referred to as the DIF. The DIF contains three distinct values: a 2-byte logical block guard, a 2-byte logical block application tag, and a 4-byte logical block reference tag. The T10 specification defines four types of usage models of data protection: Type 0, Type 1, Type 2, and Type 3 (refer to the most current revision of INCITS T10/1799-D for further information)

Figure 3 T10 Data Integrity Field for MegaRAID Protection Information
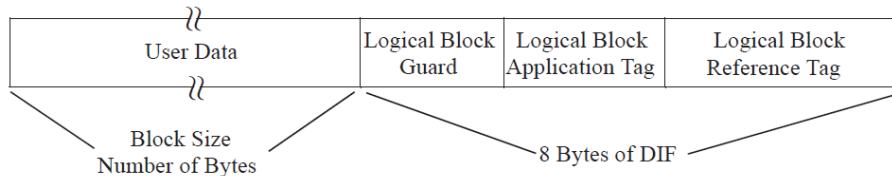
1.5.9   Drive Roaming

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 restarts; it does not resume from where the rebuild operation stopped.

Follow these steps to use drive roaming:

1. Turn off the power to the server and all physical disks, enclosures, and system components. Disconnect the power cords from the system.
2. Remove the server cover by following the instructions in the host system technical documentation.
3. Move the drives to different positions on the backplane to change the targets.
4. Determine the SAS target requirements.
5. Perform a safety check.
6. Make sure that the drives are inserted correctly.
7. Reinstall the server cover.
8. Reconnect the power cords to the system.
9. Turn on the power to the system.
10. The controller then detects the RAID configuration from the configuration data on the drives.

1.5.10   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 whole virtual disks can be migrated automatically; partial virtual disks can be migrated manually.

> **NOTE** Drive roaming and drive migration cannot be supported at the same time.

Follow these steps to migrate drives:

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.

2. Turn off the power to the server and all physical disks, enclosures, and system components. Disconnect the power cords from the systems.
3. Open the host system, following the instructions in the host system technical documentation.
4. Remove the SAS cable connectors from the internal drives that you want to migrate.
5. Make sure that pin 1 on the cable matches pin 1 on the connector.
6. Make sure that the SAS cables conform to all SAS specifications.
7. Remove the physical disks from the first system, and insert them into drive bays on the second system.
8. Connect the SAS cables to the physical disks in the second system.
9. Determine the SAS target requirements.
10. Perform a safety check.
11. Make sure that all of the cables are attached correctly.
12. Make sure that the RAID controller is installed correctly.
13. Reinstall the server cover.
14. Reconnect the power cords to the system.
15. Turn on the power to the system.
16. The controller detects the RAID configuration from the configuration data on the drives.

1.5.11   New Drives Attached to a ServeRAID Controller

In the Integrated RAID mode, when you insert a new drive with valid metadata into a ServeRAID system, the drive state of the new drive is either foreign or unconfigured bad.

The specific drive state depends on the Maintain PD Fail History setting, and whether the drive had been inserted in the system before. The Maintain PD Fail History setting, when enabled, maintains the history of all drive failures.

A foreign configuration is a storage configuration that already exists on the new drive that you install in the system. The configuration utilities allow you to import the foreign configuration to the controller, or to clear the configuration so you can create a new configuration using the new drive.

> **NOTE** See the ServeRAID-M Software User's Guide for the procedures used to import a foreign configuration or change a drive state from unconfigured bad to unconfigured good.

1.5.12 Automatic Rebuilds on New Drives

Automatic rebuilds occur when the drive slot status changes. For example, an automatic rebuild occurs when you insert a new drive or when you remove a drive and a hot spare replaces the removed drive.

1.5.13 System (JBOD) Drives

The iMR mode supports drives in pass-through mode, which are identified as "system" drives. These drives are also known as JBOD (Just a Bunch of Disks) drives. When a drive without valid metadata is inserted in a system, if the drive has a drive state of unconfigured good, it is identified as unconfigured good; otherwise, the drive is marked as a system drive.

System drives are exposed directly to the operating system. The host system can read data from and write data to the system drives; however, you cannot use system drives in a RAID configuration.

You can change system drives into unconfigured good drives (you can also change unconfigured good drives into system drives). When a system drive is changed to an unconfigured good drive, the unconfigured good drive state of the drive is maintained after reboot, drive removal, or drive insertion.

You can use system drives as bootable drives. iMR supports up to 63 system drives and up to 16 unconfigured good drives.

1.6 Hardware Specifications

You can install your ServeRAID M5210 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 3 ServeRAID M5210 SAS/SATA Controller

RAID Levels	iMR Mode: 0, 1, 5, 10, and 50
	MR Mode: 0, 1, 5, 6, 10, 50, and, 60
	NOTE To use certain RAID levels with this controller, you need to install a Feature on Demand upgrade and/or a transportable memory module. See Section1.3.1 for more information
Devices Supported per Port	Up to 8 SAS devices or 8 SATA devices (such as drives and expanders)
Ports	Eight Internal
Data Transfer Rate	Up to 12Gb/s per phy
Bus	PCI Express 3.0
Cache Function	No. See the note at the bottom of this table

Table 3 ServeRAID M5210 SAS/SATA Controller

Multiple Virtual Disks per Controller	Yes. Up to 64 virtual disks per controller
Multiple Arrays per Controller	Yes. Up to 64 virtual disks per controller
Online Capacity Expansion	Yes
Dedicated and Global Hot Spares	Yes
Hot Swap Devices Supported	Yes
Non-Disk Devices Supported	Yes
Mixed Capacity Physical Disks Supported	Yes
Number of Internal Connectors	Two SFF-8643 4i internal mini-SAS HD connectors
Hardware Exclusive OR (XOR) Assistance	Yes
Direct I/O	Yes
Architecture	Fusion-MPT

NOTE In MR mode, the ServeRAID M5210 SAS\SATA controller supports cache policy, which includes write-back, write-through, adaptive read ahead, non-read ahead, read ahead, cache I/O, and direct I/O settings. However, in iMR mode, the controller does not support these cache policy settings. See Section 1.2, "Integrated MegaRAID Mode and MegaRAID mode" for more information about MR mode and iMR mode.

1.7   Technical Support

For information about the technical support available for this product, see Appendix A:

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LSISAS3108 ServeRAID Controller Hardware Installation
Requirements

Chapter 2: ServeRAID M5210 SAS/SATA Controller for IBM System x User's Guide LSISAS3108 ServeRAID Controller Hardware Installation

2.1 Requirements

The following items are required for installation:

- A ServeRAID M5210 SAS/SATA controller
- A host system with an available PCI Express expansion slot
- The ServeRAID M Documentation CD containing the documentation
- The necessary internal cables
- SAS physical disks or SATA physical disks (Disk drives or Solid State Devices, SSDs

> **NOTE** For optimal performance, use an un-interruptible power supply.

2.2 Hardware installation

This section provides detailed instructions for installing a ServeRAID M5210 controller.

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:

   - A CD containing an electronic version of this User's Guide and other related documentation
   - Warranty information

2. **Turn off the Power to the System**

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

3. **Review the Controller Connectors**

   Refer to Chapter 3: ServeRAID M5210 SAS/SATA Controller Characteristics" for a diagram of the ServeRAID M5210 controller with its connectors.

4. **Review the Controller Limitations**

   ReviewSection 1.1.1, "Controller Guidelines," before you install the controller in the system.

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 controller is correctly seated in the slot. Secure the bracket to the server chassis.

   Figure 1 shows the installation of the ServeRAID M5210 controller in a PCI Express slot.

> **NOTE** Some PCI Express slots support PCI Express graphics cards only. If a RAID controller is installed in one of those slots, the controller does not function.

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Hardware installation

⚠ **ATTENTION** To avoid damage to the server, always remove the controller from the PCI Express slot before you relocate or ship the server.

Figure 1 ServeRAID M5210 Controller Installation in a PCI Express Slot
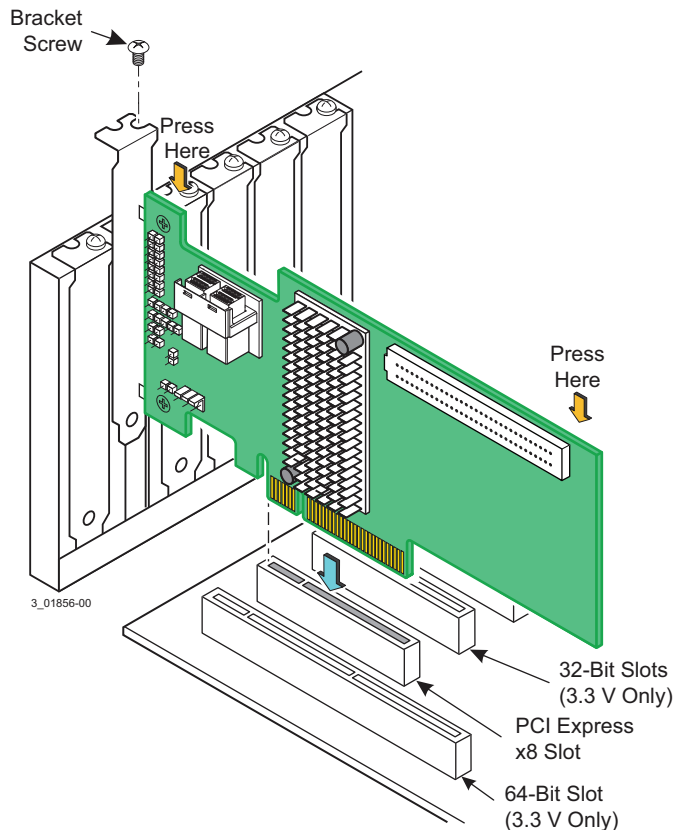
6. **Connect SAS cables between the controller and the SAS backplane or any other SATA or SAS devices (if applicable)**

