

# **USER'S GUIDE**

## **Integrated RAID for SAS**

**January 2006**

*Version 1.0*

---

This document contains proprietary information of LSI Logic Corporation. The information contained herein is not to be used by or disclosed to third parties without the express written permission of an officer of LSI Logic Corporation.

Document DB15-000357-00, Version 1.0 (January 2006)

This document describes LSI Logic Corporation's Integrated RAID (IR) software product and will remain the official reference source for all revisions/releases of this product until rescinded by an update.

LSI Logic Corporation reserves the right to make changes to any products herein at any time without notice. LSI Logic does not assume any responsibility or liability arising out of the application or use of any product described herein, except as expressly agreed to in writing by LSI Logic; nor does the purchase or use of a product from LSI Logic convey a license under any patent rights, copyrights, trademark rights, or any other of the intellectual property rights of LSI Logic or third parties.

Copyright © 2006 by LSI Logic Corporation. All rights reserved.

#### TRADEMARK ACKNOWLEDGMENT

LSI Logic, the LSI Logic logo design, Fusion-MPT, Integrated Mirroring, and Integrated Striping are trademarks or registered trademarks of LSI Logic Corporation. Windows and Windows NT are registered trademarks of Microsoft Corporation. All other brand and product names may be trademarks of their respective companies.

KL

**To receive product literature, visit us at <http://www.lsillogic.com>.**

**For a current list of our distributors, sales offices, and design resource centers, view our web page located at**

**<http://www.lsillogic.com/contacts/index.html>**

# Preface

---

This user's guide explains how to configure and use the components of the LSI Logic Integrated RAID (IR) software product with LSI Logic SAS controllers.

---

## Audience

This user's guide assumes that you have some familiarity with installing and configuring software programs and that you are familiar with computer storage devices in general. The people who benefit from this document are:

- VARs and OEMs who are evaluating the LSI Logic IR software components or who are using the IR software product in their computer systems
- End users who are using the IR software product to configure mirrored or striped volumes on LSI Logic SAS controllers.

---

## Organization

This document has the following chapters and appendixes:

- [Chapter 1, Introduction to Integrated RAID](#), provides an overview of Integrated RAID for SAS controllers, its features, and its benefits.
- [Chapter 2, Integrated Mirroring Overview](#), provides an overview of the LSI Logic Integrated Mirroring™ (IM) feature.
- [Chapter 3, Creating Integrated Mirroring Volumes](#), describes how to configure Integrated Mirroring (IM) volumes using the BIOS-based configuration utility.
- [Chapter 4, Integrated Striping \(IS\) Overview](#), provides an overview of the LSI Logic Integrated Striping™ (IS) feature.

- [Chapter 5, Creating Integrated Striping Volumes](#), describes how to configure Integrated Striping (IS) volumes using the BIOS-based configuration utility.
- [Appendix A, Using the CFGGEN IR Configuration Utility](#), describes how to create Integrated Mirroring or Integrated Striping volumes using the CFGGEN IR configuration utility (for manufacturing use only).

---

## Conventions Used in This Manual

The first time a word or phrase is defined in this manual, it is *italicized*.

Hexadecimal numbers are indicated by the prefix “0x” —for example, 0x32CF. Binary numbers are indicated by the prefix “0b” —for example, 0b0011.0010.1100.1111.

---

## Revision History

Document Number	Version/Date	Remarks
DB15-000357-00	Version 1.0 January 2006	Initial release of document.

# Contents

---

## Chapter 1

### Introduction to Integrated RAID

1.1	Introduction	1-1
1.2	Integrated RAID Benefits and Features	1-2
1.3	Using this Manual	1-2

---

## Chapter 2

### Integrated Mirroring Overview

2.1	Introduction	2-1
2.2	IM Features	2-2
2.3	IM/IME Description	2-3
2.4	Integrated Mirroring Firmware	2-5
2.4.1	Host Interface	2-5
2.4.2	Resynchronization with Concurrent Host I/O Operation	2-6
2.4.3	Metadata Support	2-6
2.4.4	Hot Swapping	2-6
2.4.5	SMART Support	2-6
2.4.6	Hot Spare Disk	2-7
2.4.7	Media Verification	2-7
2.4.8	Disk Write Caching	2-7
2.4.9	NVSRAM Usage	2-7
2.5	Fusion-MPT Support	2-8

---

## Chapter 3

### Creating Integrated Mirroring Volumes

3.1	IM Configuration Overview	3-1
3.2	Creating IM and IME Volumes	3-2
3.2.1	Creating an IM Volume	3-3

3.2.2	Creating an IME Volume	3-5
3.3	Creating a Second IM or IME Volume	3-6
3.4	Managing Hot Spares	3-6
3.5	Other Configuration Tasks	3-8
3.5.1	Viewing Volume Properties	3-8
3.5.2	Synchronizing an Array	3-8
3.5.3	Activating an Array	3-9
3.5.4	Deleting an Array	3-9
3.5.5	Locating a Disk Drive, or Multiple Disk Drives in a Volume	3-10
3.5.6	Selecting a Boot Disk	3-10

---

## Chapter 4

### Integrated Striping (IS) Overview

4.1	Introduction	4-1
4.2	IS Features	4-2
4.3	IS Description	4-2
4.4	Integrated Striping Firmware	4-4
4.4.1	Host Interface	4-4
4.4.2	Metadata Support	4-4
4.4.3	SMART Support	4-4
4.4.4	Disk Write Caching	4-4
4.5	Fusion-MPT Support	4-5

---

## Chapter 5

### Creating Integrated Striping Volumes

5.1	IS Configuration Overview	5-1
5.2	Creating IS Volumes	5-2
5.3	Creating a Second IS Volume	5-4
5.4	Other Configuration Tasks	5-5
5.4.1	Viewing IS Volume Properties	5-5
5.4.2	Activating an Array	5-5
5.4.3	Deleting an Array	5-6
5.4.4	Locating a Disk Drive, or Multiple Disk Drives in a Volume	5-6
5.4.5	Selecting a Boot Disk	5-7

---

## Appendix A

### Using the CFGGEN IR Configuration Utility

A.1	Hardware and Software Requirements	A-2
A.2	CFGGEN Interface Description	A-3
A.3	CFGGEN Commands	A-3
A.3.1	Common Command Line Parameters	A-4
A.3.2	CREATE Command	A-5
A.3.3	DEFAULTS Command	A-7
A.3.4	DISPLAY Command	A-8
A.3.5	FORMAT Command	A-11
A.3.6	HOTSPARE Command	A-12
A.3.7	STATUS Command	A-13
A.3.8	SETOFFLINE Command	A-15
A.3.9	SETONLINE Command	A-15
A.3.10	AUTO Command (EFI Version Only)	A-16
A.3.11	DISABLEIR Command (EFI Version Only)	A-18
A.3.12	ENABLEIR Command (EFI Version Only)	A-18
A.3.13	LIST Command (EFI Version Only)	A-19

---

### Customer Feedback



---

## Figures

2.1	Typical Integrated Mirroring Implementation	2-4
2.2	Integrated Mirroring with Two Disks	2-4
2.3	Integrated Mirroring with More than Two Disks (IME)	2-5
3.1	Adapter Properties Screen	3-3
3.2	Create New Array Screen	3-4
3.3	Manage Array Screen	3-7
4.1	Integrated Striping Example	4-3
4.2	Integrated Striping - Logical and Physical Views	4-3
5.1	Adapter Properties Screen	5-3
5.2	Create New Array Screen	5-4



# Chapter 1

## Introduction to Integrated RAID

---

This chapter provides an overview of the LSI Logic Integrated RAID solution for LSI Logic SAS controllers, its features, and its benefits. The chapter includes these sections:

- [Section 1.1, "Introduction," page 1-1](#)
- [Section 1.2, "Integrated RAID Benefits and Features," page 1-2](#)
- [Section 1.3, "Using this Manual," page 1-2](#)

You can use the LSI Logic Integrated RAID solution with the following LSI Logic SAS controllers:

- LSISAS 1064/1064E
  - LSISAS 1068/1068E
- 

### 1.1 Introduction

The LSI Logic Integrated RAID solution provides cost benefits for the server or workstation market where the extra performance, storage capacity, and/or redundancy of a RAID configuration are required. The two components of Integrated RAID are:

- **Integrated Mirroring (IM)**, which provides features of RAID 1 and RAID 1E (RAID 1 Enhanced). RAID 1E is also called *Integrated Mirroring Enhanced (IME)*
- **Integrated Striping (IS)**, which provides features of RAID 0

By simplifying the IM and IS configuration options and by providing firmware support in its host adapters, LSI Logic can offer the Integrated RAID solution at a lower cost than a hardware RAID implementation.

Fusion-MPT™ firmware supports IM and IS volumes. You can configure IM and IS volumes together on the same LSI Logic SAS controller.

---

## 1.2 Integrated RAID Benefits and Features

- Low cost RAID volume creation meets the needs of most internal RAID installations
- Easy to use - installation and configuration are not complex
- System can boot from an IM, IME, or IS volume
- No special OS-specific software required
- High reliability and data integrity
  - Non-volatile write journaling
  - Physical disks not visible to OS or to application software
- Low host CPU and PCI bus utilization
- Fusion-MPT architecture provides processing power
  - Shared memory architecture minimizes external memory requests
  - Functionality is contained in device hardware and firmware

---

## 1.3 Using this Manual

- Chapters 2 and 3 of this *User's Guide* list Integrated Mirroring features and explain how to configure Integrated Mirroring (IM) and Integrated Mirroring Enhanced (IME) volumes.
- Chapters 4 and 5 list Integrated Striping features and explain how to configure Integrated Striping (IS) volumes.
- Appendix A explains how to use the CFGGEN IR configuration utility to configure IM and IS volumes in the manufacturing environment.

# Chapter 2

## Integrated Mirroring Overview

---

This chapter provides an overview of the LSI Logic Integrated Mirroring (IM) feature and includes these sections:

- [Section 2.1, "Introduction," page 2-1](#)
- [Section 2.2, "IM Features," page 2-2](#)
- [Section 2.3, "IM/IME Description," page 2-3](#)
- [Section 2.4, "Integrated Mirroring Firmware," page 2-5](#)
- [Section 2.5, "Fusion-MPT Support," page 2-8](#)

---

## 2.1 Introduction

As a result of the shift towards Network Attached Storage (NAS), ISPs need a cost effective, fault-tolerant solution to protect the operating systems on small form factor, high-density, rack-mountable servers. The LSI Logic Integrated Mirroring (IM) feature—which includes Integrated Mirroring Enhanced (IME)—provide data protection for the system boot volume to safeguard critical information such as the operating system on servers and high performance workstations. The Integrated Mirroring feature gives customers a robust, high-performance, fault-tolerant solution to their storage needs, at a lower cost than a dedicated RAID controller.

The Integrated Mirroring feature supports simultaneous mirrored volumes with two disks (IM) or three to eight disks (IME), to provide fault-tolerant protection for critical data. (If a hot spare disk is used, the maximum volume size is seven mirrored disks, plus the hot spare disk.) Up to two IM volumes are supported per SAS controller, with up to ten drives total per controller.

Note: Ten disk drives is the theoretical upper limit, although the SAS controller itself may support fewer drives.

If a disk in an Integrated Mirroring volume fails, the hot swap capability allows the volume to be easily restored by simply swapping disks. The firmware then automatically re-mirrors the swapped disk. Additionally, each SAS controller can have one global hot spare disk available to automatically replace a failed disk in the one or two IM or IME volumes configured on the controller. The hot spare makes the Integrated Mirroring volume even more fault-tolerant.

Note: You can configure an Integrated Mirroring volume and an Integrated Striping volume on the same LSI Logic SAS controller.

The IM feature uses the same device drivers as the standard LSI Logic Fusion-MPT based controllers, providing seamless and transparent fault tolerance. This eliminates the need for complex backup software or expensive RAID hardware. The IM feature operates independently from the operating system, in order to conserve system resources. The BIOS-based configuration utility makes it easy to configure IM and IME volumes.

The Integrated Mirroring feature is currently available as an optional component of the Fusion-MPT architecture on LSI Logic controller products.

---

## 2.2 IM Features

LSI Logic Integrated Mirroring and Integrated Mirroring Enhanced support the following features:

- Configurations of one or two IM or IME volumes on the same LSI Logic SAS controller. Each volume can consist of two mirrored disks (IM) or three to eight mirrored disks (IME).
- (Optional) One global hot spare disk per controller. If a global hot spare disk is defined, the upper limit for an IME volume is seven mirrored disks.
- Mirrored volumes run in optimal mode or in degraded mode (if one mirrored disk fails)

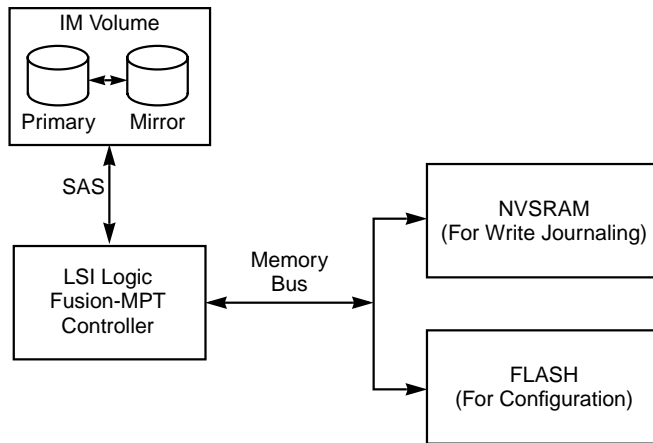
- Hot swap capability
- Presents a single virtual drive to the OS for each IM/IME volume
- Supports both SAS and SATA disks, although the two types of disks cannot be combined on the same LSI Logic SAS controller
- Fusion-MPT architecture
- Easy-to-use BIOS-based configuration utility (and DOS-based configuration utility for manufacturing use only)
- Error notification: OS-specific event log updated by drivers and errors displayed inside the Fusion-MPT BIOS
- SES status LED support for Integrated Mirroring disks
- Write journaling, which allows automatic synchronization of potentially inconsistent data after unexpected power-down situations
- Metadata used to store volume configuration on mirrored disks
- Automatic background resynchronization while host I/Os continue
- Background media verification ensures that data on the IM volume is accessible

---

## 2.3 IM/IME Description

The LSI Logic Integrated Mirroring (IM) feature supports one or two mirrored volumes on each LSI Logic SAS controller (or one mirrored volume and one Integrated Striping volume). Typically, one of these volumes is the boot volume, as shown in [Figure 2.1](#). This is accomplished through the firmware of the LSI Logic SAS controller that supports the standard Fusion-MPT interface. The runtime mirroring of the boot disk is transparent to the BIOS, drivers, and operating system. Host-based status software monitors the state of the mirrored disks and reports any error conditions. In [Figure 2.1](#) the system is configured with a second disk as a mirror of the first (primary) disk.

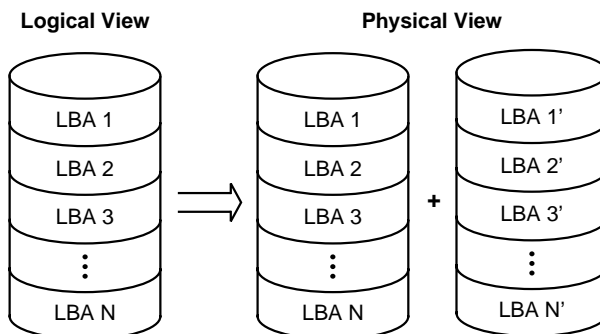
**Figure 2.1 Typical Integrated Mirroring Implementation**



The advantage of Integrated Mirroring (RAID 1), is that there is always a mirrored copy of the data. The disadvantage is that writes take longer because data must be written twice. On the other hand, performance is actually improved during reads.

Figure 2.2 shows the logical view and physical view of an Integrated Mirroring configuration with two disks in the mirrored volume.

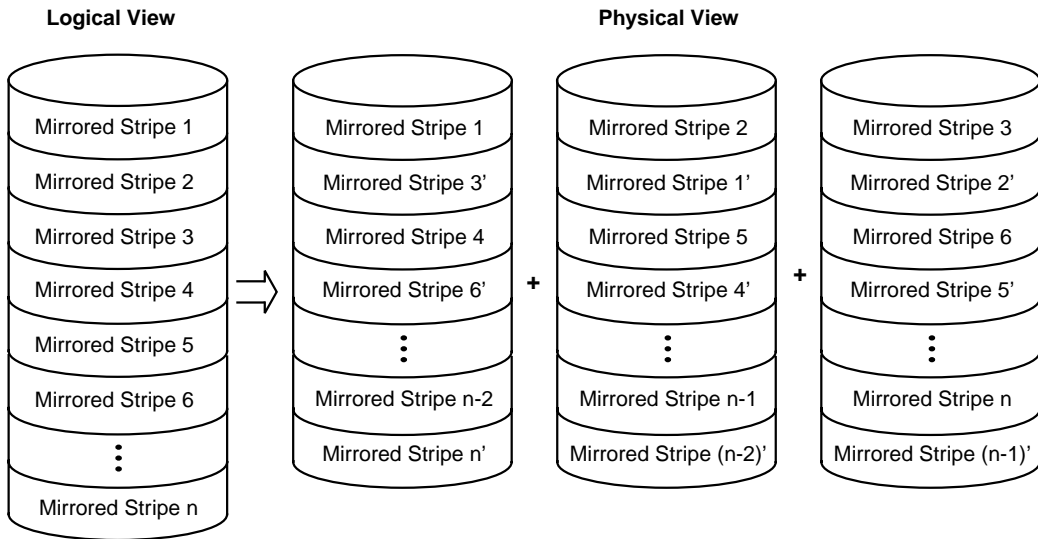
**Figure 2.2 Integrated Mirroring with Two Disks**



An IME volume can be configured with up to eight mirrored disks, or seven mirrored disks and a global hot spare. Figure 2.3 shows the logical view and physical view of an Integrated Mirroring Enhanced (IME) volume with three mirrored disks. Each *mirrored stripe* is written to a disk

and mirrored to an adjacent disk. This type of configuration is also called RAID 1E.

**Figure 2.3 Integrated Mirroring with More than Two Disks (IME)**



LSI Logic provides the BIOS-based configuration utility to enable the user to create IM and IME volumes during initial setup and to reconfigure them in response to hardware failures or changes in the environment.

## 2.4 Integrated Mirroring Firmware

This section describes features of the LSI Logic Integrated Mirroring (IM) firmware, which supports up to two IM volumes per LSI Logic SAS controller.

### 2.4.1 Host Interface

The IM host interface uses the Message Passing Interface, as described in the *Fusion-MPT Message Passing Interface Specification*. Through the Fusion-MPT interface, the host OS has access to the IM volume as well as the physical disks.

## 2.4.2 Resynchronization with Concurrent Host I/O Operation

The IM firmware allows Host I/Os to continue on the IM/IME volume while the volume is being re-synchronized in the background. Resynchronization is attempted after a hot spare is activated due to a physical device failure, or after a hot swap has occurred to a physical disk in the IM or IME volume.

## 2.4.3 Metadata Support

The firmware supports metadata, which describes the IM/IME logical drive configuration stored on each member disk. When the firmware is initialized, each member disk is queried to read the stored metadata in order to verify the configuration. The usable disk space for each member disk is adjusted down to leave room for this data.

## 2.4.4 Hot Swapping

The IM firmware supports *hot swapping*. The hot-swapped disk is automatically resynchronized in the background, without any host or user intervention. The firmware detects hot swap removal and disk insertion.

Following a hot swap event, the firmware readies the new physical disk by spinning it up and verifying that it has enough capacity for the mirrored volume. The IM firmware resynchronizes all hot-swapped disks that have been removed, even if the same disk is re-inserted. In a two-disk mirrored volume, the IM firmware marks the hot-swapped disk as the secondary disk and marks the other mirrored disk as the primary disk. The firmware resynchronizes all data from the primary disk onto the new secondary disk.

## 2.4.5 SMART Support

The IM firmware enables Mode 6 SMART on the member disks in the mirrored volume. Mode 6 SMART requires each physical disk to be polled at regular intervals. If a SMART ASC/ASCQ code is detected on a physical disk in the volume, the firmware processes the SMART data, and the last received SMART ASC/ASCQ is stored in non-volatile memory. The IM/IME volume does not support SMART directly, since it is just a logical representation of the physical disks in the volume.

## 2.4.6 Hot Spare Disk

One disk can be configured as a *global hot spare* disk, which protects data on the one or two volumes configured on the controller. If the IM firmware fails one of the mirrored disks, the firmware automatically replaces it with the hot spare disk. The IM firmware then resynchronizes the mirrored data. The IM firmware is automatically notified when the failed disk has been replaced, and the firmware then designates that disk as the new hot spare.

## 2.4.7 Media Verification

The IM firmware supports a background *media verification feature* that runs at regular intervals when the IM/IME volume is in optimal mode. If the verification command fails for any reason, the other disk's data for this segment is read and written to the failing disk in an attempt to refresh the data. The current Media Verification Logical Block Address is written to non-volatile memory occasionally to allow Media Verification to continue approximately where it left off prior to a power-cycle.

## 2.4.8 Disk Write Caching

The IM firmware disables disk write caching by default. This is done to increase data integrity, so that the disk write log stored in NVSRAM is always valid. If disk write caching were enabled (not recommended), the disk write log could be invalid.

## 2.4.9 NVSRAM Usage

For the LSISAS1064/1064E and LSISAS1068/1068E controllers, the IM firmware requires at least a 32K NVSRAM in order to perform write journaling. Write journaling is used to verify that the mirrored disks in the IM/IME volume are synchronized with each other.

---

## 2.5 Fusion-MPT Support

The BIOS uses the LSI Logic Fusion-MPT interface to communicate to the SAS controller and firmware to enable Integrated Mirroring. This includes reading the Fusion-MPT configuration to gain access to the parameters that are used to define behavior between the SAS controller and the devices connected to it. The Fusion-MPT drivers for all supported operating systems implement the Fusion-MPT interface to communicate with the controller and firmware.

# Chapter 3

## Creating Integrated Mirroring Volumes

---

This chapter describes how to create Integrated Mirroring (IM) and Integrated Mirroring Enhanced (IME) volumes using the LSI Logic SAS BIOS Configuration Utility (SAS BIOS CU). The chapter includes these topics:

- [Section 3.1, “IM Configuration Overview,” page 3-1](#)
  - [Section 3.2, “Creating IM and IME Volumes,” page 3-2](#)
  - [Section 3.3, “Creating a Second IM or IME Volume,” page 3-6](#)
  - [Section 3.4, “Managing Hot Spares,” page 3-6](#)
  - [Section 3.5, “Other Configuration Tasks,” page 3-8](#)
- 

### 3.1 IM Configuration Overview

You can use the SAS BIOS CU to create one or two IM or IME volumes on each LSI Logic SAS controller, with an optional global hot spare disk. All disks in an IM or IME volume must be connected to the same LSI Logic SAS controller.

Although you can use disks of different size in IM and IME volumes, the smallest disk determines the “logical” size of each disk in the volume. In other words, the excess space of the larger member disk is not used.

Refer to [Section 2.2, “IM Features,”](#) for more information about Integrated Mirroring volumes.

---

## 3.2 Creating IM and IME Volumes

The SAS BIOS CU is part of the Fusion-MPT BIOS. When the BIOS loads during boot and you see the message about the LSI Logic Configuration Utility, press **Ctrl-C** to start the CU. After you do this, the message changes to:

Please wait, invoking SAS Configuration Utility...

After a brief pause, the main menu of the SAS BIOS CU appears. On some systems, however, the following message appears next:

LSI Logic Configuration Utility will load following initialization!

In this case, the SAS BIOS CU will load after the system has completed its power-on self test.

You can configure one or two IM or IME volumes per Fusion-MPT controller. You can also combine IM, IME, and Integrated Striping volumes on the same controller, up to a maximum of 10 physical disk drives.

The following guidelines also apply when creating an IM or IME volume:

- All physical disks in the volumes must be either SATA (with extended command set support) or SAS (with SMART support). SAS and SATA disks *cannot* be combined in the same volume.
- Disks must have 512-byte blocks and must not have removable media.
- An IM volume must have two drives, plus an optional global hot spare. An IME volume can have three to eight drives, or three to seven drives if you also create a global hot spare.

Note: If a disk in an IM or IME volume fails, it is rebuilt on the global hot spare if one is available. So adding a global hot spare greatly increases the level of data protection. (One global hot spare is allowed for the one or two volumes configured on a controller.)

## 3.2.1 Creating an IM Volume

Follow these steps to create an IM volume with the SAS BIOS CU:

1. On the Adapter List screen, use the arrow keys to select an LSI Logic SAS adapter.
2. Press **Enter** to go to the Adapter Properties screen, shown in [Figure 3.1](#).

**Figure 3.1 Adapter Properties Screen**

```
LSI Logic MPT Setup Utility    v6.01.03.00
Adapter Properties -- SAS1068

Adapter                      SAS1068
PCI Slot                     03
PCI Address(Bus/Dev/Func)    03:00:00
MPT Firmware Revision       00.03.23.00-IT
SAS Address                  500605B0:0000C580
Status                      Enabled
Boot Order                   1
Boot Support                 [Enabled BIOS & OS]

RAID Properties

SAS Topology

Advanced Adapter Properties

Esc = Exit Menu             F1/Shift+l = Help
Enter = Select Item         -/+ = Change Item
```

3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** on the screen and press **Enter**.
4. When you are prompted to select a volume type, select **Create IM Volume**.

The Create New Array screen shows a list of disks that can be added to a volume.

5. Move the cursor to the “RAID Disk” column and select a disk. To add the disk to the volume, change the “No” to “Yes” by pressing the + key, – key, or space bar.

When the first disk is added, the SAS BIOS CU prompts you to either keep existing data or overwrite existing data.

6. Press **M** to keep the existing data on the first disk or press **D** to overwrite it.

If you keep the existing data, this is called a *migration*. The first disk will be mirrored onto the second disk, so the data you want to keep *must* be on the first disk added to the volume. Any data on the second disk is overwritten.

As disks are added the Array Size field changes to reflect the size of the new volume.

7. (optional) Add a global hot spare by moving the cursor to the hot spare column and pressing the + key, – key, or space bar.

Figure 3.2 shows an IM volume configured with a global hot spare disk.

**Figure 3.2 Create New Array Screen**

```
LSI Logic MPT Setup Utility      v6.01.03.00
Create New Array -- SAS1068

    Array Type:                      IM
    Array Size(MB)                   34332

Slot  Device Identifier              RAID  Hot   Drive   Pred  Size
Num                                     Disk  Spr   Status Fail  (MB)
  1  MAXTOR ATLAS15K2_36SAS BG34    [Yes] [No]  Primary ---  35074
  2  MAXTOR ATLAS15K2_36SAS BG34    [Yes] [No]  Secondary ---  35074
  8  MAXTOR ATLAS15K2_36SAS BG34    [No]  [Yes] Hot Spare ---  35074
 11  MAXTOR ATLAS15K2_36SAS BG34    [No]  [No]  Max Dsk ---  35074

Esc = Exit Menu      F1/Shift+l = Help
Space/+/- = Select disk for array or hot spare      C = Create array
```

8. When the volume has been fully configured, press **C** and then select **Save changes then exit this menu** to commit the changes.

The SAS BIOS CU pauses while the array is being created.

### 3.2.2 Creating an IME Volume

Follow these steps to create an IME volume with the SAS BIOS CU:

1. On the Adapter List screen, use the arrow keys to select an LSI Logic SAS adapter.
2. Press **Enter** to go to the Adapter Properties screen, shown in [Figure 3.1](#).
3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** on the screen and press **Enter**.
4. When you are prompted to select a volume type, select **Create IME Volume**.

The Create New Array screen shows a list of disks that can be added to a volume.

5. Move the cursor to the “RAID Disk” column and select a disk. To add the disk to the volume, change the “No” to “Yes” by pressing the + key, – key, or space bar.
6. Repeat this step to select a total of three to eight disks for the volume (or three to seven disks if you will create a global hot spare).

All existing data on all the disks you select will be overwritten. As you add disks, the Array Size field changes to reflect the size of the new volume.

7. (optional) Add a global hot spare to the volume by moving the cursor to the hot spare column and pressing the + key, – key, or space bar.
8. When the volume has been fully configured, press **C** and then select **Save changes then exit this menu** to commit the changes.

The SAS BIOS CU pauses while the array is being created.

---

## 3.3 Creating a Second IM or IME Volume

The LSI Logic SAS controllers allow you to configure two IM or IME volumes. If one volume is already configured, and if there are available disk drives, there are two ways to add a second volume. The first is as follows:

1. In the configuration utility, select an adapter from the Adapter List. Select the **RAID Properties** option.

This will display the current volume.

2. Press **C** to create a new volume.
3. Continue with step 4 of the IM or IME creation procedure in the previous section to create a second volume.

The other way in which to add a second volume is as follows:

1. On the Adapter List screen, use the arrow keys to select an LSI Logic SAS adapter.
2. Press **Enter** to go to the Adapter Properties screen, shown in [Figure 3.1](#).
3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** and press **Enter**.
4. Continue with step 4 of the IM or IME creation procedure in the previous section to create a second volume.

---

## 3.4 Managing Hot Spares

You can create one global hot spare disk to protect the one or two IM/IME volumes defined on a SAS controller. Usually, you create the global hot spare at the same time you create the IM/IME volume. Follow these steps to add a global hot spare disk later for the existing IM/IME volumes on the controller:

1. On the View Array screen, select **Manage Array**.
2. Select **Manage Hot Spare** on the Manage Array screen, shown in [Figure 3.3](#).

**Figure 3.3 Manage Array Screen**

```
LSI Logic MPT Setup Utility      v6.01.03.00
Manage Array -- SAS1068

Identifier                      LSILOGICLogical Volume  3000
Type                           IM
Scan Order                     1
Size(MB)                       34332
Status                         Optimal

Manage Hot Spare

Synchronize Array

Activate Array

Delete Array

Esc = Exit Menu      F1/Shift+l = Help
Enter = Choose array type to create      Esc = Return to Adapter Properties
```

3. Select a disk from the list by pressing the + key, – key, or space bar.
4. After you select the global hot spare disk, press **C**.

An error message appears if the selected disk is not at least as large as the smallest disk used in the IM/IME volume(s). The global hot spare disk must have 512-byte blocks, it cannot have removable media, and the disk type must be either SATA with extended command set support or SAS with SMART support.

If SATA disks are used for the IM/IME volume(s), the hot spare disk must also be a SATA disk. If SAS disks are used, the hot spare disk must also be a SAS disk. An error message appears if the selected disk is not the same type as the disks used in the IM/IME volumes.

5. Select **Save changes then exit this menu** to commit the changes. The configuration utility will pause while the global hot spare is being added.

Follow these steps to delete a global hot spare:

1. Select **Manage Hot Spare** on the Manage Array screen.
2. