



12Gb/s Intel[®] RAID Controllers

Hardware User Guide

A document providing installation instructions and product specifications

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Preface

This is the primary user guide for the 12Gb/s Intel® RAID Controllers. It contains installation instructions and specifications.

Audience

The people who benefit from this document are:

- 12Gb/s Intel® RAID Controller users

Organization

This document includes the following chapters and glossary:

- [Chapter 1](#) provides a general overview of the 12Gb/s Intel® RAID Controller.
- [Chapter 2](#) provides the instructions on how to install the 12Gb/s Intel® RAID Controller.
- [Chapter 3](#) describes the characteristics of the 12Gb/s Intel® RAID Controller.
- [Chapter 4](#) provides a general overview and installation instructions of the Intel® RAID Maintenance Free Backup Unit AXXRMFBU4 and AXXRMFBU5.

Related Publication

This is the primary hardware guide for the 12Gb/s Intel® RAID Controllers. It contains installation instructions and specifications to aid in the configuration and use of this product.

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1 12Gb/s Intel® RAID Controller Overview

This document is the primary reference and user's guide for the Intel® RAID Controllers based on the 12Gb/s SAS/SATA RAID-on-a-chip (ROC) devices. This document contains complete installation instructions and specifications for these RAID controllers.

1.1 Overview

The 12Gb/s Intel® RAID Controllers are high-performance intelligent PCIe-to- SATA+SAS controllers with RAID control capability. The 12Gb/s Intel® RAID Controllers provide reliability, high-performance, and fault-tolerant drive subsystem management. They are an ideal RAID solution for the internal storage of workgroup, departmental, and enterprise systems. The 12Gb/s Intel® RAID Controllers offer a cost-effective way to implement RAID in a server.

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. The 12Gb/s Intel® RAID Controller gives you the flexibility to combine these two similar technologies on the same controller, within the same enclosure, and in the same virtual drive.

Note: Carefully assess any decision to mix SAS drives and SATA drives within the same virtual drive. Although you can mix drives, the practice is strongly discouraged.

Intel offers a family of 12Gb/s Intel® RAID Controllers that address the needs for both internal and external solutions. The 12Gb/s Intel® RAID Controllers are based on the LSI first-to-market SAS IC technology and proven MegaRAID technology. As second-generation PCIe RAID controllers, these controllers address the growing demand for increased data throughput and scalability requirements across midrange and enterprise-class server platforms. These controllers provide these features:

- 12 Gb/s Serial Attached SCSI (SAS) performance
- 6 Gb/s SATA III performance
- Eight-lane, 8 GT/s PCIe host interface

1.1.1 12Gb/s Intel® RAID Controllers with Support for RAID Maintenance Free Back Units

The Intel® RAID Controllers RS3DC0x0, RS3SC008, RS3MC044, and RMS3CC080 support the RAID Maintenance Free Backup Unit that protects the integrity of the cached data on Intel® Integrated RAID Modules by offloading the data stored in the RAM cache to NAND flash during a power loss event. And it eliminates the need for lithium ion (Li-ion) batteries traditionally used to protect DRAM cache memory on RAID controllers.

1.1.2 SAS/SATA Standards and Communication Protocols

The 12Gb/s Intel® RAID Controllers support the ANSI *Serial Attached SCSI standard, version 3.0*. In addition, the controller supports the SATA III protocol defined by the *Serial ATA specification, version 3.0*. Supporting

both the SAS interface and the SATA interface, the SAS controller is a versatile controller that provides the backbone of both server and high-end workstation environments.

Each port on your RAID controller supports SAS devices, SATA devices, or both, by using the following protocols:

- 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 SATA devices through an attached expander

1.2 General Description

The 12Gb/s Intel® RAID Controllers bring 12.0 Gb/s Serial Attached SCSI and SATA III performance to host adapter, workstation, and server designs. The 12Gb/s Intel® RAID Controller RS3WC080 and Module RMS3HC080 are based on the LSISAS3008 PCIe RAID On-a-Chip (ROC) device. The following Intel® RAID Controllers are based on the LSISAS3108 PCIe RoC device:

- RS3DC080
- RS3DC040
- RS3SC008
- RS3MC044
- RMS3CC080
- RMS3CC040

The controllers support internal storage devices and external storage devices, which allow you to use a system that supports enterprise-class SAS drives and desktop-class SATA III drives. Each 12Gb/s Intel® RAID Controller can connect to drives directly and can use expanders to connect to additional drives. Simplified cabling between devices is an additional benefit.

These devices are compliant with the Fusion-MPT™ architecture and provides a PCIe x8 interface. Each port on the 12Gb/s Intel® RAID Controllers supports SAS devices, SATA devices, or both, using SSP, SMP, STP, and SATA. The SSP protocol enables the 12Gb/s Intel® RAID Controllers to communicate with other SAS devices. The SATA protocol enables the 12Gb/s Intel® RAID Controllers to communicate with SATA devices.

Note: All of these RAID controllers provide an x8 PCIe 3.0 interface.

1.3 12Gb/s Intel® RAID Controller Detailed Descriptions

The 12Gb/s Intel® RAID Controllers are described in detail in the following subsections.

1.3.1 Intel® RAID Controller RS3WC080

The Intel® RAID Controller RS3WC080 is a PCIe 3.0 Low-Profile SAS Controller that controls eight internal SAS/SATA ports through two SFF-8643 mini-SAS HD-4i internal connectors.

1.3.2 Intel® RAID Module RMS3HC080

The Intel® RAID Module RMS3HC080 is a PCI-Express* (PCIe*) 3.0 RAID adapter whose PCIe* connector is a custom 80-pin connector capable of performance up to 8GT/s per lane. The Intel® RAID Module RMS3HC080 is based on the LSISAS3008 I/O controller, uses a 16-MB Flash memory device for storing the BIOS and firmware, and controls eight internal SAS/SATA ports through two SFF-8643 mini-SAS HD-4i internal connectors.

1.3.3 Intel® RAID Controller RS3DC040 and RS3DC080

- The Intel® RAID Controller RS3DC040 is a PCIe 3.0 Low-Profile SAS Controller that controls four internal SAS/SATA ports through one SFF-8643 mini-SAS HD-4i internal connector.
- The Intel® RAID Controller RS3DC080 is a PCIe 3.0 Low-Profile SAS Controller that controls eight internal SAS/SATA ports through two SFF-8643 mini-SAS HD-4i internal connectors.

1.3.4 Intel® RAID Controller RS3MC044

The Intel® RAID Controller RS3MC044 is a PCIe 3.0 Serial-Attached SCSI/SATA Disk Array Controller that controls four internal SAS/SATA ports through one SFF-8643 mini-SAS HD-4i internal connector and four external SAS/SATA ports through one SFF-8644 mini-SAS HD-4e external connector.

1.3.5 Intel® RAID Controller RS3SC008

The Intel® RAID Controller RS3SC008 is a PCIe 3.0 Serial-Attached SCSI/SATA Disk Array Controller that controls eight external SAS/SATA ports through two SFF-8644 mini-SAS HD-4e external connectors.

1.3.6 Intel® RAID Module RMS3CC080 and RMS3CC040

The Intel® RAID Module RMS3CC080 and RMS3CC040 are PCI-Express* (PCIe*) 3.0 RAID adapters whose PCIe* connector is a custom 80-pin connector capable of performance up to 8GT/s per lane. The Intel® RAID Module RMS3CC080 is based on the LSISAS3108 ROC controller, uses 1GB of DDR3 1866MHz memory as cache, and controls eight internal SAS/SATA ports through two SFF-8643 mini-SAS HD-4i internal connectors.

1.4 Configuration Scenarios

You can use the 12Gb/s Intel® RAID Controllers in three main scenarios:

- **Low-end internal SATA configuration:** In this configuration, use the RAID controller as a high-end SATA II or SATA III compatible controller that connects up to eight drives either directly or through a port expander. This configuration is mostly for low-end or entry servers. An out-of-band I²C bus provides enclosure management. Side bands of both types of internal SAS connectors support the SFF-8485 (SGPIO) interface.
- **Midrange internal SAS configuration:** This configuration is like an internal SATA configuration, but with high-end SAS drives. This configuration is more suitable for low-range to midrange servers.
- **High-end external SAS/SATA configuration:** This configuration is for external connectivity using SATA II drives, SATA III drives, SAS drives, or combinations of SATA and SAS drives. External enclosure management is supported through in-band, SCSI-enclosed storage. The configuration must support STP and SMP.

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.

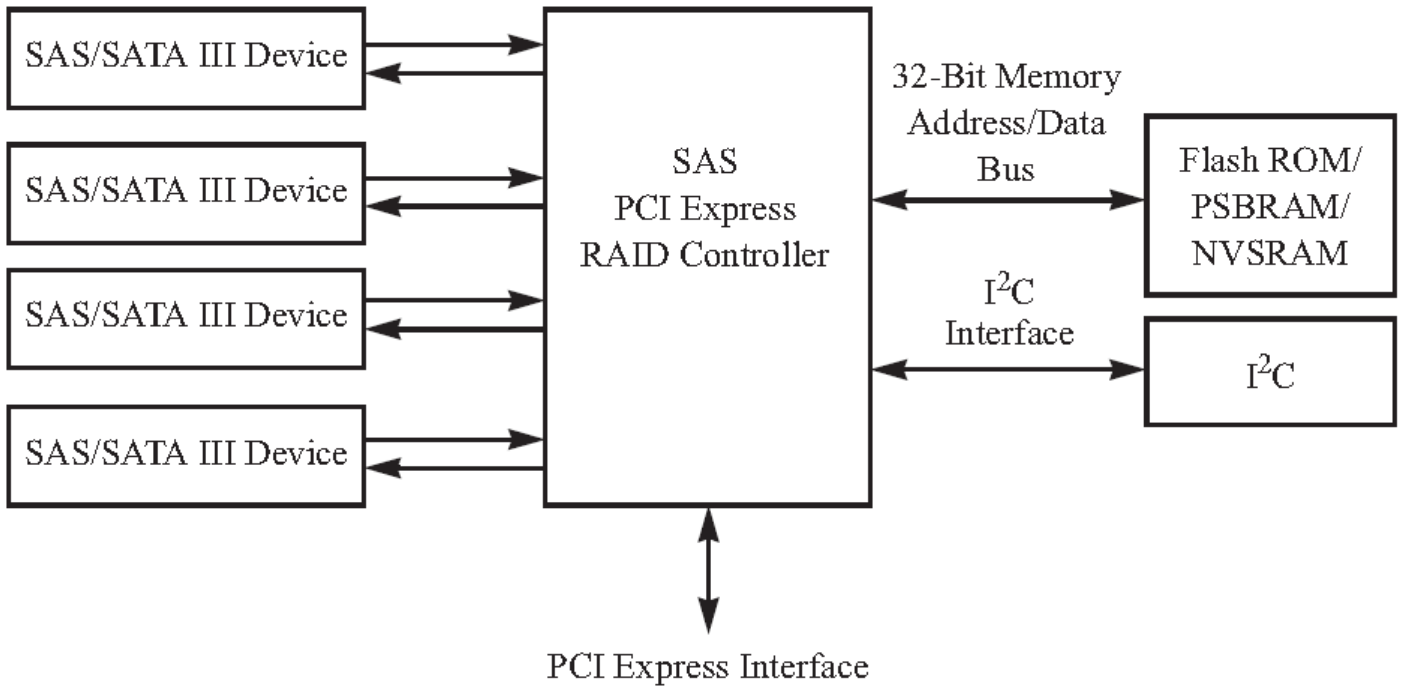


Figure 1. Example of an Intel SAS Direct-Connect Application

The following figure shows an example of a SAS RAID controller configured with an LSISASx12 expander that is connected to SAS drives, SATA III drives, or both.

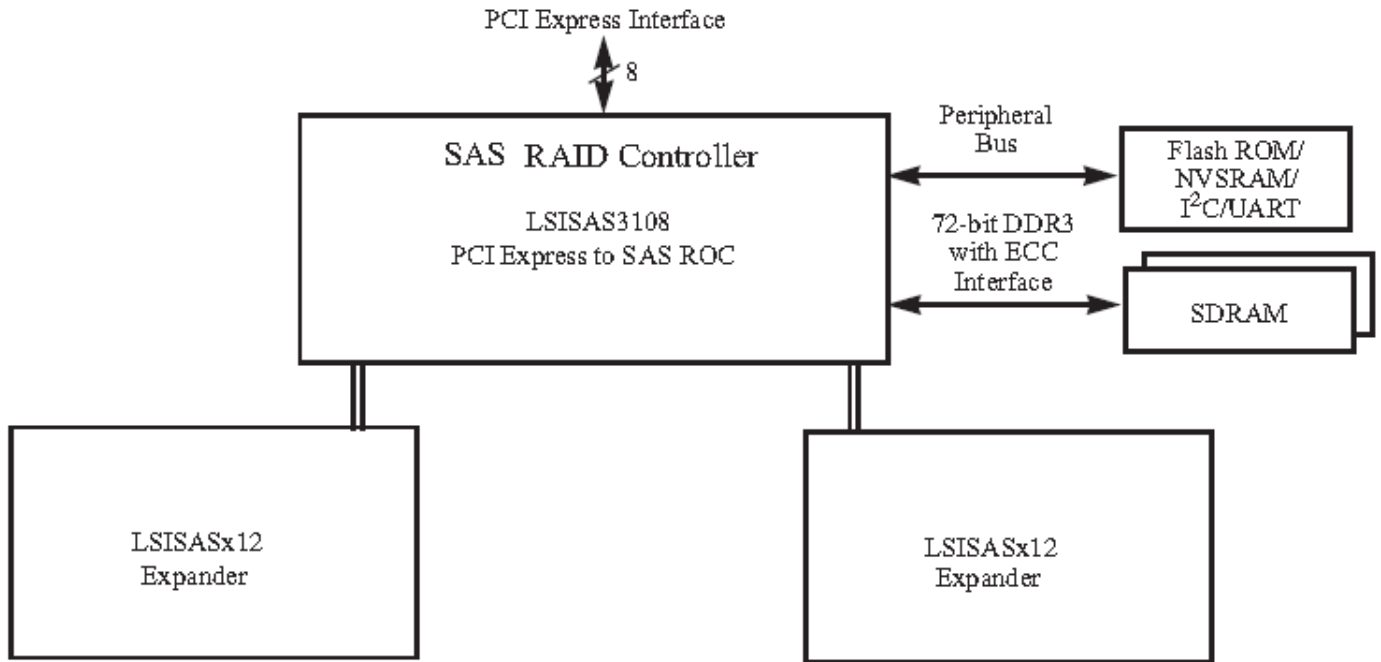


Figure 2. Example of an Intel SAS RAID Controller Configured with an LSISASx12 Expander

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 is a convergence of the advantages of SATA, SCSI, and Fibre Channel, and it 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 SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA technology. The SAS protocols and the SATA III 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.

1.5.1 PCI Express Architecture

PCIe is a local bus system designed to increase data transfers without slowing down the central processing unit (CPU). You can install the 12Gb/s Intel® RAID Controllers in PCIe computer systems with a standard bracket type. With these controllers in your system, you can connect SAS devices and SATA devices over the bus.

Note: Some PCIe slots support PCIe graphics cards only; RAID controllers installed in these PCIe slots do not function.

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

1.5.2 Operating System Support

The 12Gb/s Intel® RAID Controllers support the following operating systems:

- Microsoft Windows 2003* R2 SP2, Windows Vista* SP2, Windows 7* Client SP1, Windows 8*, Windows 2008* SP2, Windows 2008* R2 SP1, Window Server 2012* and Window Server 2016*
- Red Hat* Enterprise Linux
- SuSE* Linx SLES
- Ubuntu* Linux
- VMware*

To download the latest operating system drivers, go to the [Intel Download Center](#)

The 12Gb/s Intel® RAID Controllers use Fusion-MPT architecture for all major operating systems, thinner drivers, and better performance.

1.6 Summary of 12Gb/s Intel® RAID Controller Characteristics

This section summarizes the features and benefits offered by the 12Gb/s Intel® RAID Controllers. It contains information on SAS features, SATA features, PCI performance, integration, usability, and flexibility.

The 12Gb/s Intel® RAID Controllers have the following features.

Table 1. 12Gb/s Intel® RAID Controller Features

| Feature | RS3WC080/ RMS3HC080 | RS3DC040/ RMS3CC040 | RS3DC080/ RMS3CC080 | RS3MC044 | RS3SC008 |
|--|------------------------|------------------------|------------------------|------------------------|------------------------|
| LSI SAS ROC or IOC | LSI3008 | LSI3108 | LSI3108 | LSI3108 | LSI3108 |
| PCIe x8 lane width (with support for x16 connectors) | Yes | Yes | Yes | Yes | Yes |
| PCIe performance up to 8GT/s per lane | Yes | Yes | Yes | Yes | Yes |
| 1-GB DDR3 1866-MT/s onboard SDRAM | No | Yes | Yes | Yes | Yes |
| Number of internal 4-port SAS connectors | 2 | 1 | 2 | 1 | 0 |
| Number of external 4-port SAS connectors | 0 | 0 | 0 | 1 | 2 |
| Supported RAID levels | 0, 1, 5, 10, 50 | 0, 1, 5, 6, 10, 50, 60 | 0, 1, 5, 6, 10, 50, 60 | 0, 1, 5, 6, 10, 50, 60 | 0, 1, 5, 6, 10, 50, 60 |
| Advanced array configuration and management utilities | Yes | Yes | Yes | Yes | Yes |
| Support for global hot spares and dedicated hot spares | Yes | Yes | Yes | Yes | Yes |
| Support for user-defined strip sizes: 64, 128, 256, 512, or 1024 KB | No | Yes | Yes | Yes | Yes |
| Advanced array configuration and management utilities offer these capabilities: <ul style="list-style-type: none"> • Online capacity expansion to add space to an existing drive or a new drive • Online RAID level migration • Drive migration • Drive roaming • No reboot necessary after expansion • Load balancing • Media scan | Yes | Yes | Yes | Yes | Yes |
| User-specified rebuild rate (specifying the percentage of system resources to use from 0 percent to 100 percent) | Yes | Yes | Yes | Yes | Yes |
| Nonvolatile random access memory (NVRAM) of 32 KB for storing RAID system configuration information; the MegaRAID SAS firmware is stored in flash ROM for easy upgrade. | Yes | Yes | Yes | Yes | Yes |
| Full MegaRAID Software Stack | No | Yes | Yes | Yes | Yes |
| iMR Software Stack | Yes | No | No | No | No |

SAS Features

The 12Gb/s Intel® RAID Controllers support the following SAS features:

- They provide four fully independent PHYs or eight fully independent PHYs, depending on the controller.
- They support 12 Gb/s, 6Gb/s, and 3Gb/s SAS data transfers per PHY.
- They support SMP to communicate topology-management information.

- They support SSP to enable communication with other SAS devices.
- They support STP to enable communication with SATA devices through an attached expander.
- They provide a serial, point-to-point, enterprise-level storage interface.
- They simplify cabling between devices.
- They provide a scalable interface that supports up to 240 devices through the use of expanders.

Note: The number of devices varies depending on the Intel® RAID Controller product. Check the Intel website, <http://www.intel.com>, for specific details about your product.

- They support wide ports that consist of two, three, or four PHYs within a single quad port.
- They support narrow ports consisting of a single PHY.
- They transfer data by using SCSI information units.

1.6.1 SAS Array Limitations

This section describes the array limitations of the 12Gb/s Intel® RAID Controllers. These limitations include the number of drives supported per controller, the maximum number of drives per controller, and the maximum number of virtual drives allowed per controller.

The following table lists the array limitations for the 12Gb/s Intel® RAID Controllers.

Table 2. 12Gb/s Intel® RAID Controller Array Limitations

| Specification | RS3WC080/RMS3HC080 | RS3DC040/RS3DC080/ RS3MC044/RS3SC008/ RMS3CC080/ RMS3CC040 |
|--|-----------------------------|--|
| Maximum virtual drives per controller | 32 | 64 |
| Maximum drive groups per controller | 32 | 128 |
| Maximum virtual drives per drive group | 16 | 16 |
| Maximum drives per drive group | 32 | 32 |
| Maximum drives per controller | 64 (32 configurable drives) | 240 |
| Maximum hot spares per controller | 32 | 240 |
| Maximum spans per virtual drive | 8 | 8 |
| Maximum enclosures | 2 | 16 per port |

The maximum numbers in the previous table depend on how many physical devices you have connected to the RAID controller. For example, the maximum number of drive groups is equal to the number of drives that are supported by the controller. Thus, for the Intel® RAID Controller RS3DC0x0, the maximum number of drive groups per controller is 240, which is based on the maximum number of physical devices that you can connect. In addition, the maximum number of hot spares per controller is equal to the maximum number of drives per controller.

Although you can have up to 16 virtual drives per drive group, and up to 128 drive groups on most of the controllers, a limit of 64 virtual drives exists on those controllers.

These RAID controllers support 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 this table rather than by actual RAID volume capacity.

1.6.2 SATA III Features

The following list describes the SATA III features of the RAID controllers:

- They support SATA III data transfers of 6Gb/s for LSISAS3108-based controllers.
- They support STP data transfers of 3Gb/s.
- They provide a serial, point-to-point storage interface.
- They simplify cabling between devices.
- They eliminate the master-slave construction used in parallel ATA.
- They permit addressing of multiple SATA targets through an expander.
- They permit multiple initiators to address a single target (in a fail-over configuration) through an expander.

1.6.3 PCI Express Performance

The following list describes the PCIe performance features of the RAID controllers:

- They provide a PCIe interface that does the following:
 - Supports a dedicated PCIe bus.
 - Supports x8 lane configuration.
 - Supports transfer rates of up to 8GT/s per lane.
 - Complies with the *PCI Express specification, Revision 3.0*, and the *Serial ATA specification, version 3.0*.
- They provide unequaled performance through the Fusion-MPT architecture.
- They provide high throughput and low CPU utilization to offload the host processor.

1.6.4 Usability Features

The following list describes the usability features of the RAID controllers:

- They simplify cabling with point-to-point, serial architecture.
- They support smaller, thinner cables that do not restrict airflow.
- They provide drive spin-up sequencing control.
- They provide one LED signal for each PHY to indicate link activity (this is a fault LED only for controllers with internal port connectors).
- They provide an I2C interface for enclosure management.
- They support the internal SAS Sideband signal SFF-8485 (SGPIO) interface.

Note: LED signals indicate an error condition or drive activity. The MegaRAID controllers support different blink patterns for these LEDs, depending on the user configuration and storage enclosure. For information about the LED blink patterns, contact your storage enclosure manufacturer.

1.6.5 Flexibility Features

These features increase the flexibility of the RAID controllers:

- They support a Flash ROM interface, a nonvolatile static RAM (NVSRAM) interface, and a pipelined synchronous burst SRAM (PSBRAM) interface.
- They offer a flexible programming interface to tune I/O performance.
- They permit mixed connections to SAS targets or SATA III targets.
- They leverage compatible connectors for SAS connections and SATA III connections.
- They permit grouping of up to four PHYs in a single quad port to form a wide port.

- They permit programming of the World Wide Name.

1.6.6 Drive Roaming

Drive roaming occurs when the drives 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.

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 physical device ID.

Note: If you move a drive that is being rebuilt, the rebuild operation restarts; it does not resume from the stopping point.

Follow these steps to use the drive roaming feature:

1. Turn off the power to the server and all drives, enclosures, and system components. Disconnect the power cords from the system.
2. Open the host system 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.
 - a) Make sure that the drives are inserted correctly.
 - b) Close the cabinet of the host system.
6. Reconnect the power cords to the system.
7. Turn on the power to the system.

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

1.6.7 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: Partial configurations, which include individual virtual drives, can be migrated.

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 drives that make up the virtual drive (not all of the drives in a drive group), so that you do not see 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 power to the server and all drives, enclosures, and system components. Disconnect the power cords from the systems.
3. Open the host system by following the instructions in the host system technical documentation.
4. Either remove the SAS cable connectors from the internal drives, or remove the shielded cables from the external 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.
5. Remove the drives from the first system, and insert them into the drive bays on the second system.
6. Connect the SAS cables to the drives in the second system.
7. Determine the SAS target requirements.
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.
9. Reconnect the power cords to the system.
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 the 12Gb/s Intel® RAID Controllers in a computer with a motherboard that has a PCIe slot. The following table describes the hardware configuration features for the 12Gb/s Intel® RAID Controllers.

Table 3. 12Gb/s Intel® RAID Controller Hardware Specifications

| Specification | RS3WC080/RMS3HC080 | RS3DC040/RS3DC080/RS3MC044/ RS3SC008/RMS3CC080 |
|---|--|--|
| RAID levels | 0, 1, 5, 10, 50 | 0, 1, 5, 6, 10, 50, 60 |
| Devices supported per port | Up to 64 SAS devices or SATA III devices (such as drives and expanders) | Up to 255 SAS devices or SATA III devices (such as drives and expanders) |
| Number of ports | Eight ports through two SFF-8643 mini-SAS HD-4i connectors | <ul style="list-style-type: none"> • RS3DC040/RMS3CC040 – Four ports through one SFF-8643 mini-SAS HD-4i connector • RS3DC080/RMS3CC080 – Eight ports through two SFF-8643 mini-SAS HD-4i connectors • RS3MC044 – Four external ports through one SFF-8644 mini-SAS HD-4e connector and four internal ports through one SFF-8643 mini-SAS HD-4i connector • RS3SC080 – Eight external ports through two SFF-8644 mini-SAS HD-4e connectors |
| Data transfer rate | Up to 12Gb/s per PHY | Up to 12Gb/s per PHY |
| Bus | PCIe 3.0 | PCIe 3.0 |
| PCIe form factor | <ul style="list-style-type: none"> • RS3WC080: Standard PCIe • RMS3HC080: Mezzanine port | <ul style="list-style-type: none"> • RS3DC040/RS3DC080/RS3MC044/RS3SC008: Standard PCIe • RMS3CC080//RMS3CC040: Mezzanine port |
| Cache function | No cache capabilities, settings fixed at Write-through, non-read-ahead, direct I/O | Write-back, write-through, non-read-ahead, read-ahead, cache I/O, direct I/O |
| RAID Maintenance Free Backup Unit (RMFBU) | No support | <ul style="list-style-type: none"> • RS3DC040/RS3DC080/RS3MC044/RS3SC080: RMFBU4 • RMS3CC080/RMS3CC040: RMFBU5 |

12Gb/s Intel® RAID Controllers User Guide

| Specification | RS3WC080/RMS3HC080 | RS3DC040/RS3DC080/RS3MC044/ RS3SC008/RMS3CC080 |
|--|--|--|
| Multiple virtual drives per controller | Up to 32 (this value is dependent on the firmware) | Up to 64 (this value is dependent on the firmware) |
| Online capacity expansion | Yes | Yes |
| Dedicated and global hot spares | Yes | Yes |
| Hot-swap supported devices | Yes | Yes |
| Non-drive supported devices | Yes | Yes |
| Mixed-capacity drives supported | Yes | Yes |
| Hardware exclusive OR (XOR) assistance | Yes | Yes |
| Direct I/O | Yes | Yes |
| Architecture | Fusion-MPT | Fusion-MPT |

2 12Gb/s Intel® RAID Controller Hardware Installation

2.1 Requirements

The following items are required to install a 12Gb/s Intel® RAID Controller:

- A 12Gb/s Intel® RAID Controller
 - A host system with an available x8 PCIe 3.0 slot
-

Note: These controllers also work in PCI Express first generation slots. The PCI Express software is backward compatible with previous revisions of the PCI bus and the PCI-X bus.

- The necessary internal cables, external cables, or both
 - SAS drives or SATA drives
-

Note: Make sure to use an uninterruptible power supply.

2.2 Quick Installation

The following steps quickly install your 12Gb/s Intel® RAID Controller. These steps are for experienced computer users or installers. [Detailed Installation for 12Gb/s Intel® RAID Controllers](#) or [Detailed Installation for 12Gb/s Intel® RAID Modules](#) contains the steps for all other users to follow.

1. Turn off the power to the system and all drives, enclosures, and system components, and disconnect the PC power cord.
 2. Open the cabinet of the host system by following the instructions in the host system technical documentation.
 3. Check the jumper settings to make sure that they are in the desired position. The jumpers are set at the factory, and you usually do not need to change them.
-

Note: See [Chapter 3, 12Gb/s Intel® RAID Controller Characteristics](#), for detailed information about the jumpers and the connectors.

4. Install the 12Gb/s Intel® RAID Controller in the server, and connect SAS devices or SATA II devices to it. Make sure that the cables you use conform to all specifications.
5. Perform a safety check.
 - a) Make sure that all cables are attached correctly.
 - b) Make sure that the RAID controller is installed correctly.
 - c) Close the cabinet of the host system.
6. Reconnect the power cords to the system.
7. Turn on the power to the system.

Make sure that the power is turned on to any external drives before the power is turned on to the host computer. If the computer is powered up before these devices, the devices might not be recognized.

2.3 Detailed Installation for 12Gb/s Intel® RAID Controllers

This section provides detailed instructions on how to install your 12Gb/s Intel® RAID Controller.

The figure in this section shows the installation of the Intel® RAID Controller RS3DC080 in a PCIe slot. You can install the Intel® RAID Controller RS3WC080, RS3DC040, RS3MC044, and RS3SC008 in the same way.

1. **Unpack the 12Gb/s Intel® RAID Controller.**
Unpack and remove your RAID controller. Inspect it for damage. If it appears damaged, contact your Intel Customer and Technical Support representative.
 2. **Turn off the power to the system.**
Turn off the power to the computer, and disconnect the AC power cord. Remove the computer cover. Refer to the system documentation for instructions.
-

Caution: Before you install the controller, make sure that the computer is disconnected from the power and from any networks.

3. **Review the RAID controller jumpers and connectors.**
The jumpers are set at the factory, and you usually do not need to change them. See [Chapter 3, 12Gb/s Intel® RAID Controller Characteristics](#), for diagrams of the 12Gb/s Intel® RAID Controllers that show their jumpers and connectors.
 4. **Install the RAID controller.**
Select a PCIe slot, and align the controller's PCIe bus connector to the slot, as shown in the following figure. Press down gently, but firmly, to make sure that the card is seated correctly in the slot. Secure the bracket to the computer chassis with the bracket screw.
-

Note: This RAID controller is a PCIe x8 card, and it can operate in x8 or x16 slots. Some PCIe slots, however, support only PCIe graphics cards; if a RAID controller is installed in one of these slots, the RAID controller will not function. Refer to the guide for your motherboard for information about the PCIe slot.

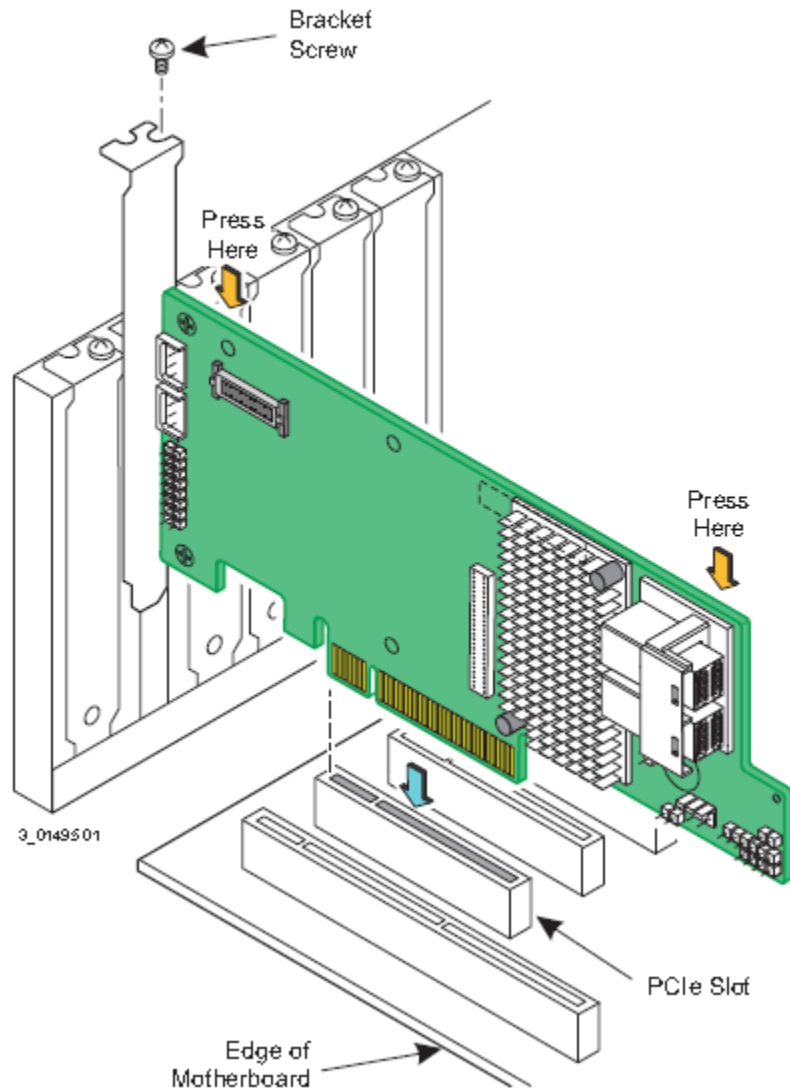


Figure 3. Example of the Intel® RAID Controller RS3DC080 Installation in a PCIe Slot

5. Configure and install the SAS devices, the SATA devices, or both in the host computer case.
6. Refer to the documentation for the devices for any pre-installation configuration requirements.
7. Connect the RAID controller to the devices.

Use SAS cables to connect SAS devices, SATA devices, or both to the 12Gb/s Intel® RAID Controller. See [SAS Device Cables and Connectors](#) for SAS cable and connector information. See [Connecting a RAID Controller with Internal Port Connectors by Cable to Internal Drives](#) for information about connecting the controller to the drives.

The maximum cable length is 10 meters (393.37 in.). 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, use the following guidelines:

- Use cables no longer than 10 meters (393.37 in.). (Use shorter cables, if possible.)
 - Use cables that meet the SAS specification.
 - Route the SAS cables carefully.
8. Turn on the power to the system.
Reinstall the computer cover, and reconnect the AC power cords. Turn on power to the host computer. Make sure that the power is turned on to the SAS devices, SATA devices, or both before or at the same time that the power is turned on to the host computer. If the computer is powered on before these devices,

the devices might not be recognized.

During boot, a BIOS message appears. The firmware takes several seconds to initialize. The configuration utility prompt times out after several seconds. The second portion of the BIOS message shows the 12Gb/s Intel® RAID Controller number, firmware version, and cache SDRAM size. The numbering of the controllers follows the PCI slot scanning order used by the host motherboard.

9. Run the RAID BIOS Console Configuration Utility.

Run the RAID BIOS Console Configuration Utility to configure the drive groups and the virtual drives. When the message Press Ctrl+R for RAID BIOS Console appears on the screen, immediately press Ctrl+R to run the utility.

10. Install the operating system driver.

The 12Gb/s Intel® RAID Controllers can operate under various operating systems. To operate under these operating systems, you must install the software drivers.

2.4 Detailed Installation for 12Gb/s Intel® RAID Modules

This section provides detailed instructions on how to install your 12Gb/s Intel® RAID Module.

The figures in this section show the installation of the Intel® RAID Modules RMS3CC080, RMS3CC040 and RMS3HC080 in the Mezzanine connector.

1. Unpack the 12Gb/s Intel® RAID Module.

Unpack and remove your RAID module. Inspect it for damage. If it appears damaged, contact your Intel Customer and Technical Support representative.

2. Turn off the power to the system.

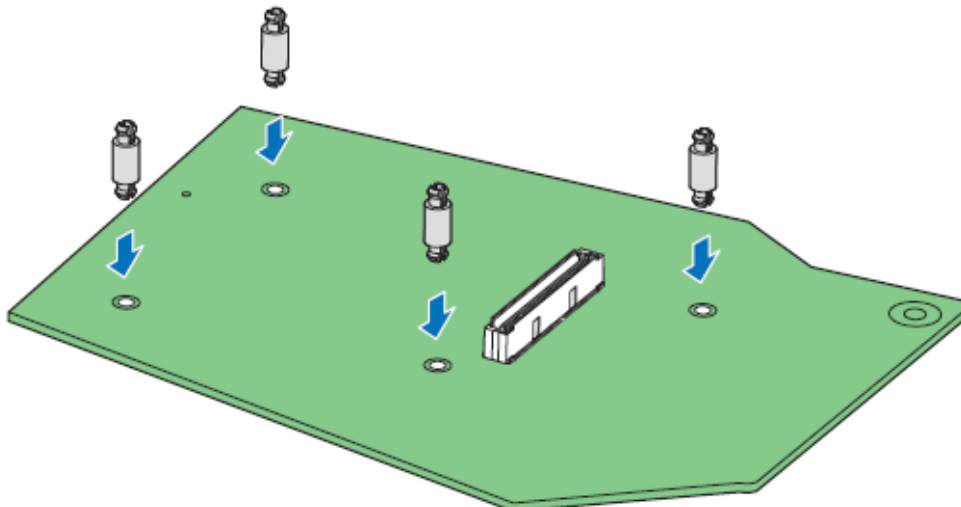
Turn off the power to the computer, and disconnect the AC power cord. Remove the computer cover. Refer to the system documentation for instructions.

Caution: Before you install the module, make sure that the computer is disconnected from the power and from any networks.

3. Install the barrel standoff.

a) Locate the matching SAS module connector on your server board. See your server board documentation.

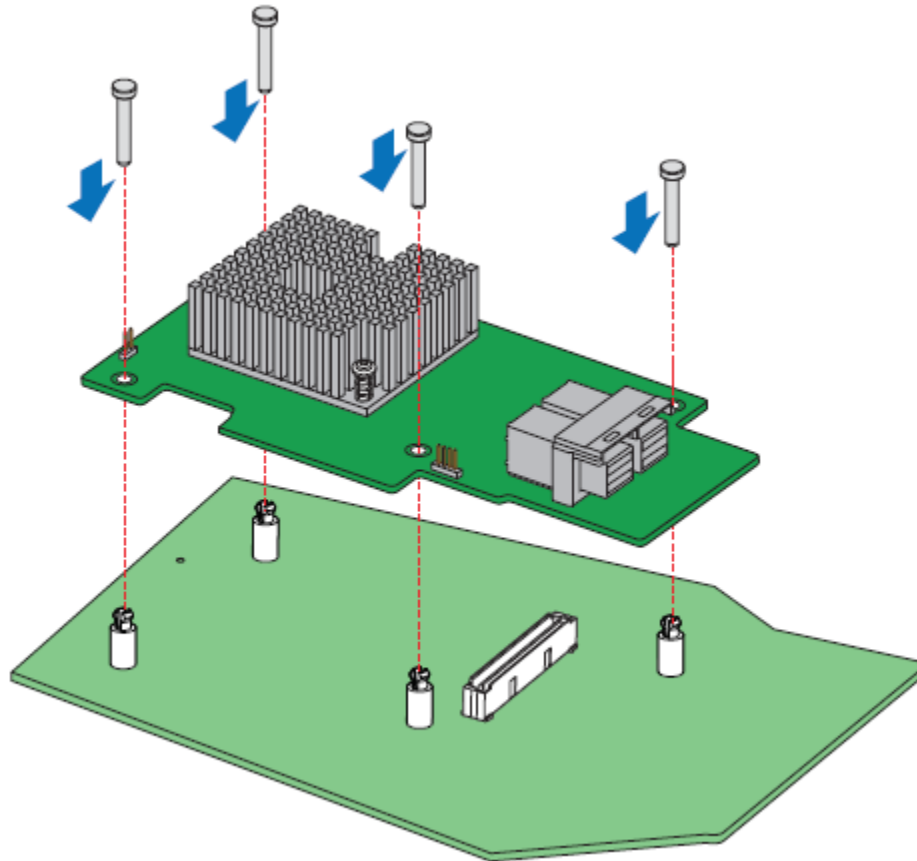
b) Insert the barrel standoffs into the matching holes in the server board.



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Figure 4. Install the Barrel Standoff

4. Review the RAID module jumpers and connectors.
The jumpers are set at the factory, and you usually do not need to change them. See [Chapter 3, 12Gb/s Intel® RAID Controller Characteristics](#), for diagrams of the 12Gb/s Intel® RAID Module that show their jumpers and connectors.
5. Install the RAID module.
 - a) Attach the RAID module to the matching server board connector and press the module card firmly to engage the barrel standoffs.
 - b) Press down gently but firmly to ensure that the card is properly seated in the connectors, and then insert the four pin standoffs into the barrel standoffs respectively.



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Figure 5. Install the RAID Module

6. Configure and install the SAS devices, the SATA devices, or both in the host computer case. Refer to the documentation for the devices for any pre-installation configuration requirements.
7. Connect the RAID module to the devices.
Use SAS cables to connect SAS devices, SATA devices, or both to the 12Gb/s Intel® RAID Module. See [SAS Device Cables and Connectors](#) for SAS cable and connector information. See [Connecting a RAID Controller with Internal Port Connectors by Cable to Internal Drives](#) for information about connecting the module to the drives.

The maximum cable length is 10 meters (393.37 in.). 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, use the following guidelines:

- Use cables no longer than 10 meters (393.37 in.). (Use shorter cables, if possible.)
 - Use cables that meet the SAS specification.
 - Route the SAS cables carefully.
8. Turn on the power to the system.
Reinstall the computer cover, and reconnect the AC power cords. Turn on power to the host computer. Make sure that the power is turned on to the SAS devices, SATA devices, or both before or at the same time that the power is turned on to the host computer. If the computer is powered on before these devices, the devices might not be recognized.
During boot, a BIOS message appears. The firmware takes several seconds to initialize. The configuration utility prompt times out after several seconds. The second portion of the BIOS message shows the 12Gb/s Intel® RAID Module number, firmware version, and cache SDRAM size. The numbering of the modules follows the PCI slot scanning order used by the host motherboard.
9. Run the RAID BIOS Console Configuration Utility.
Run the RAID BIOS Console Configuration Utility to configure the drive groups and the virtual drives. When the message `Press Ctrl+R for RAID BIOS Console` appears on the screen, immediately press `Ctrl+R` to run the utility.

2.5 After Installing the RAID Controller

After you install the 12Gb/s Intel® RAID Controller, you must configure the controller and install the operating system driver. The *Intel® RAID Software User Guide for full featured and entry level RAID controllers* instructs you on the configuration options and how to set them on your 12Gb/s Intel® RAID Controller. The *Intel Device Driver Installation Guide* provides detailed installation instructions for operating system drivers.

2.6 SAS Device Cables and Connectors

This section describes the cables and the connectors used on the 12Gb/s Intel® RAID Controllers and provides step-by-step instructions for connecting SAS drives, SATA drives, or both to the 12Gb/s Intel® RAID Controller. The SAS protocol and the SATA protocol use a thin, 7-wire connector instead of the 68-wire SCSI cable or the 40-wire ATA cable.

Note: Use only straight SAS cables, not crossover SAS cables.

The following figure shows the SAS cable that connects the internal connectors on a SAS RAID controller to SAS drives, SATA drives, or both.

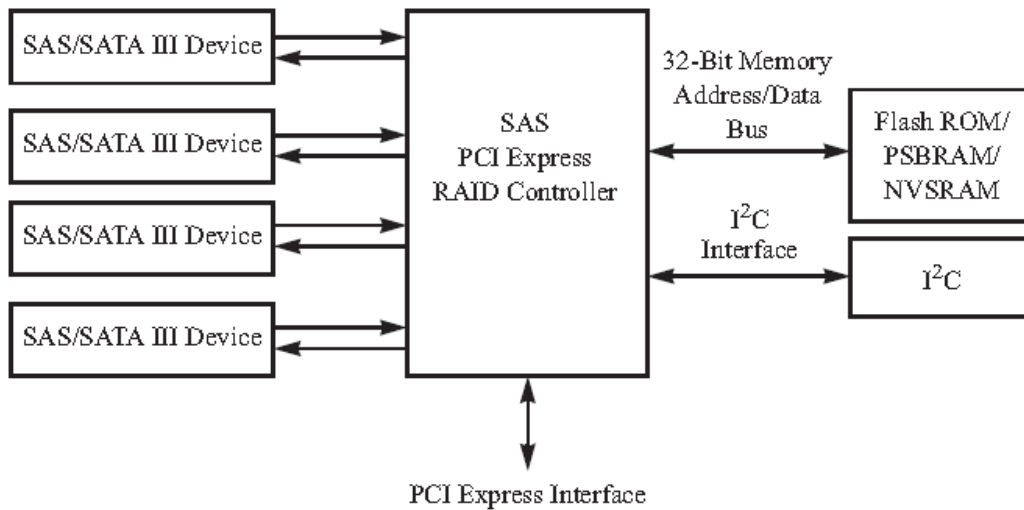


Figure 6. Internal SAS Cable for Connection to SAS Drives, SATA II Drives, or SATA III Drives

The following figure shows the SATA III device plug connector that connects a SAS RAID controller with internal connectors to the host receptacle connector on a backplane. A SATA III connector consists of a signal connector and a power connector.

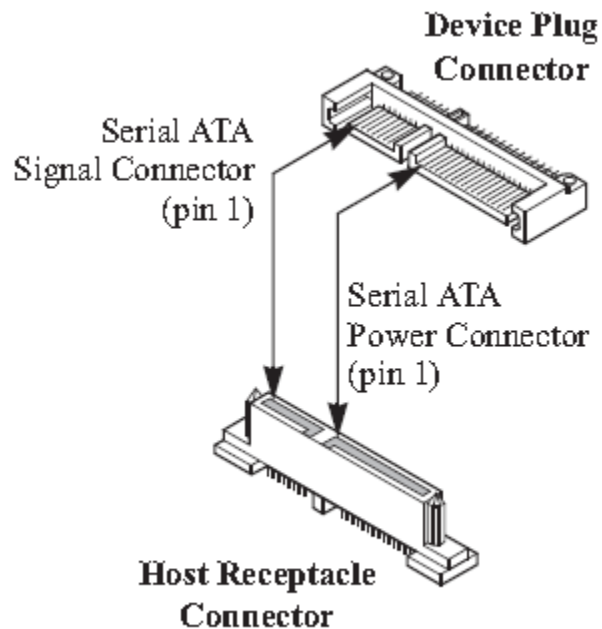


Figure 7. SATA III Connectors

The following figure shows SAS connectors and SATA connectors on SAS drives and SATA drives, respectively. Cables connect internal connectors on the RAID controllers to connectors on SAS drives, SATA drives, or both. Both SAS drives and SATA drives can connect to SAS backplane receptacle connectors. The difference between the SAS connector and the SATA connector is the bridge between the SAS primary physical link and the power connector on the SAS controller, which the SATA connector does not have.

Note: SAS backplane connectors accept SAS drives or SATA drives, but SATA backplane connectors cannot accept SAS drives.

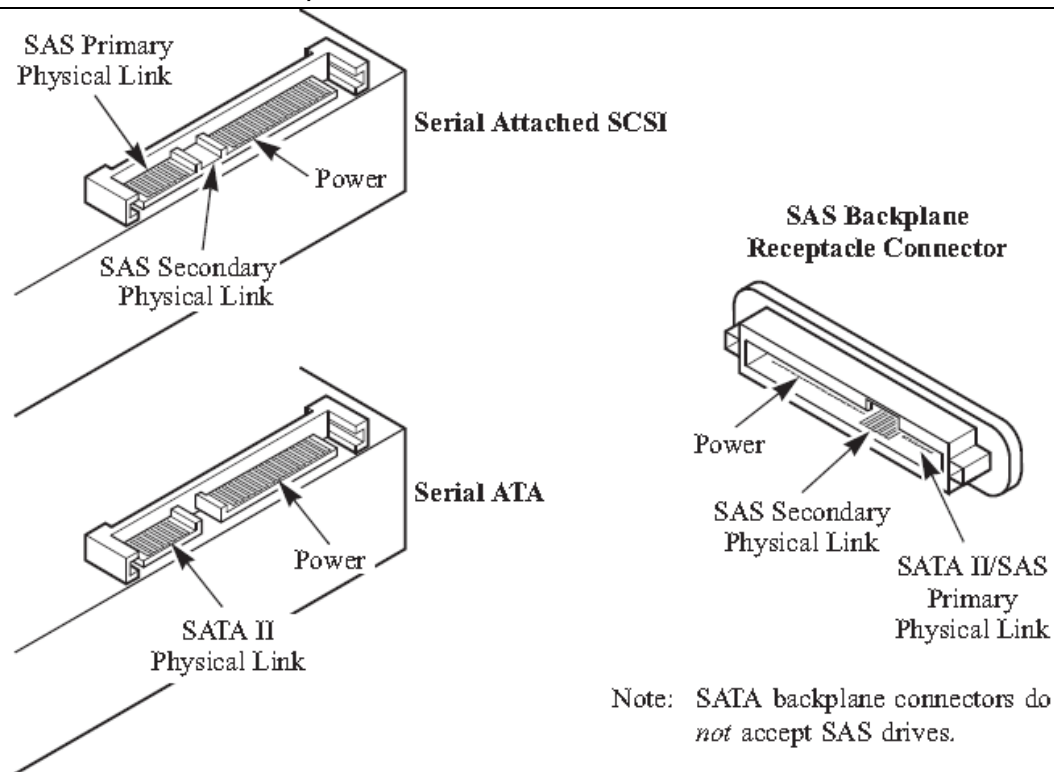


Figure 8. SAS Plugs, SATA Plugs, and SAS Backplane Receptacle Connector

Note: SATA backplane connectors do *not* accept SAS drives.

The following subsection provides step-by-step instructions for connecting the 12Gb/s Intel® RAID Controllers to SAS drives and SATA drives, either directly or through an expander.

Connecting a RAID Controller with Internal Port Connectors by Cable to Internal Drives

This section provides step-by-step instructions for connecting the SAS cable from the internal SAS port connectors on the RAID controller to internal SAS drives and SATA drives.

Follow these steps to connect your RAID controller with internal SAS port connectors directly to SAS drives or SATA drives.

Note: The Intel® RAID Controller RS3DC080 is shown as an example. You can connect the Intel® RAID Controller RS3DC040 in the same way.

1. Insert the SFF-8643 internal mini-SAS HD-4i connector on the cable into a SFF-8643 internal mini-SAS HD-4i connector on the Intel® RAID Controller RS3DC080, as shown in the following figure.
2. Plug the HDD connector on the other end of the cable into the connector on the SAS drive or SATA drive.
3. If you have another drive, connect it to another plug on the internal cable. You can connect other devices if the cable has more connectors.

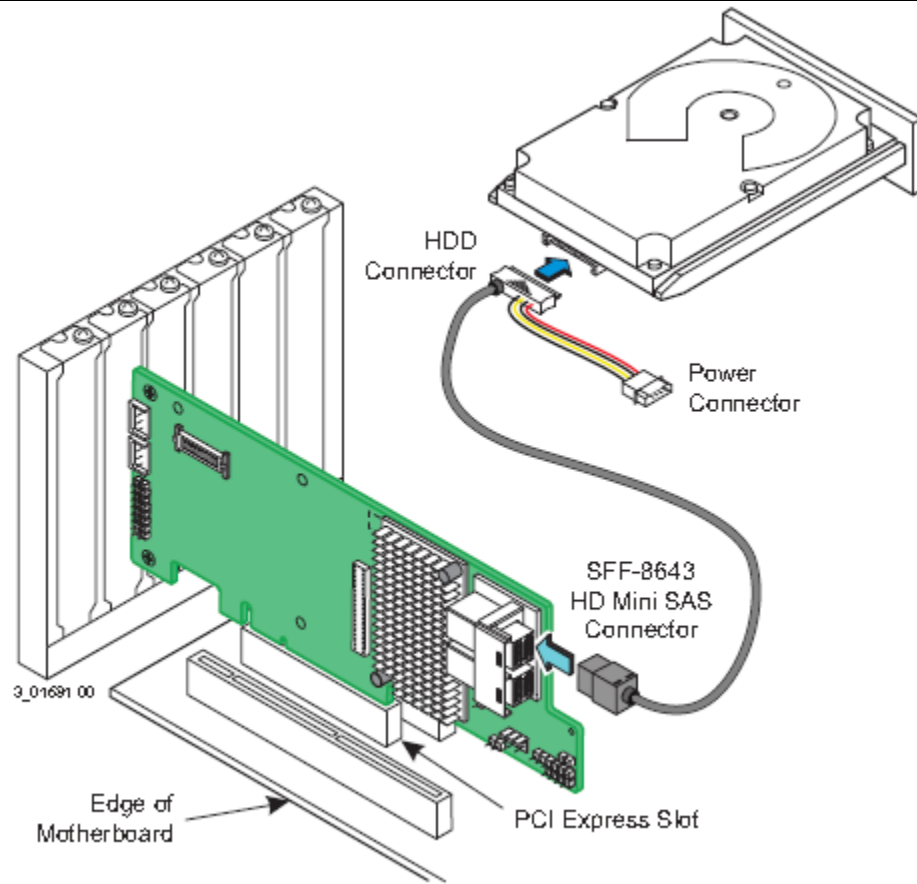


Figure 9. Connecting the Intel® RAID Controller RS3DC080 to a Drive

3 12Gb/s Intel® RAID Controller Characteristics

3.1 12Gb/s Intel® RAID Controller Family

The 12Gb/s Intel® RAID Controllers are dual-PHY, SAS PCI Express RAID controllers and are used in a system 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 devices, servers, communications, and embedded devices.

The following subsections provide figures and connector information for the 12Gb/s Intel® RAID Controllers.

3.1.1 Intel® RAID Controller RS3WC080

The Intel® RAID Controller RS3WC080 is a low-profile SAS+SATA RAID controller that controls eight internal SAS/SATA ports through two SFF-8643 internal mini-SAS HD-4i connectors.

3.1.1.1 Intel® RAID Controller RS3WC080 – Board Layout and Jumper and Connector Information

This subsection provides the board layout, and the connector and jumper information for the Intel® RAID Controller RS3WC080. The following figure shows the jumpers and the connectors on the Intel® RAID Controller RS3WC080.

Note: Pin 1 on the headers and connectors is highlighted in red in this figure.

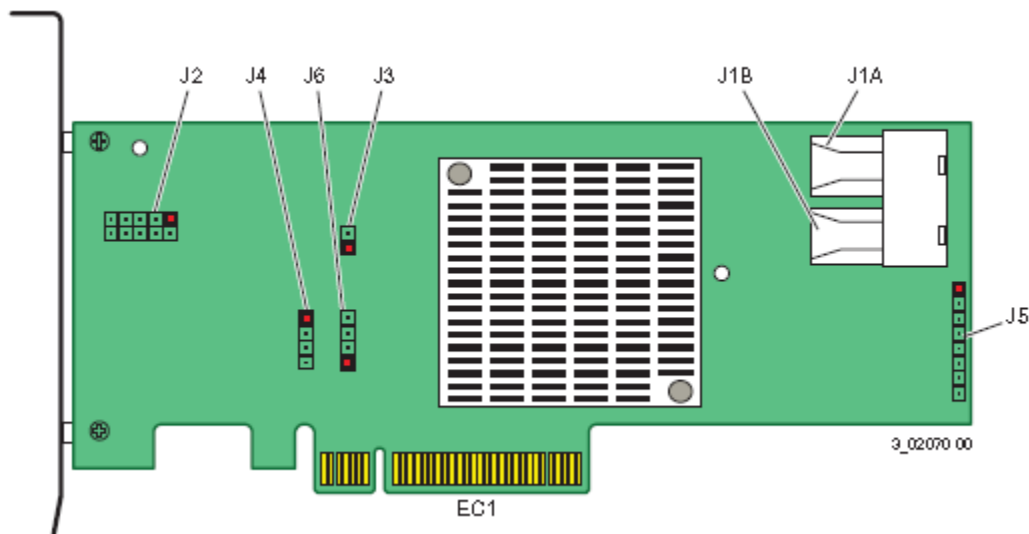


Figure 10. Card Layout for the Intel® RAID Controller RS3WC080

The following table describes the jumpers and the connectors on the Intel® RAID Controller RS3WC080.

Table 4. Jumpers and Connectors on the Intel® RAID Controller RS3WC080

| Jumper/ Connector | Type | Description |
|----------------------|--|--|
| EC1 | Standard edge card connector | PCIe* x8 board edge connector |
| J1A | SFF-8643 mini-SAS HD-4i internal connector | x4 SAS Port 0 through Port 3 |
| J1B | SFF-8643 mini-SAS HD-4i internal connector | x4 SAS Port 4 through Port 7 |
| J2 | 10-pin header | Complex programmable logic device (CPLD) header Reserved for use. |
| J3 | 2-pin connector | Modular RAID Key connector Reserved for use. |
| J4 | 4-pin connector | On-board Serial Universal Asynchronous Receiver/Transmitter (UART) connector Reserved for use. |
| J5 | 16-pin header | RISCwatch header Reserved for use. |
| J6 | 2-pin header | Test header Reserved for use. |

3.1.2 Intel® RAID Controller RS3DC040 and RS3DC080

The Intel® RAID Controller RS3DC040 is a low-profile SAS+SATA RAID controller that controls four internal SAS/SATA ports through one SFF-8643 internal mini-SAS HD-4i connectors.

The Intel® RAID Controller RS3DC080 is a low-profile SAS+SATA RAID controller that controls eight internal SAS/SATA ports through two SFF-8643 internal mini-SAS HD-4i connectors.

3.1.2.1 Intel® RAID Controller RS3DC080 – Board Layout and Jumper and Connector Information

This subsection provides the board layout, and the connector and jumper information for the Intel® RAID Controller RS3DC0x0. The following figure shows the jumpers and the connectors on the Intel® RAID Controller RS3DC080.

Note: The Intel® RAID Controller RS3DC040 is the same as the Intel® RAID Controller RS3DC080 except that the J5A1 connector on the Intel® RAID Controller RS3DC040 is a single internal port connector. The J5A1 connector on the Intel® RAID Controller RS3DC080 is a dual internal port connector.

Note: Pin 1 on the headers and connectors is highlighted in red in this figure.

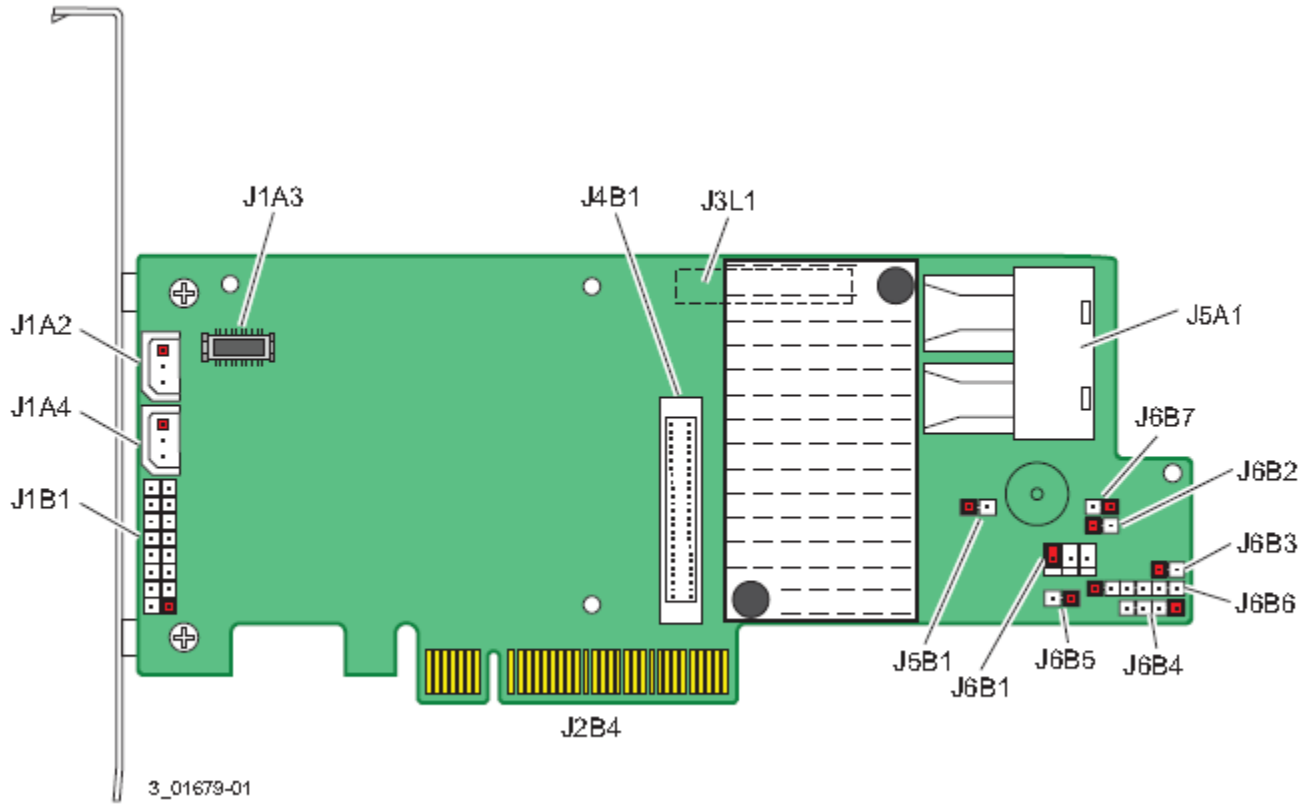


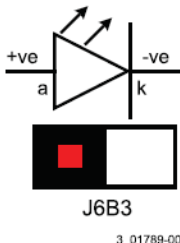
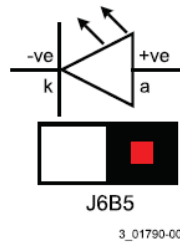
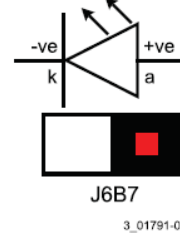
Figure 11. Card Layout for the Intel® RAID Controller RS3DC080

The following table describes the jumpers and the connectors on the Intel® RAID Controller RS3DC080.

Table 5. Jumpers and Connectors on the Intel® RAID Controller RS3DC080

| Jumper/ Connector | Type | Description |
|----------------------|------------------|---|
| J1A2 | 3-pin connector | IPMI-style I ² C connector for Ports 4 to 7. Supports SCSI Enclosure Services (SES) over I ² C through an internal I ² C backplane cable. |
| J1A3 | 20-pin connector | Local RAID Maintenance Free Backup Units connector. Connects the RMFBU directly to the RAID controller. |
| J1A4 | 3-pin connector | IPMI-style I ² C connector for Ports 0 to 3. Supports SES over I ² C through an internal I ² C backplane cable. |

| Jumper/ Connector | Type | Description |
|-------------------|--|---|
| J1B1 | <p>2x8-pin header Ports 0 to 3 Ports 4 to 7</p> <p>PORT 0</p> <p>...</p> <p>PORT 7</p> <p>J1B1</p> <p>3_01788-00</p> | <p>Individual PHY and drive fault indication header.</p> <p>Connects to an LED that indicates whether a drive is in a fault condition. One LED exists per port. When lit, each LED indicates the corresponding drive has failed or is in the <i>Unconfigured-Bad</i> state.</p> <p>The LEDs function in a direct-attach configuration (no SAS expanders exist). Direct attach is defined as a maximum of one drive connected directly to each port.</p> <p>Note: <i>The J5A1 connector on the Intel® RAID Controller RS3DC040 is a single internal port connector.</i></p> |
| J2B4 | Standard edge card connector | <p>The interface between the RAID controller and the host system.</p> <p>Along with the PCIe interface, this connector provides power to the board and an I²C interface connected to the I²C bus for the Intelligent Platform Management Interface (IPMI).</p> |
| J3L1 | 20-pin connector | <p>Remote RAID Maintenance Free Backup Units connector (on the backside of the controller).</p> <p>Connects the remote RMFBU to the RAID controller.</p> |
| J4B1 | 70-pin connector | <p>Flash Module DDR3 Interface.</p> <p>Connects the controller to a flash module.</p> |
| J5A1 | Dual x4 SAS Port 0 through Port 7 internal connector | <p>Two SFF-8643 mini-SAS HD-4i internal connectors.</p> <p>Connects the controller by cable to SAS drives or SATA drives.</p> |
| J5B1 | 2-pin connector | <p>Test header.</p> <p>Reserved for use.</p> |
| J6B1 | 3-pin header | <p>Premium Feature Key header.</p> <p>Enables support for selected advanced features, such as Recovery, CacheCade*, FastPath, and SafeStore* disk encryption.</p> |
| J6B2 | 2-pin connector | <p>Default Serial boot ROM (SBR) header.</p> <p>Reserved for use.</p> |

| Jumper/ Connector | Type | Description |
|----------------------|--|---|
| J6B3 | 2-pin connector  <p>J6B3 3_01789-00</p> | Global hard disk drive (HDD) activity LED header. Connects to an LED that indicates activity on the drives connected to the controller. |
| J6B4 | 4-pin connector | On-board Serial Universal Asynchronous Receiver/Transmitter (UART) connector. Reserved for use. |
| J6B5 | 2-pin connector  <p>J6B5 3_01790-00</p> | Global drive fault LED header. Connects to an LED that indicates whether a drive is in a fault condition. |
| J6B6 | 6-pin connector | Complex programmable logic device (CPLD) header. Reserved for use. |
| J6B7 | 2-pin connector  <p>J6B7 3_01791-00</p> | Cache write pending header. Connector for an LED mounted on the system enclosure. The LED indicates that the data in the cache has yet to be written to the storage devices. |

3.1.3 Intel® RAID Controller RS3MC044

The Intel® RAID Controller RS3MC044 is a low-profile SATA+SAS RAID controller that controls four internal SAS/SATA ports through one SFF-8643 internal mini-SAS HD-4i connector and four external SAS/SATA ports through one SFF-8644 mini-SAS HD-4e connector.

3.1.3.1 Intel® RAID Controller RS3MC044 – Board Layout and Jumper and Connector Information

This subsection provides the board layout, and the connector and jumper information for the Intel® RAID Controller RS3MC044. The following figure shows the jumpers and the connectors on the controller.

Note: Pin 1 on the headers and connectors is highlighted in red in this figure.

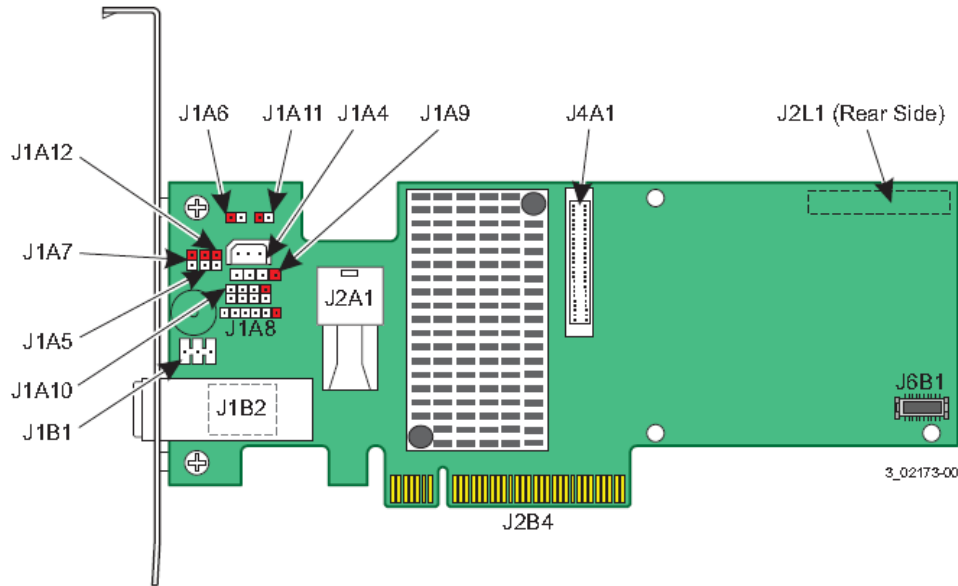


Figure 12. Card Layout for the Intel® RAID Controller RS3MC044

The following table describes the jumpers and the connectors on the Intel® RAID Controller RS3MC044.

Table 6. Jumpers and Connectors on the Intel® RAID Controller RS3MC044

| Jumper/ Connector | Type | Description |
|----------------------|--|--|
| J1A4 | 3-pin connector | IPMI-style I ² C connector for Ports 4 to 7. Supports SCSI Enclosure Services (SES) over I ² C through an internal I ² C backplane cable. |
| J1A5 | 2-pin connector | Default Serial boot ROM (SBR) header. Reserved for use. |
| J1A6 | 2-pin connector | Global drive fault LED header. Connects to an LED that indicates activity on the drives connected to the controller. |
| J1A7 | 2-pin connector | Cache write pending header. Connector for an LED mounted on the system enclosure. The LED indicates that the data in the cache has yet to be written to the storage devices. |
| J1A8 | 5-pin connector | CPLD header. Reserved for use. |
| J1A9 | 4-pin connector | On-board Serial Universal Asynchronous Receiver/Transmitter (UART) connector. Reserved for use. |
| J1A10 | 2x8-pin header Ports 0 to 3 Ports 4 to 7 | Individual PHY and drive fault indication header. Connects to an LED that indicates whether a drive is in a fault condition. One LED exists per port. When lit, each LED indicates the corresponding drive has failed or is in the <i>Unconfigured-Bad</i> state. The LEDs function in a direct-attach configuration (no SAS expanders exist). Direct attach is defined as a maximum of one drive connected directly to each port. |

| Jumper/ Connector | Type | Description |
|----------------------|---|---|
| J1A11 | 2-pin connector | Global hard disk drive (HDD) activity LED header. Connects to an LED that indicates activity on the drives connected to the controller. |
| J1A12 | 2-pin connector | Test header. Reserved for use. |
| J1B1 | 3-pin header | Premium Feature Key header. Enables support for selected advanced features, such as Recovery, CacheCade*, FastPath, and SafeStore* disk encryption. |
| J1B2 | x4 SAS Port 0 through Port 3 internal connector | One SFF-8644 mini-SAS HD-4e external connector. Connects the controller by cable to an enclosure containing SAS drives or SATA drives. |
| J2A1 | x4 SAS Port 0 through Port 3 external connector | One SFF-8643 mini-SAS HD-4i internal connector. Connects the controller by cable to SAS drives or SATA drives. |
| J2B4 | Standard edge card connector | The interface between the RAID controller and the host system. Along with the PCIe interface, this connector provides power to the board and an I ² C interface connected to the I ² C bus for the Intelligent Platform Management Interface (IPMI). |
| J2L1 | 20-pin connector | Remote RAID Maintenance Free Backup Units connector (on the backside of the controller). Connects the remote RMFBU to the RAID controller. |
| J4A1 | 80-pin connector | Flash Module DDR3 Interface. Connects the controller to a flash module. |
| J6B1 | 20-pin connector | Local RAID Maintenance Free Backup Units connector. Connects the RMFBU directly to the RAID controller. |

3.1.4 Intel® RAID Controller RS3SC008

The Intel® RAID Controller RS3SC008 is a low-profile SATA+SAS RAID controller that controls eight external SAS/SATA ports through two SFF-8644 mini-SAS HD-4e connectors.

3.1.4.1 Intel® RAID Controller RS3SC008 – Board Layout and Jumper and Connector Information

This subsection provides the board layout, and the connector and jumper information for the Intel® RAID Controller RS3SC008. The following figure shows the jumpers and the connectors on the controller.

Note: Pin 1 on the headers and connectors is highlighted in red in this figure.

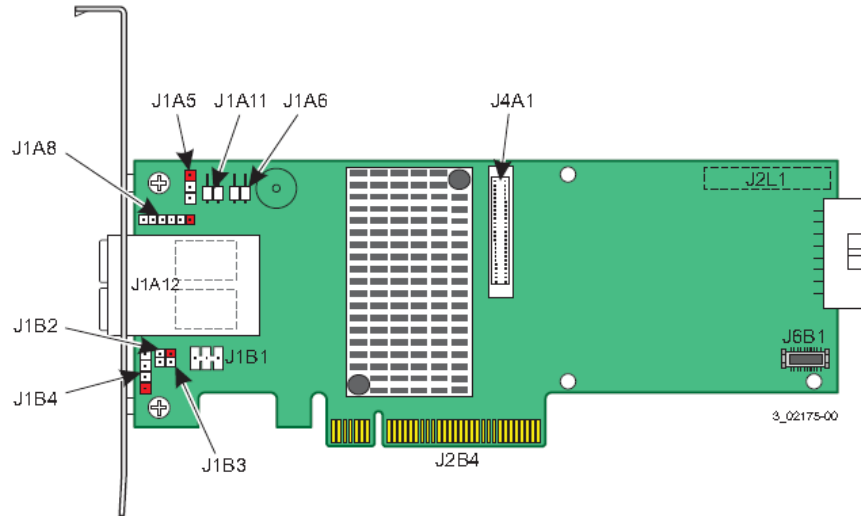


Figure 13. Card Layout for the Intel® RAID Controller RS3SC008

The following table describes the jumpers and the connectors on the Intel® RAID Controller RS3SC008.

Table 7. Jumpers and Connectors on the Intel® RAID Controller RS3SC008

| Jumper/ Connector | Type | Description |
|-------------------|---|---|
| J1A5 | 2-pin connector | Default Serial boot ROM (SBR) header. Reserved for use. |
| J1A6 | 2-pin connector | Global drive fault LED header. Connects to an LED that indicates activity on the drives connected to the controller. |
| J1A8 | 5-pin connector | CPLD header. Reserved for use. |
| J1A11 | 2-pin connector | Global hard disk drive (HDD) activity LED header. Connects to an LED that indicates activity on the drives connected to the controller. |
| J1A12 | x4 SAS Port 0 through Port 7 external connector | Two SFF-8644 mini-SAS HD-4e external connectors. Connects the controller by cable to an enclosure containing SAS drives or SATA drives. |
| J1B1 | 3-pin header | Premium Feature Key header. Enables support for selected advanced features, such as Recovery, CacheCade*, FastPath, and SafeStore* disk encryption. |
| J1B2 | 2-pin connector | Cache write pending header. Connector for an LED mounted on the system enclosure. The LED indicates that the data in the cache has yet to be written to the storage devices. |
| J1B3 | 2-pin connector | Test header. Reserved for use. |
| J1B4 | 4-pin connector | On-board Serial Universal Asynchronous Receiver/Transmitter (UART) connector. Reserved for use. |

| Jumper/ Connector | Type | Description |
|----------------------|------------------------------|---|
| J2B4 | Standard edge card connector | The interface between the RAID controller and the host system. Along with the PCIe interface, this connector provides power to the board and an I ² C interface connected to the I ² C bus for the Intelligent Platform Management Interface (IPMI). |
| J2L1 | 20-pin connector | Remote RAID Maintenance Free Backup Units connector (on the backside of the controller). Connects the remote RMFBU to the RAID controller. |
| J4A1 | 80-pin connector | Flash Module DDR3 Interface. Connects the controller to a flash module. |
| J6B1 | 20-pin connector | Local RAID Maintenance Free Backup Units connector. Connects the RMFBU directly to the RAID controller. |

3.1.5 Intel® RAID Module RMS3CC080 and RMS3CC040

The Intel® RAID Modules RMS3CC080 and is an LSI* SAS3108 ROC based SATA+SAS RAID controller that controls eight internal SAS/SATA ports through two SFF- 8643 internal mini-SAS HD-4i connectors.

The Intel® RAID Modules RMS3CC040 is an LSI* SAS3108 ROC based SATA+SAS RAID controller that controls four internal SAS/SATA ports through one SFF- 8643 internal mini-SAS HD-4i connector.

Both modules are a PCI-Express* (PCIe*) 3.0 RAID adapter with a mezzanine port that is a custom 80-pin connector capable of performance up to 8GT/s per lane.

3.1.5.1 Intel® RAID Module RMS3CC080 and RMS3CC040 – Board Layout and Jumper and Connector Information

This subsection provides the board layout, and the connector and jumper information for the Intel® RAID Modules RMS3CC080 and RMS3CC040. The following figures shows the jumpers and the connectors on the Intel® RAID Modules RMS3CC080 and RMS3CC040.

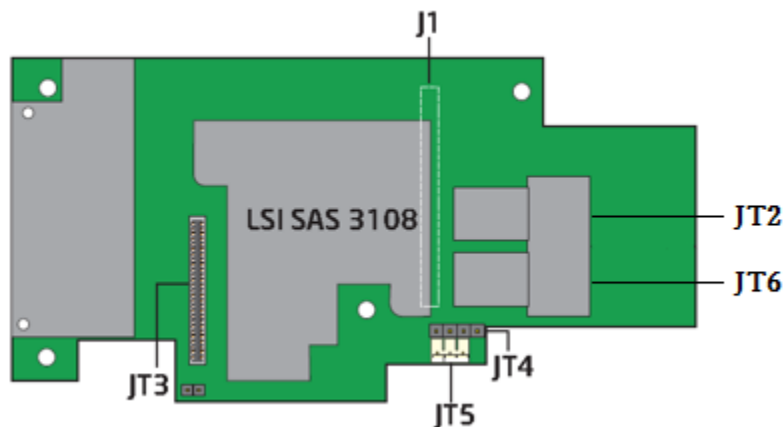


Figure 14. Card Layout for the Intel® RAID Modules RMS3CC080

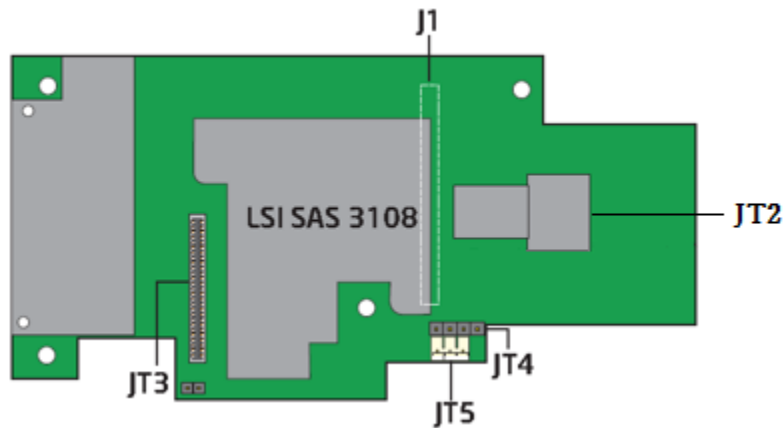


Figure 15. Card Layout for the Intel® RAID Modules RMS3CC040

The following table describes the jumpers and the connectors on the Intel® RAID Module RMS3CC080.

Table 8. Jumpers and Connectors on the Intel® RAID Module RMS3CC080 and RMS3CC040

| Jumper/ Connector | Type | Description |
|-------------------|---|--|
| J1 | Mezzanine connector (on the backside of the module) | The PCIe* interface to the host system that is implemented with a board-to-board Mezzanine connector. |
| JT2 | Connector for SAS Ports 0 through 3 | SFF-8643 mini-SAS HD-4i internal connectors. Connects the controller by cable to SAS drives or SATA drives. |
| JT3 | Cache off-load connector | Remote RAID Maintenance Free Backup Unit connector (on the backside of the controller). Connects the remote RMFBU to the RAID controller. |
| JT4 | 4-pin connector | On-board Serial Universal Asynchronous Receiver/Transmitter (UART) connector. |
| JT5 | 3-pin header | Premium Feature Key header. Enables support for selected advanced features, such as Recovery, CacheCade*, FastPath, and SafeStore* disk encryption. |
| JT6 | Connector for SAS Ports 4 through 7 | SFF-8643 mini-SAS HD-4i internal connectors. Connects the controller by cable to SAS drives or SATA drives. |

3.1.6 Intel® RAID Module RMS3HC080

The Intel® RAID Module RMS3HC080 is an LSI* SAS3008 ROC based SATA+SAS RAID controller that controls four internal SAS/SATA ports through one SFF- 8643 internal mini-SAS HD-4i connector.

The Intel® RAID Module RMS3HC080 is a PCI-Express* (PCIe*) 3.0 RAID adapter with a mezzanine port that is a custom 80-pin connector capable of performance up to 8GT/s per lane.

3.1.6.1 Intel® RAID Module RMS3HC080 – Board Layout and Jumper and Connector Information

This subsection provides the board layout, and the connector and jumper information for the Intel® RAID Module RMS3HC080. The following figure shows the jumpers and the connectors on the Intel® RAID Module RMS3HC080.

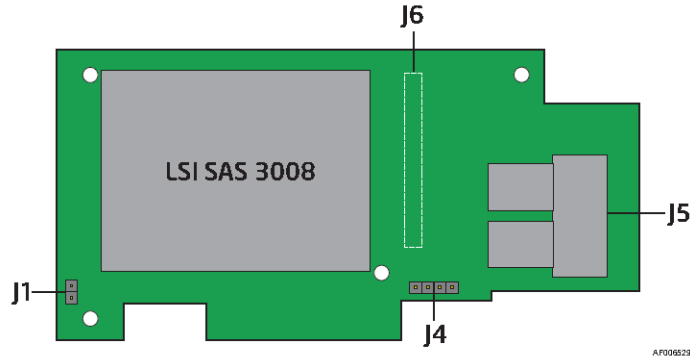


Figure 16. Card Layout for the Intel® RAID Module RMS3HC080

Table 9. Jumpers and Connectors on the Intel® RAID Module RMS3HC080

| Jumper/Connector | Type | Description |
|------------------|--|--|
| J1 | 2-pin connector | Test Header. Reserved for use. |
| J4 | 4-pin connector | On-board Serial Universal Asynchronous Receiver/Transmitter (UART) connector. |
| J5 | Dual x4 SAS Port 0 through Port 7 internal connector | Two SFF-8643 mini-SAS HD-4i internal connectors. Connects the controller by cable to SAS drives or SATA drives. |
| J6 | Mezzanine connector (on the backside of the module) | The PCIe* interface to the host system that is implemented with a board-to-board Mezzanine connector. |

3.2 12Gb/s Intel® RAID Controller Characteristics

The following table shows the general characteristics for all 12Gb/s Intel® RAID Controllers.

Table 10. 12Gb/s Intel® RAID Controller Characteristics

| Flash ROM ^A | Serial EEPROM ^B | Data Transfer Rate | SCSI Feature | SCSI Termination |
|------------------------|----------------------------|---|--|------------------|
| Yes | Yes | Up to 12Gb/s per port for SAS and up to 6Gb/s per port for SATA III | Plug-and-Play Scatter/Gather Activity LED | Active |

- A. For boot code and firmware.
B. For BIOS configuration storage.

Each 12Gb/s Intel® RAID Controller ensures data integrity by intelligently validating the compatibility of the SAS domain. The 12Gb/s Intel® RAID Controllers use Fusion-MPT architecture, which allows for thinner drivers and better performance.

3.3 Technical Specifications

The design and implementation of the 12Gb/s Intel® RAID Controllers minimize electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The 12Gb/s Intel® RAID Controllers show the following marks and certifications:

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

The following hardware is compliant with CSA C22.2 No. 60950-1, UL 60950-1 First Edition-listed accessory, UL file number E257743:

- Intel® RAID Controller RS3WC080
- Intel® RAID Controller RS3DC040
- Intel® RAID Controller RS3DC080

3.3.1 RAID Controller Specifications

The following table lists the specifications for the 12Gb/s Intel® RAID Controllers.

Table 11. RAID Controller Specifications

| Specification | RS3WC080, RMSHC080, RS3DC040, RS3DC080, RS3MC044, RS3SC008, and RMS3CC080 |
|------------------------------------|--|
| SAS controller and processor | LSISAS3008 SAS/SATA Controller <ul style="list-style-type: none"> • RS3WC080 • RMS3HC080 LSISAS3108 ROC Controller <ul style="list-style-type: none"> • RS3DC040/RS3DC080 • RS3MC044 • RS3SC008 • RMS3CC080 • RMS3CC040 |
| Operating voltage | +3.3 V, +12 V |
| Card size | <ul style="list-style-type: none"> • RS3WC080: Low-profile PCI Express adapter card size (68.90 mm x 152.35 mm) • RMS3HC080: Mezzanine port PCI Express card size (64.39 mm x 128.98 mm) • RS3DC0x0: Low-profile PCI Express adapter card size (68.90 mm x 167.65 mm) • RS3MC044: Low-profile PCI Express adapter card size (68.90 mm x 167.65 mm) • RS3SC008: Low-profile PCI Express adapter card size (68.90 mm x 167.65 mm) • RMS3CC080: Mezzanine port PCI Express card size (64.39 mm x 139.16 mm) • RMS3CC040: Mezzanine port PCI Express card size (64.39 mm x 139.16 mm) |
| Array interface to the host | PCIe Rev. 3.0 |
| PCI Express bus data transfer rate | <ul style="list-style-type: none"> • Up to 8GT/s per lane • x8 lane width |
| Serial port | 4-pin RS232-compatible connector (for manufacturing use only) |
| SAS bus speed | 12Gb/s |
| SAS ports | SAS connectors with four SAS ports each |
| Cache configuration | The RS3DC0x0, RS3MC044, RS3SC008, and RMS3CC0x0 support the following cache configuration: <ul style="list-style-type: none"> • 1 GB – 72b arrangement (5) 128Mbx16, Double Data Rate III (DDR3) @ 1866 MHz with Intel® RAID Maintenance Free Backup support. |
| Size of flash ROM for firmware | 16 MB |
| NVRAM | 32 KB for storing RAID configurations |

3.3.2 Array Performance Features

The following table shows the array performance features for the 12Gb/s Intel® RAID Controllers.

Table 12. Array Performance Features

| Specification | RS3WC080, RSMHC080, RS3DC040, RS3DC080, RS3MC044, RS3SC008, RMS3CC080 and RMS3CC040 |
|---------------------------------------|---|
| PCI Express host data transfer rate | 8GT/s per lane |
| Drive data transfer rate | 12Gb/s per lane |
| Maximum scatter/gather I/O | 80 elements |
| Maximum size of I/O requests | 6.4 MB in 64-KB strips |
| Maximum queue tags per drive | As many as the drive can accept |
| Strip sizes* | 64 KB, 128 KB, 256 KB, 512 KB, or 1 MB |
| Maximum number of concurrent commands | 255 |

* RS3WC080 and RMS3HC080 have a fixed 64 KB strip size.

3.3.3 Fault Tolerance

The following table lists the fault tolerance features for the 12Gb/s Intel® RAID Controllers.

Table 13. Fault Tolerance Features

| Specification | RS3WC080, RSMHC080, RS3DC040, RS3DC080, RS3MC044, RS3SC008, RMS3CC080 and RMS3CC040 |
|--------------------------------|---|
| Support for SMART ^A | Yes |
| Drive failure detection | Automatic |
| Drive rebuild using hot spares | Automatic |
| Parity generation and checking | Yes |

^A 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 Electrical and Environmental Requirements

This subsection provides the power supply requirements for the 12Gb/s Intel® RAID Controllers.

3.3.4.1 Power Supply Requirements for the Intel® RAID Controller RS3WC080

All power is supplied to the Intel® RAID Controller RS3WC080 through the PCIe 3.3V and the 12V rails. On-board switching regulator circuitry operating from the 12V rail provides the necessary voltages.

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge

connector only). The following table lists the power for the RAID controllers at peak and normal status.

Table 14. Power Supply for the Intel® RAID Controller RS3WC080

| Power Mode | Power (Watts) |
|-------------------|---------------|
| Peak (on-max) | 19.04 |
| On-Normal/Typical | 13 |

3.3.4.2 Operating and Non-operating Limits for the Intel® RAID Controller RS3WC080

For the Intel® RAID Controller RS3WC080, the operating (thermal and atmospheric) conditions are as follows:

- Relative humidity range is 5 percent to 90 percent noncondensing.
- Airflow must be at least 75 linear feet per minute (LFPM)*
- Ambient temperature range: 0°C to +55°C

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

- Relative humidity range is 5 percent to 90 percent noncondensing.
- Ambient temperature range: -45°C to +105°C

* See appendix B

3.3.4.3 Power Supply Requirements for the Intel® RAID Controller RS3DC0x0

All power is supplied to the Intel® RAID Controller RS3DC0x0 through the PCIe 3.3V rails and the 12V rail. On-board switching regulator circuitry operating from the 3.3V rails and the 12V rail provides the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: While sitting idle at the DOS prompt
- State 2: During a drive stress test

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). The following table lists the power supply for the RAID controllers for these two states at the different voltages.

Table 15. Power Supply for the Intel® RAID Controller RS3DC0x0

| PCI Edge Connector | State 1 | State 2 |
|-----------------------|---------|---------|
| 3.3V supply | 793 mA | 793 mA |
| +12V supply | 915 mA | 1090 mA |
| 3.3V auxiliary supply | 1 mA | 1 mA |
| Total Power | 13.95 W | 16.15 W |

Note: The charging circuitry for the Supercap on the optional RMFBU unit uses +12V. If the RMFBU unit is mounted, the following additional consumption apply:
During charging of the Supercap: 600mA in +12V rail.

3.3.4.4 Operating and Non-operating Limits for the Intel® RAID Controller RS3DC0x0

For the Intel® RAID Controller RS3DC0x0, the operating (thermal and atmospheric) conditions are as follows:

- Relative humidity range is 20 percent to 80 percent noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM)*.
- Ambient temperature range: +10°C to +55°C without battery backup unit
- Ambient temperature range: +10°C to +45°C with battery backup unit

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

- Relative humidity range is 5 percent to 90 percent noncondensing.
- Ambient temperature range: –40°C to +70°C without battery backup unit
- Ambient temperature range: 0°C to +45°C with battery backup unit

* See appendix B

3.3.4.5 Power Supply Requirements for the Intel® RAID Controller RS3MC044

All power is supplied to the Intel® RAID Controller RS3MC044 through the PCIe 3.3V rails and the 12V rail. On-board switching regulator circuitry operating from the 3.3V rails and the 12V rail provides the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: While sitting idle at the DOS prompt
- State 2: During a drive stress test

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). The following table lists the power supply for the RAID controllers for these two states at the different voltages.

Table 16. Power Supply for the Intel® RAID Controller RS3MC044

| PCI Edge Connector | State 1 | State 2 |
|-----------------------|---------|---------|
| 3.3V supply | 727mA | 1030mA |
| +12V supply | 1050mA | 1410mA |
| 3.3V auxiliary supply | 10mA | 10mA |
| Total Power | 15.212W | 20.574W |

Note: The charging circuitry for the Supercap on the optional RMFBU unit uses +12V. If the RMFBU unit is mounted, the following additional consumption apply:
During charging of the Supercap: 600mA in +12V rail.

3.3.4.6 Operating and Non-operating Limits for the Intel® RAID Controller RS3MC044

For the Intel® RAID Controller RS3MC044, the operating (thermal and atmospheric) conditions are as follows:

- Relative humidity range is 20 percent to 80 percent noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM)*.

- Ambient temperature range: 10°C to +55°C

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

- Relative humidity range is 5 percent to 90 percent noncondensing.
- Ambient temperature range: -40°C to +70°C

* See appendix B

3.3.4.7 Power Supply Requirements for the Intel® RAID Controller RS3SC008

All power is supplied to the Intel® RAID Controller RS3SC008 through the PCIe 3.3V rails and the 12V rail. On-board switching regulator circuitry operating from the 3.3V rails and the 12V rail provides the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: While sitting idle at the DOS prompt
- State 2: During a drive stress test

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). The following table lists the power supply for the RAID controllers for these two states at the different voltages.

Table 17. Power Supply requirements for the Intel® RAID Controller RS3SC008

| PCI Edge Connector | State 1 | State 2 |
|-----------------------|---------|---------|
| 3.3V supply | 800mA | 880mA |
| +12V supply | 1000mA | 1220mA |
| 3.3V auxiliary supply | 20mA | 20mA |
| Total Power | 14.95W | 17.91W |

Note: The charging circuitry for the Supercap on the optional RMFBU unit uses +12V. If the RMFBU unit is mounted, the following additional consumption apply:
During charging of the Supercap: 600mA in +12V rail.

3.3.4.8 Operating and Non-operating Limits for the Intel® RAID Controller RS3SC008

For the Intel® RAID Controller RS3SC008, the operating (thermal and atmospheric) conditions are as follows:

- Relative humidity range is 20 percent to 80 percent noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM) *.
- Ambient temperature range: 10°C to +55°C

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

- Relative humidity range is 5 percent to 90 percent noncondensing.
- Ambient temperature range: -40°C to +70°C

* See appendix B

3.3.4.9 Power Supply Requirements for the Intel® RAID Controller RMS3CC0x0

All power is supplied to the Intel® RAID Controller RMS3CC0x0 through the PCIe 3.3V rails and the 12V rail. On-board switching regulator circuitry operating from the 3.3V rails and the 12V rail provides the necessary voltages. The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). The following table lists the power supply for the RAID controllers for nominal and worst case scenarios.

Table 16. Power Supply requirements for the Intel® RAID Controller RMS3CC0x0

| PCI Edge Connector | Nominal | Maximum |
|----------------------------------|---------|---------|
| 3.3V supply (includes auxiliary) | 800mA | 873mA |
| +12V supply | 923mA | 1038mA |
| Total Power | 13.72W | 15.33W |

Note: The charging circuitry for the Supercap on the optional RMFBU unit uses +12V. If the RMFBU unit is mounted, the following additional consumption apply:
During charging of the Supercap: 600mA in +12V rail.

3.3.4.10 Operating and Non-operating Limits for the Intel® RAID Module RMS3CC0x0

For the Intel® RAID Module RMS3C RMS3CC0x0, the operating (thermal and atmospheric) conditions are as follows:

- Relative humidity range is 20 percent to 80 percent noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM)*.
- Ambient temperature range: +10°C to +55°C without battery backup unit
- Temperature range: +10°C to +45°C with battery backup unit

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

- Relative humidity range is 5 percent to 90 percent noncondensing.
- Ambient temperature range: -40°C to +70°C without battery backup unit
- Ambient temperature range: 0°C to +45°C with battery backup unit

* See appendix B

3.3.4.11 Power Supply Requirements for the Intel® RAID Controller RMS3HC080

All power is supplied to the Intel® RAID Controller RMS3HC080 through the PCIe 3.3V rails and the 12V rail. On-board switching regulator circuitry operating from the 3.3V rails and the 12V rail provides the necessary voltages. The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). The following table lists the power supply for the RAID controllers for nominal and worst case scenarios.

Table 16. Power Supply requirements for the Intel® RAID Controller RMS3HC080

| PCI Edge Connector | Nominal | Maximum |
|----------------------------------|---------|---------|
| 3.3V supply (includes auxiliary) | 210mA | 210mA |
| +12V supply | 830mA | 930mA |
| Total Power | 10.653W | 11.853W |

3.3.4.12 Operating and Non-operating Limits for the Intel® RAID Module RMS3HC080

For the Intel® RAID Controller RS3SC008, the operating (thermal and atmospheric) conditions are as follows:

- Relative humidity range is 20 percent to 80 percent noncondensing.
- Airflow must be at least 75 linear feet per minute (LFPM)*.
- Ambient temperature range: 10°C to +55°C

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

- Relative humidity range is 5 percent to 90 percent noncondensing.
- Ambient temperature range: -40°C to +70°C

* See appendix B

3.3.5 Safety Characteristics

All 12Gb/s Intel® RAID Controllers meet or exceed 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. For the boards installed in a PCI Express bus slot, all voltages are lower than the SELV 42.4V limit.

4 Intel® RAID Maintenance Free Backup Unit AXXRMFBU4 and AXXRMFBU5

4.1 About the Intel® RAID Maintenance Free Backup Unit AXXRMFBU

Intel® RAID Controllers and Intel® Integrated RAID Modules provide reliability, high performance, and fault-tolerant disk subsystem management. A complete fault-tolerant strategy requires protection of all data, including the unwritten cached data in the RAM cache. If power is lost, the data in the RAM cache is lost. To avoid data loss, a RAID Maintenance Free Backup Unit (RMFBU) can be added to store unwritten cached data from the RAID RAM during an AC power outage or if the AC power cord is removed.

A RAID Maintenance Free Backup Unit protects the integrity of the cached data on Intel® RAID Controllers and Intel® Integrated RAID Modules by offloading data stored in the RAM cache to the NAND flash if there is a complete AC power failure or a brief power outage. The Intel® RAID Maintenance Free Backup Unit provides an alternative to use an uninterruptible power supply (UPS) or it can act as a second level of fault tolerance when used with a UPS. Furthermore, it eliminates the need for lithium ion (Li-ion) batteries traditionally used to protect DRAM cache memory on PCI RAID controllers. Therefore this is a greener and lower total cost cache protection solution.

The cache memory available on Intel® RAID Controllers and Intel® Integrated RAID Modules can improve the overall system performance. Writing data to the controller's cache memory is much faster than writing it to a storage device.

Write operations appear to complete very quickly at the software application level. The Intel® Integrated RAID Module writes the cached data to the storage device when system activity is low or when the cache is getting full. The risk of using write-back cache is that the cached data can be lost if the AC power fails before it is written to the storage device. This risk factor is eliminated when the Intel® Integrated RAID Module has an RMFBU installed.

The Intel® RAID Maintenance Free Backup Unit AXXRMFBU4 and AXXRMFBU5 consist of a cache off-load module and a super capacitor module. The RMFBU monitors the voltage level of the DRAM modules of the Intel® RAID Controller or Intel® Integrated RAID Module. If the voltage drops below a predefined level, the RMFBU offloads the data from the RAID RAM to the NAND flash of the cache off-load module and the super capacitor module provides sufficient power to complete the data transferring. When the voltage level returns to an acceptable level, the RAID RAM is recovered from flash, and all pending writes to storage devices are completed without losing any data.

The Intel® RAID Maintenance Free Backup Unit has built-in functionality to charge the super capacitor module automatically and to communicate entire unit status information such as voltage, temperature, and current to the host server system.

The Intel® RAID Maintenance Free Backup Unit is a smart backup module and uses MegaRAID CacheVault™ Technology. It is compatible with a backup auxiliary power source. The super capacitor module is charged automatically.

4.2 Supported Intel® RAID Controllers and Modules

The Intel® RAID Maintenance Free Backup Unit AXRMFBU4 supports the following Intel® RAID Controllers:

- Intel® RAID Controller RS3DC040
- Intel® RAID Controller RS3DC080
- Intel® RAID Controller RS3MC044
- Intel® RAID Controller RS3SC008

The Intel® RAID Maintenance Free Backup Unit AXRMFBU5 supports the following Intel® Integrated RAID Modules:

- Intel® Integrated RAID Module RMS3CC040
- Intel® Integrated RAID Module RMS3CC080

4.3 Installing the Intel® RAID Maintenance Free Backup Unit

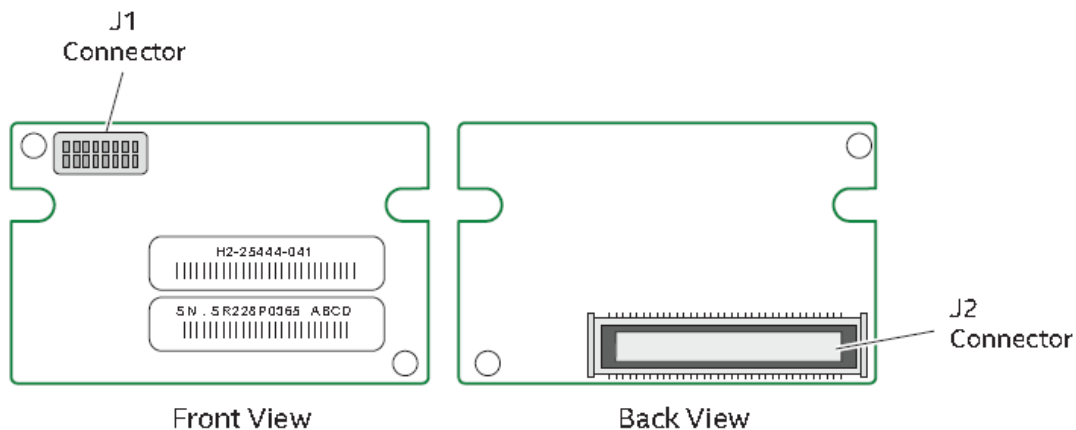
4.3.1 Important Pre-installation Considerations

Warning: Always ground yourself and/or use a ground strap before touching the RAID controller/module or the Intel® RAID Maintenance Free Backup Unit. Perform all installation work at an ESD-safe workstation. Use an ESD-safe Phillips* screwdriver set to a maximum torque of 2.25 inch-pounds, and be sure the screwdriver is centered in the screw to avoid damaging the screw head. If you exceed the maximum torque specification, you may damage the board, connectors, or screws, and you will void the warranty of the board.

4.3.2 Installing the Intel® RAID Maintenance Free Backup Unit AXRMFBU4 Cache Off-load Module

The Intel® RAID Maintenance Free Backup Unit 4 (RMFBU4) cache off-load module attaches directly to the RAID controller and then it connects by cable to a super capacitor module that is attached to a remote mount board or an Intel® Server Chassis.

The following figure shows the front view and the back view of the RMFBU4 cache off-load module. The front view is the side that you can see when the module is installed on a RAID controller.



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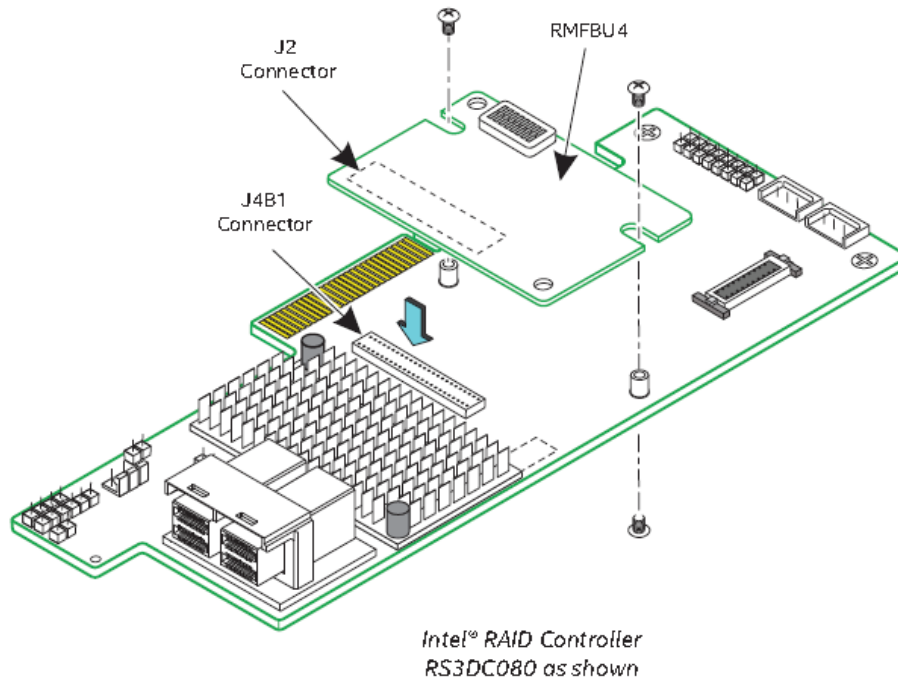
J1: 9-pin Connector to the Remote Super Capacitor Module
 J2: 70-pin Board-to-Board Connector

Figure 17. RMFBU4 cache off-load module

To install the Intel® AXRMFBU4 cache off-load module on the Intel® RAID Controller, you must perform the following steps:

1. Ground yourself, and take the Intel® RAID Maintenance Free Backup Unit AXRMFBU4 out of the package.
2. Verify that the RMFBU4 cache off-load module and the super capacitor module are installed in the plastic bracket already.
3. Mount the two standoffs on the front side of the RAID controller by screwing in two screws from the back side of the RAID controller, as shown in the following figure.

The standoffs are threaded at both ends, and the screws thread from the back side of the RAID controller into the board-to-board standoffs. Center the screwdriver carefully to avoid stripping the screw heads. Do not over-tighten the screws.



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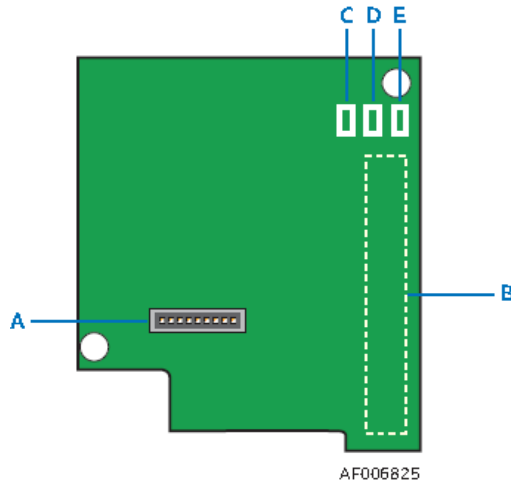
Figure 18. Installing the RMFBU4 cache off-load module

4. Hold the RMFBU4 cache off-load module so that the front side faces upward, and align the J2 connector on the RMFBU4 cache off-load module with the connector on the RAID controller.
5. Carefully press the RMFBU4 cache off-load module to the RAID controller so that the two connectors are firmly joined.
6. Secure the cache off-load module to the RAID controller by screwing in the two screws from the top side of the RAID controller. The standoffs are threaded at both ends and the screws thread from the back side of the RAID controller into the board-to-board standoffs.

4.3.3 Installing the Intel® RAID Maintenance Free Backup Unit AXRMFBU5 Cache Off-load Module

The Intel® RAID Maintenance Free Backup Unit 5 (RMFBU5) cache off-load module attaches directly to the Intel® Integrated RAID Module RMS3CC040/RMS3CC080 and then it connects by cable to a super capacitor module that is attached to a remote mount board or an Intel® Server Chassis.

The following figure shows the front view and the back view of the RMFBU5 cache off-load module. The front view is the side that you can see when the module is installed on a RAID module.



- A: J1 9-pin Connector to the Remote Super Capacitor Module
- B: J2 80-pin Board-to-Board Connector
- C: Power LED (CR1)
- D: Active LED (CR2)
- E: Fault LED (CR3)

Figure 19. RMFBU5 cache off-load module

To install the Intel® AXRMFBU5 cache off-load module on the Intel® Integrated RAID Module, you must perform the following steps:

1. Ground yourself, and take the Intel® RAID Maintenance Free Backup Unit AXRMFBU5 out of the package.
2. Verify that the RMFBU5 cache off-load module and the super capacitor module are installed in the plastic bracket already.
3. Hold the RMFBU5 cache off-load module so that the front side faces upward, and align the J2 connector on the RMFBU5 with connector JT3 on the RAID module (see letter “A” in the figure).

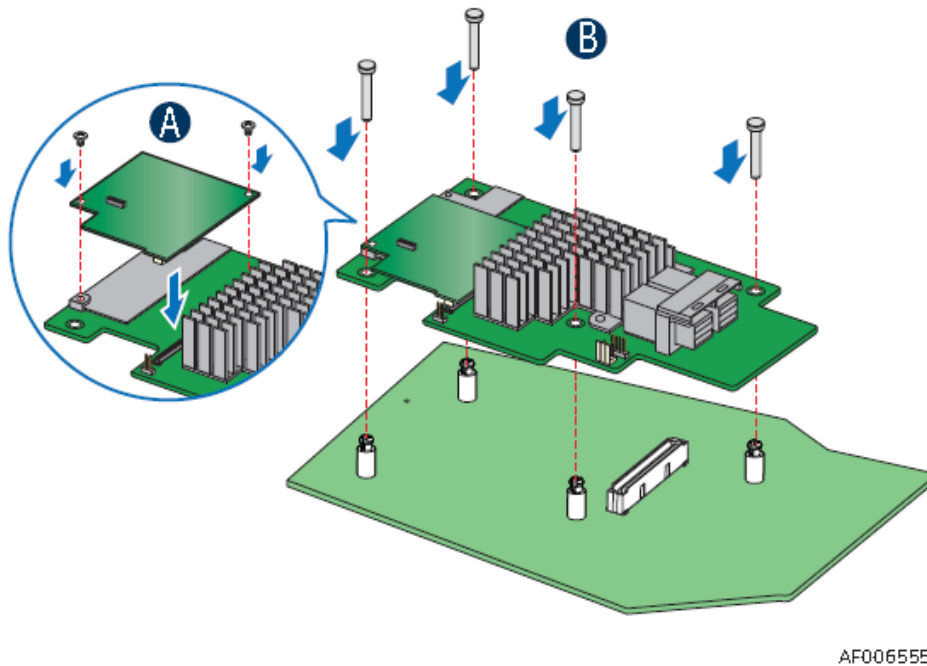

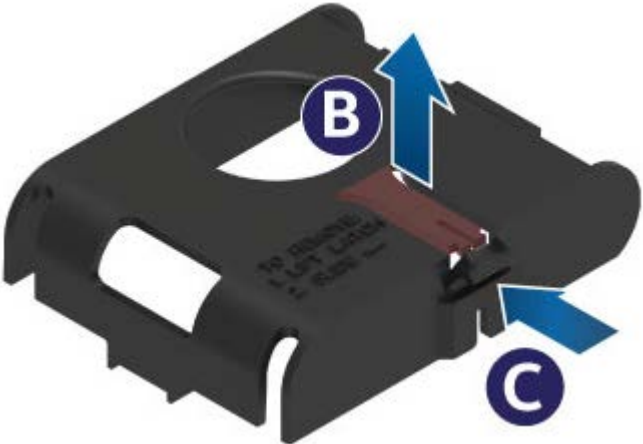




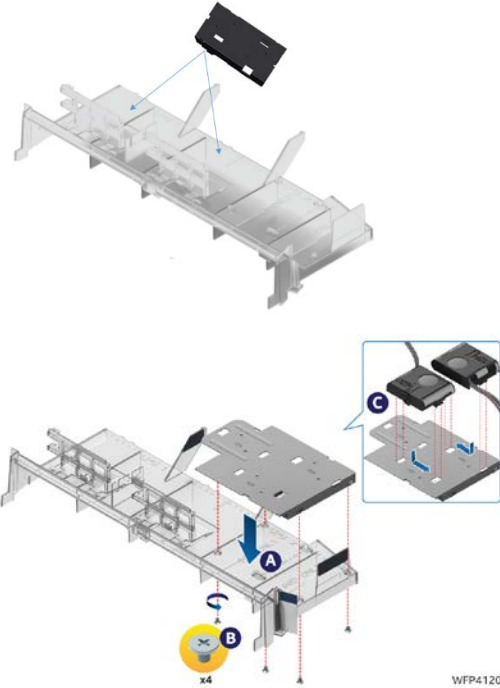
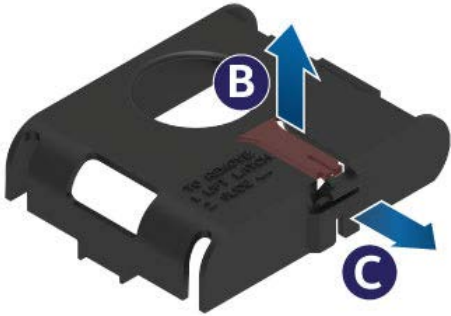
Figure 20. Installing the RMFBU5 cache off-load module

4. Press down gently but firmly to ensure that the RAID module is properly seated in the connectors and then insert the four pin standoffs into the barrel standoffs respectively (see letter “B” in the figure).

4.3.4 Installing the Plastic RMFBU4 and RMFBU5 Super Capacitor Module to the Chassis

The Intel® RMFBU4 and RMFBU5 (RMFBUx) share the same super capacitor module which is designed for easy attachment to either an Intel® pedestal or rack mount chassis. Complete the following instructions for your server.

| Instructions to assemble and install the RMFBUx onto the metallic bracket | |
|---|--|
| 1. | <ul style="list-style-type: none"> Identify the parts from the RMFBUx kit. Ensure that the latch protuberance is facing downwards (A).  |
| 2. | <ul style="list-style-type: none"> Gently push up the tab on the plastic case (B). Insert the small latch and make it turn downwards (C). You should feel a "click".  |
| 3. | <p>This is how the case looks with the latch assembled.</p>  <p style="text-align: right;">WFP4100</p> |

| | |
|---|--|
| <p>4.</p> <p>Insert the Supercap into the pre-assembled plastic case pressing down until it is perfectly locked. Route the cable thru the case.</p> |  <p>WFP4110</p> |
| <p>5.</p> <p>Install one of the 2 possible brackets to be used:</p> <p>NOTE: when the supercap case is slide properly, the pre-installed plastic latch will “click” securing the case onto the bracket. At this point, there should not be any possible movement of the case.</p> |  <p>WFP4120</p> |
| <p>6.</p> <p>In case it is necessary, in order to disengage the supercap case assembly from the bracket, lift up the latch (B) and then slide it sideways (C)</p> |  |

If you are installing this component into a third-party chassis, you must first install an attachment mechanism, such as industrial-grade Velcro*. Refer to your server chassis documentation or discuss an appropriate attachment mechanism with your server chassis manufacturer to ensure the attachment mechanism complies with the chassis requirements.

4.3.5 Connecting the RMFBU4 Cache Off-load Module to the Super Capacitor Module

1. Ground yourself and make sure the system is grounded. The system power cords have been unplugged.
2. Insert one 9-pin cable connector on the cable into the J1 connector on the RMFBU4 cache off-load module, as shown in the following figure.

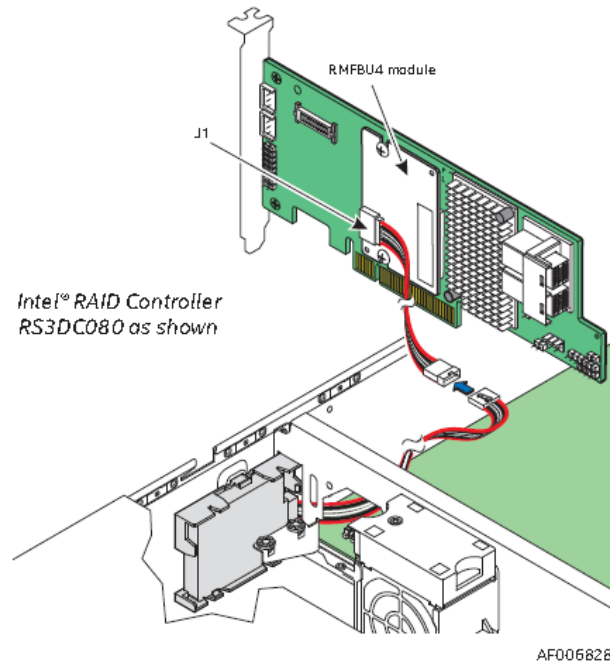
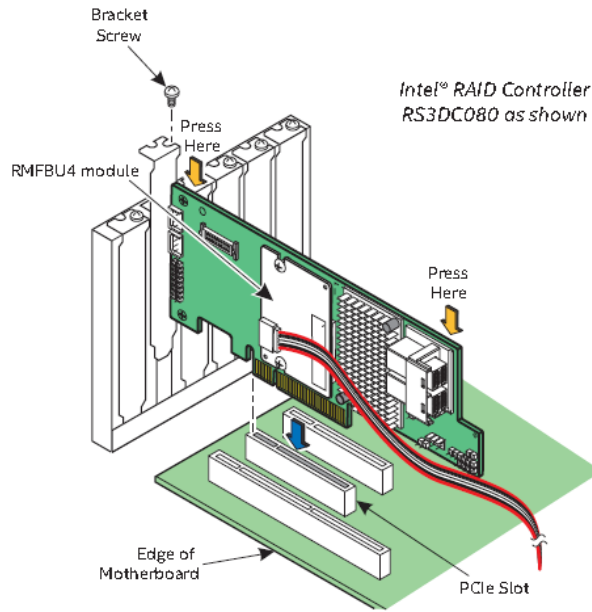


Figure 21. Connecting the RMFBU4

3. Insert the other 9-pin cable connector into the connector on the super capacitor module. Align the cable connectors to make sure that they are connected correctly.
4. Make sure that the power to the chassis is still turned off, the power cords are unplugged, and the chassis is grounded and has no AC power.
5. Install the RAID controller in a PCIe slot on the motherboard, as shown in the following figure.
6. Press down gently but firmly to seat the card correctly in the slot.
7. Secure the RAID controller to the computer chassis with the bracket screw.
8. Reinstall the computer cover and reattach the power cords.
9. Turn on the power to the computer.

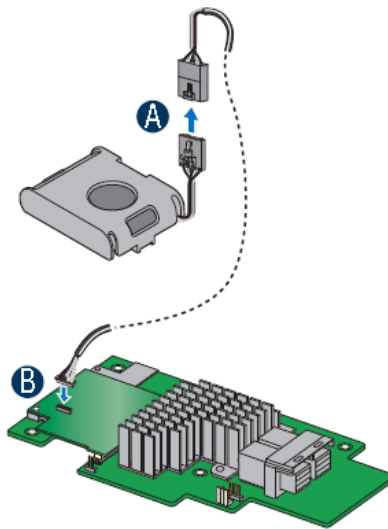


AF006829

Figure 22. Install the RAID controller in a PCIe slot

4.3.6 Connecting the RMFBU5 Cache Off-load Module to the Super Capacitor Module

1. Ground yourself and make sure the system is grounded. The system power cords have been unplugged.
2. Make sure the Intel® Integrated RAID Module has been properly seated on the server board.
3. Connect the SuperCap cable with the super capacitor module, and align the cable connectors to make sure that they are connected correctly.
4. Insert the other 9-pin connector of the SuperCap cable to the RMFBU5 cache off-load module connector J1.
5. Reinstall the computer cover and reattach the power cords.
6. Turn on the power to the computer.



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Figure 23. Connecting the RMFBU5

4.4 Monitoring the Intel® RAID Maintenance Free Backup Unit

Multiple utilities are available to display and configure the RMFBU4 and RMFBU5 information.

Note: This section describes only the RMFBU related features of the utility programs. For complete information on these utilities, see the *Intel® RAID Software User Guide for full featured and entry level RAID controllers*.

4.4.1 Monitoring the RMFBU unit with the Intel® RAID BIOS Configuration Utility

The Intel® RAID BIOS Console can be used to configure disk arrays and logical drives. It is independent of the operating system and can be accessed at server start-up by pressing <Ctrl>+<R>.

To view the RMFBU information, do the following:

1. At boot, press <Ctrl>+<R> when prompted.
2. Once the Intel® RAID BIOS Console loads and the main menu is displayed, choose **Ctrl Mgmt** page.
3. Click **Next** to view the second page of **Ctrl Mgmt**.

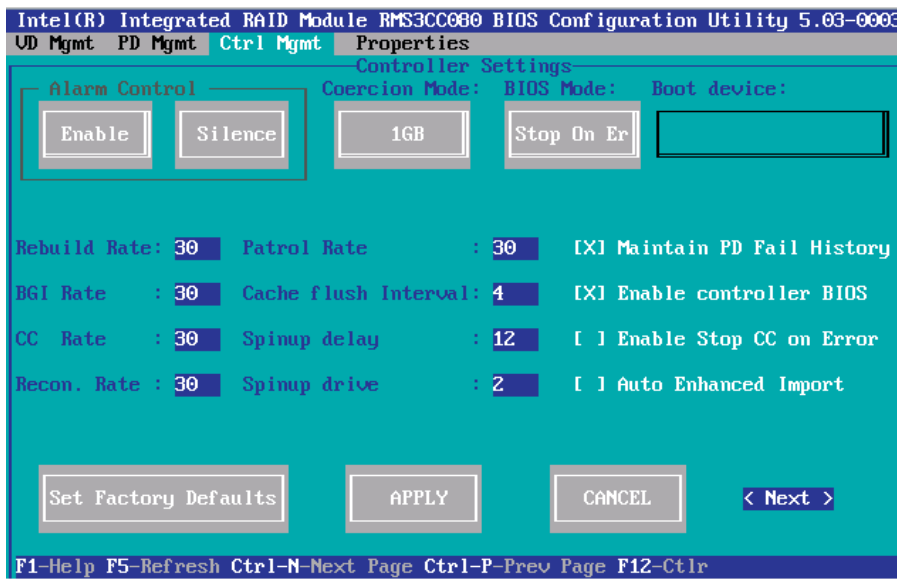


Figure 24. RAID BIOS Configuration Utility Controller Management Menu (page 1)

4. Enter the **Manage Battery** field at the top right of the **Ctrl Mgmt** screen.

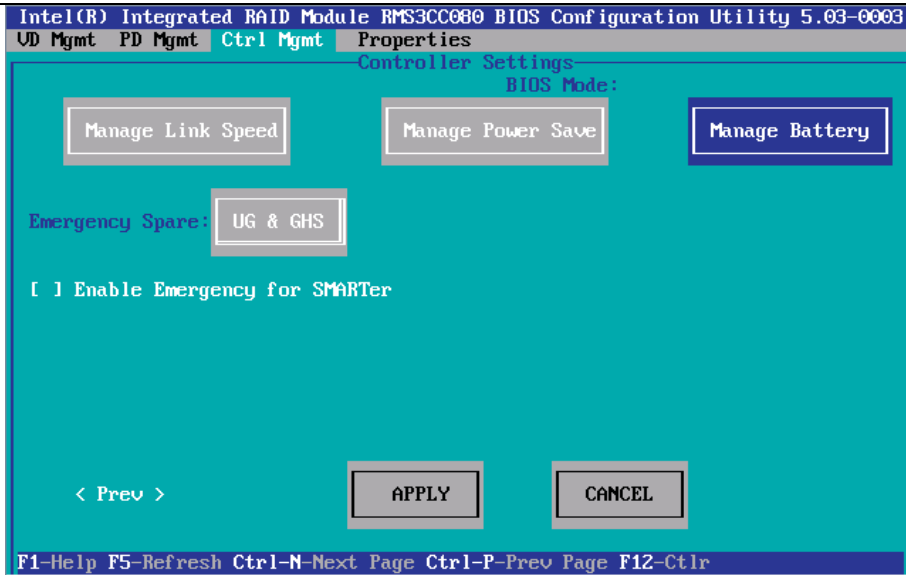


Figure 25. AID BIOS Configuration Utility Controller Management Menu (page 2)

5. The **Battery Properties** screen contains the following information:

- Battery Type
- Battery Status
- Temperature
- Learn Mode
- Learn Period
- Next Learn Time

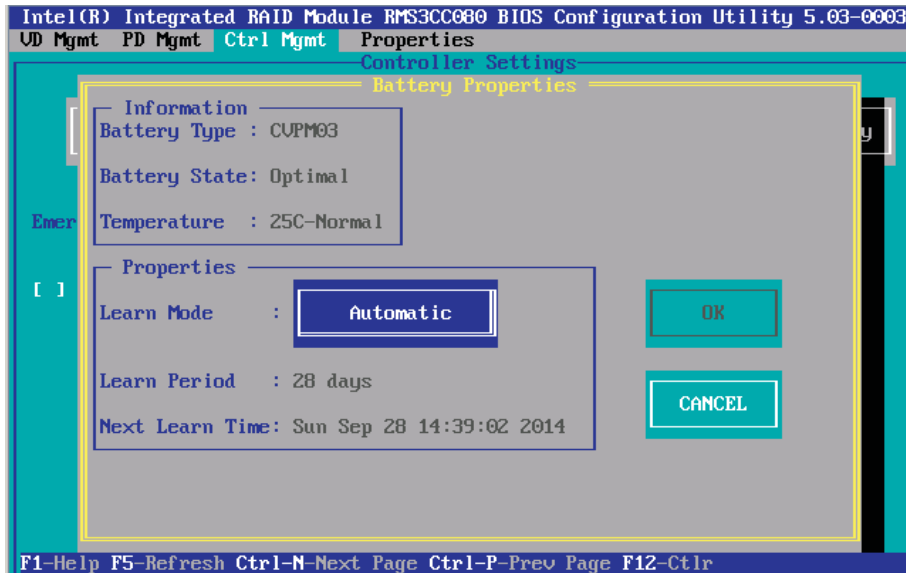


Figure 26. Battery Properties screen

4.4.2 Visual Indicators of the LEDs on the RMFBU4 and RMFBU5 Cache Off-load Module

4.4.2.1 Power LED (CR1)

One surface mounted GREEN LED indicates the status of backup power. When LED is ON, it indicates that Supercap backup power is enabled and Supercap is powering the controller when host system's power is lost. Once turned ON this LED remains ON during entire cache off-load operation even if host power comes back and controller power switches back to host power.

4.4.2.2 Activity (ONFI) LED (CR2)

One surface mounted BLUE LED indicates activity on ONFI interface. When LED is ON on RMFBU5 or blinking on RMFBU4, it indicates that either cache off-load from DDR3 memory to NAND flash or restore operation from NAND flash to DDR3 memory is in progress.

4.4.2.3 Fault LED (CR3)

One surface mounted ORANGE LED indicates FAULT condition. When LED is ON, it indicates that Supercap pack is in FAULT condition. This LED is controlled by the firmware.

4.5 RAID Maintenance Free Backup Unit Specifications

4.5.1 MegaRAID CacheVault™ Technology

Avago* MegaRAID CacheVault™ flash cache protection uses NAND flash memory powered by a super capacitor to protect data stored in the MegaRAID controller cache. This module eliminates the need for a lithium ion battery traditionally used to protect DRAM cache memory on PCI RAID controllers. The RAID controller automatically writes the data in cache to flash when a power failure occurs, while the super capacitor keeps the current going during the process.

When the power comes back, the DRAM is recovered from flash and the system goes on without loss of data. The benefits of this technology are elimination of hardware maintenance associated with LiON batteries, lower total cost of ownership over the life of the adapter, and more environmentally friendly cache protection.

The power module is a super capacitor pack with 6.8F, 13.2V capacitors that provide the power to offload cached data from the DRAM to the nonvolatile Flash memory on the flash module if a power failure or outage occurs. The super capacitor pack can hold the memory circuit at voltage for enough long time, and the RMFBU4 requires about 18 seconds and the RMFBU5 requires about 42 seconds to transfer data from cache to flash. The capacitors take approximately two minutes at power-on to charge with current of 500mA, and capacitor charge is maintained via a small constant current.

4.5.2 RMFBU Specifications

Table 18. RMFBU4 Specifications

| Specifications | RMFBU4 |
|--|--|
| Super Capacitor Module Operating Environment | -40°C to 55°C |
| Super Capacitor Module Storage Temperature | -40°C to 70°C |
| Fast Charge Rate | 500 mA |
| Super Capacitor Module Voltage | Nominal Voltage: 13.2 V |
| Super Capacitor Module Capacity | 6.4 F |
| Super Capacitor Module Mechanical | 65 mm x 52 mm |
| RMFBU4 Cache Off-load Module Mechanical | 53 mm x 35 mm |
| Super Capacitor Module Charge Time | Typical: Approximately 2 minutes |
| Super Capacitor Module Shelf Life | 3 years |
| Super Capacitor Module Operational Life | Intel provides a three year warranty on the Intel® RAID Maintenance Free Backup Unit AXRMFBU4. |
| RMFBU4 Cache Off-load Module Capacity | 4 GB NAND Flash |
| Smart Monitoring | Temperature is monitored using the I ² C interface. |

Table 19. RMFBU5 Specifications

| Specifications | RMFBU5 |
|--|--|
| Super Capacitor Module Operating Environment | -40°C to 55°C |
| Super Capacitor Module Storage Temperature | -40°C to 70°C |
| Fast Charge Rate | 500 mA |
| Super Capacitor Module Voltage | Nominal Voltage: 13.2 V |
| Super Capacitor Module Capacity | 6.4 F |
| Super Capacitor Module Mechanical | 65 mm x 52 mm |
| RMFBU5 Cache Off-load Module Mechanical | 45 mm x 42 mm |
| Super Capacitor Module Charge Time | Typical: Approximately 2 minutes |
| Super Capacitor Module Shelf Life | 3 years |
| Super Capacitor Module Operational Life | Intel provides a three year warranty on the Intel® RAID Maintenance Free Backup Unit AXRMFBU5. |
| RMFBU5 Cache Off-load Module Capacity | 4 GB NAND Flash |
| Smart Monitoring | Temperature is monitored using the I ² C interface. |

Appendix A. Glossary

B

| | |
|------|--|
| 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 motherboard of a computer boots and controls the system. The BIOS on your host adapter acts as an extension of the system BIOS. |
|------|--|

C

| | |
|---------------|--|
| 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. |
|---------------|--|

D

| | |
|-------------------|--|
| device driver | A program that permits a microprocessor (through the operating system) to direct the operation of a peripheral device. |
| domain validation | A software procedure in which a host queries a device to determine its ability to communicate at the negotiated data rate. |
| drive group | A group of physical 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 a drive group. |

E

| | |
|---------------------|--|
| 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. See NVRAM. |
| external SAS device | A SAS device installed outside the computer cabinet. These devices are connected using specific types of shielded cables. |

F

| | |
|-------------------------|--|
| Fusion-MPT architecture | An acronym for Fusion-Message Passing Technology architecture. Fusion-MPT 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. |
|-------------------------|--|

H

| | |
|--------------------|--|
| host | The computer system in which a RAID controller is installed. It uses the RAID controller to transfer information to and from devices attached to the SCSI bus. |
| host adapter board | A circuit board or integrated circuit that provides a device connection to the computer system. |
| hot spare | An idle, powered on, standby drive that is ready for immediate use in case of drive failure. A hot spare 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 drive 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 drives with redundancy (RAID levels 1, 5, 6, 10, 50, and 60; not RAID level 0), and the hot spare must have sufficient capacity. |

I

| | |
|---------------------|---|
| internal SAS device | A SAS device installed inside the computer cabinet. These devices are connected by using a shielded cable. |
| M | |
| main memory | The part of computer memory that is directly accessible by the CPU (usually synonymous with RAM). |
| N | |
| NVRAM | Acronym for nonvolatile random access memory. An EEPROM (electronically erasable read-only memory) chip that stores configuration information. See EEPROM. |
| P | |
| 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 an Intel® RAID Controller (host adapter). |
| 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. |
| R | |
| RAID | Acronym for Redundant Array of Independent Disks (originally Redundant Array of Inexpensive Disks). An array (group) of multiple independent drives managed together to yield higher reliability, performance, or both exceeding that of a single drive. The RAID array appears to the controller as a single storage unit. I/O is expedited because several drives 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 drive groups to deliver higher data availability, performance characteristics, or both to host environments. Each virtual drive must have a RAID level assigned to it. |
| S | |
| 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. SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA. The SAS controllers support the ANSI <i>Serial Attached SCSI Standard, Version 2.0</i> . In addition, the controller supports the Serial ATA III (SATA III) protocol defined by the <i>Serial ATA Specification, Version 3.0</i> . Supporting both the SAS interface and the SATA III interface, the SAS controller is a versatile controller that provides the backbone of both server and high-end workstation environments. Each port on the SAS RAID controller supports SAS devices, SATA devices, or both. |

| | |
|-------------|---|
| SAS device | Any device that conforms to the SAS standard and is attached to the SAS bus by a SAS cable. This includes SAS RAID controllers (host adapters) 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. |
| SMP | Acronym for Serial Management Protocol. SMP communicates topology management information directly with an attached SAS expander device. Each PHY on the controller can function as an SMP initiator. |
| 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 an 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. |
| strip | The portion of a stripe that resides on a single drive. |
| stripe size | The total drive space consumed by a stripe not including a parity drive. For example, if a stripe contains 64 KB of drive space and has 16 KB of data residing on each drive, the stripe size is 64 KB and the strip size is 16 KB. 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 | Drive striping writes data across two or more drives. Each stripe spans two or more drives but consumes only a portion of each drive. Each drive, therefore, may have several stripes. The amount of space consumed by a stripe is the same on each drive that is included in the stripe. The portion of a stripe that resides on a single drive is a strip, also known as a stripe element. Striping by itself does not provide data redundancy; striping in combination with parity provides data redundancy. |
| strip size | The drive space consumed by a strip. For example, if a stripe contains 64 KB of drive space and has 16 KB of data residing on each drive, the stripe size is 64 KB and the strip size is 16 KB. The stripe depth is four (four drives in the stripe). You can specify strip sizes of 64 KB, 128 KB, 256 KB, 512 KB, or 1 MB. |

Appendix B. Thermal and cooling considerations.

The 12Gb/s Intel® RAID Controllers have strict air flow requirements to dissipate the heat generated and keep them working inside the thermal range. Consult the *Operating and Non-operating Conditions* section for your particular RAID controller in this guide to know these requirements.

The airflow depends on many factors like chassis type, PCIe slot position, BMC version, fan profile, PWM offset, etc., all these factors must be taken into account when installing and operating the RAID controllers. Below are some recommendations to help to comply with the air flow requirements.

- 1) Avoid blocking the air flow by routing the cables in a way that allows free air flow through the heat sink.
- 2) Make sure the chassis air ducts are properly installed and all covers are in place.
- 3) Make sure the ambient temperature is within the allowed limits.
- 4) When installing the RAID card, choose a PCIe slot with enough air flow*.
- 5) Make sure the system has the latest BIOS and BMC installed.
- 6) Choose the adequate system's fan profile and/or adjust the PWM offset to ram up the fans if necessary.

* Consult section E.4 on the [Intel® Server Board S2600ST Product Family TPS](#) if the RAID card is being installed on a P4304XXMFEN2 or 4304XXMUXX chassis.

Consult section 4.1 on the [Intel® Server System R2000WF Product Family TPS](#) if the RAID card is being installed on an R2000WF or R2000WT system.