   Connect serial cables between the controller and a drive backplane or any other SATA or SAS devices. The preceding figure shows the locations of the controller connectors. The controller uses two internal x4 mini-SAS HD (SFF-8643) connectors to connect to internal devices. You may use other cables appropriate for your usage scenario as long as they conform to the controller specifications and limitations as outlined in N2115 SAS/SATA HBA for IBM System x User's Guide.

   Refer to Section 2.3, "Connecting a ServeRAID M5210 SAS/SATA Controller to a Drive Backplane on an Enclosure," for details about connecting the controller to the enclosure.

7. **Replace the cover and any power cords, and power up the system**

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

   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 server. If the power is turned on to the server before it is turned on to the devices, the server might not recognize the devices.

   For the Unified 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 system board.

8. **Run the WebBIOS Configuration Utility**

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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.

9. **Install the Operating System Device Driver**

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

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

    For details on installing the device driver, refer to the ServeRAID-M Device Driver Installation User's Guide on the ServeRAID matrix website at this link:
    http://www-947.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-5086126

    Be sure to use the latest Service Packs provided by the operating system manufacturer and to review the readme file that accompanies the device driver.

2.3 Connecting a ServeRAID M5210 SAS/SATA Controller to a Drive Backplane on an Enclosure

This section describes how to connect the ServeRAID M5210 SAS/SATA 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 an internal x4 mini-SAS HD 4i (SFF-8643) connector at each end is used to connect the controller to the drive backplane of an enclosure containing SAS drives and/or SATA drives.
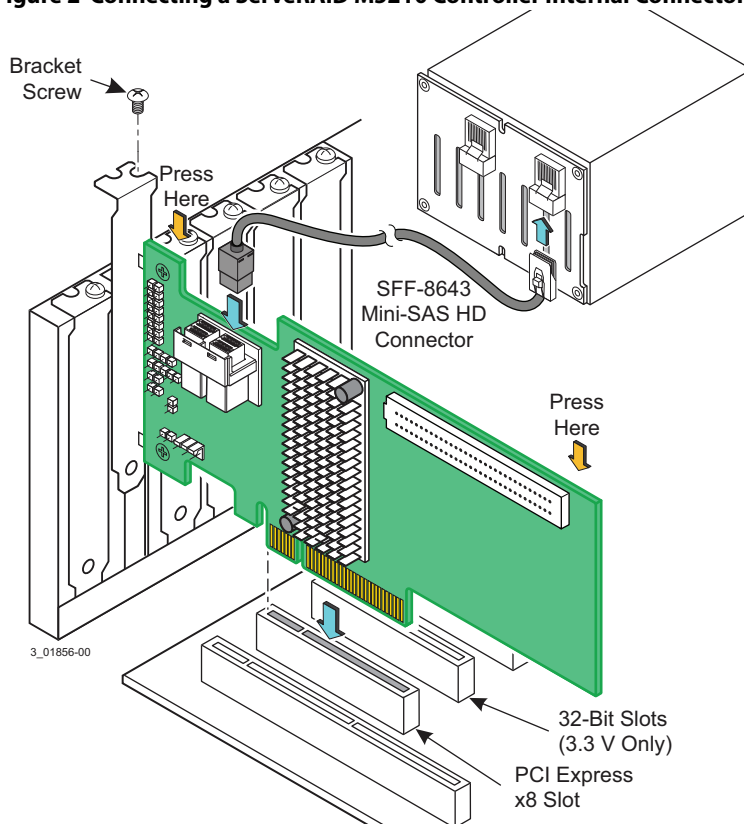
> **NOTE** Use only straight SAS cables, not cross-over SAS cables.

Follow these steps to connect the internal x4 mini-SAS HD 4i (SFF-8643) connector on the cable to the controller and the drive backplane:

1. Read the safety information that comes with the controller.
2. Turn off the server and peripheral devices and disconnect the power cords.
3. Slide the server out of the server rack (if applicable).
4. Remove the server cover.
5. Plug the internal x4 mini-SAS HD 4i (SFF-8643) connector on one end of the cable into the x4 SAS port 0-3 connector on the controller, as shown in the following figure.
6. Plug the internal x4 mini-SAS HD 4i (SFF-8643) connector on the other end of the cable into the port connector on the drive backplane.

    You can use another cable to connect the other internal x4 mini-SAS HD 4i (8643) connector on the controller to the other port connector on the drive backplane.

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Figure 2 Connecting a ServeRAID M5210 Controller Internal Connector to a Drive Backplane

7. Replace the server cover.

8. Slide the server into the rack.

9. Reconnect the power cords and any cables that you removed.

10. Turn on the peripheral devices and the server.

2.4   After Installing the Controller

After you install the controller, you must configure it and install the operating system device 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 device drivers.

Chapter 3: ServeRAID M5210 SAS/SATA Controller Characteristics

3.1 Board Layout and Connector Information

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

The following figure displays the connectors on the controller, which are described on Table 1. Pin 1 on each connector is highlighted in red
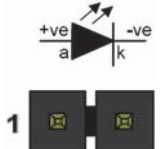
Figure 1 Card Layout for the ServeRAID M5210 SAS/SATA Controller

Table 1 Controller Connectors

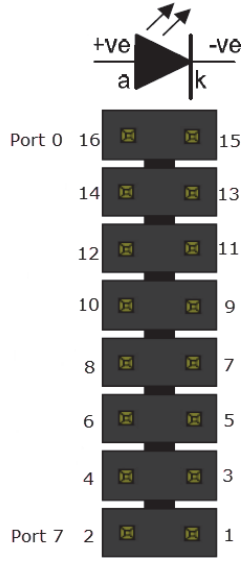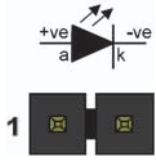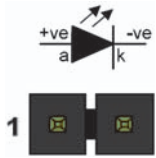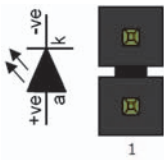| Connector	Description	Type	Comments
J1A1	x4 mini-SAS HD Connector (2)	SFF-8643 mini-SAS 4i Internal Connector	Connect the controller by cable to SAS drives or SATA III drives.
J1A2	Individual Drive Fault LED Header	2-pin Connector	Connects to a range of LEDs that will indicate which connected drive has faulted.
J1B2	Global Drive Activity LED Header		A connected LED will blink indicating that there is activity occurring in any of the connected drives.
J1B3	Write Pending LED Header	2-pin Connector	A connected LED will indicate that a write command is pending by turning the LED on. This feature is used with the write-back feature.
J1B4	SBR Defaults Load Jumper	2-pin Connector	When shunted provides the ability to bypass loading the Bootstrap configuration from external SBR EEPROM device and load the default system values within the ROC. This will allow the hardware to recover the blank or corrupted SBR device using Mega RAID software utilities. Default mode of operation is to not have a shunt on this jumper and load the Bootstrap configuration from external SBR EEPROM device.
J1B5	RAID Upgrade Key Connector		Allows a connection to a RAID upgrade key to allow additional RAID level capabilities.

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Characteristics of the ServeRAID M5210 SAS/SATA Controller

Table 1 Controller Connectors

Connector	Description	Type	Comments
J1B7	UART Header	4-pin Connector	Provides access to an external UART dongle for serial communications access to each of the internal processors within the SAS3108 ROC. **NOTE** Signaling levels are +1.8Vdc and need a special ongle for the correct interface. UART pins are clamped to +1.8Vdc on the controller to protect the ROC.
J4A1	Local Cache Offloader Connecter	300-pin Board-to-Board Connector	Used to connect one of 4 transportable memory modules available for the ServeRAID M5210 controller.
J6A1	Global Drive Fault LED Header	2-pin Connector	A connected LED that indicates a failure in an attached drive.

3.2 Characteristics of the ServeRAID M5210 SAS/SATA Controller

Table 2 shows the general characteristics of the ServeRAID M5210 SAS/SATA controller

Table 2 SAS\SATA Controller Characteristics

Flash ROM	Serial EEPROM	SAS Data Transfers	SCSI Features	SCSI Termination
Yes	Yes	Up to 12 Gb/s per port	Plug and Play Scatter/Gather Activity LED	Active

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

3.2.1 Controller Specifications

Table 3 lists the specifications for the ServeRAID m5210 SAS/SATA controller.

Table 3 Controller Specifications

Specification	ServeRAID M5210 SAS/SATA
Processor (PCI Express Host Controller to PCI Secondary I/O Controller)	LSISAS3108 ROC device with Integrated PowerPC processor
Operating Voltage	+3.3 V, +12 V
Card Size	Low profile PCI Express controller card size (2.713" x 6.6")
Array Interface to Host	PCI Express Rev 3.0
Type of Drives Supported	Serial Attached SCSI (SAS) and Serial ATA (SATA)

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Characteristics of the ServeRAID M5210 SAS/SATA Controller

Table 3 Controller Specifications

Specification	ServeRAID M5210 SAS/SATA
PCI Express Bus Data Transfer Rate	· Up to 8 GT/s (1 GB/s) per lane · x8 lane width · Up to 2 GB/s per direction for SAS x4 cards (4 GB/s total)
Serial Port	3-pin RS232-compatible connector (for manufacturing use only)
SAS Controller(s)	One LSISAS3108 Single SAS controller
SAS Bus Speed	12 Gb/s
SAS Ports	Two SAS connectors with four SAS ports each
Size of Flash ROM for Firmware	8 Mbytes
Nonvolatile Random Access Memory (NVRAM)	32 Kbytes for storing RAID configuration

3.2.2   Array Performance Features

Table 4 shows the array performance features for the ServeRAID M5210 SAS/SATA controller.

Table 4 Array Performance Features

Specification	ServeRAID M5210 SAS/SATA Controller
PCI Express Host Data Transfer Rate	8 GT/s (1 GB/s) per lane
Drive Data Transfer Rate	12.0 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, or 64 Kbyte
Maximum Number of Concurrent Commands	255

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Characteristics of the ServeRAID M5210 SAS/SATA Controller

3.2.3 Fault Tolerance

Table 5 Fault Tolerance Features

Specification	ServeRAID M5210 SAS/SATA Controller
Support for SMART	Yes
Drive Failure Detection	Automatic
Drive Rebuild Using Hot Spares	Automatic
Parity Generation and Checking	Yes

3.2.4 Power Supply Requirements for the ServeRAID M5210 SAS/SATA Controller

All power is supplied to the controller 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:

1. During a hard reset
2. During a disk stress test
3. While sitting idle at the DOS prompt
4. During a disk stress test and deeply discharged Supercap pack.

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± - 9 percent (from PCI edge connector only). Table 6 lists the power supply for the controller for each of the three states at the different voltages.

Table 6 Power Supply

PCI Edge Connector	State1	State 2	State 3	State 4
3.3V Supply	0.540A	1.08	0.960A	1.08A
+12V Supply	0.780A	1.28A	1.06A	1.78A
3.3V Auxiliary Supply	0.010A	0.010A	0.010A	0.010A

3.2.5 Operating and Non-operating Conditions

The operating (thermal and atmospheric) conditions for the ServeRAID M5210 SAS/SATA controller are:

■ Relative humidity range is 20 percent to 80 percent noncondensing
■ Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the Intel IOP333 processor above the maximum ambient temperature
■ Temperature range: +10 °C to +60 °C

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

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

3.2.6 Safety Characteristics

The ServeRAID M5210 SAS/SATA controller meets or exceeds the requirements of UL flammability rating 94 V0. Each bare board is also marked with the supplier name or trademark, type, and UL flammability rating. The board is installed in a PCI Express bus slot, so all voltages are lower than the SELV 42.4 V limit.

Appendix A: Getting 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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UNIX is a registered trademark of The Open Group in the United States and other countries.

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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IBM makes no representations or warranties with respect to non-IBM products.
Support (if any) for the non-IBM products is provided by the third party, not IBM.

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.
    New Orchard Road
    Armonk, New York 10504
    914-499-1900

European Community contact:
    IBM Deutschland GmbH
    IBM Technical Regulations, Department M372
    IBM-Allee 1,71139 Ehningen, Germany
    Telephone: +49 7032 15 2941
    Email: lugi@de.ibm.com

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.
New Orchard Road
Armonk, New York 10504
914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:
IBM Deutschland GmbH
Technical Regulations, Abteilung M372
IBM-Allee 1, 71139 Ehningen, Germany
Telephone: +49 7032 15-2941
E-mail: lugi@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 전자파적합기기로
서 판매자 또는 사용자는 이 점을 주의하시기
바라며, 가정외의 지역에서 사용하는 것을 목
적으로 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。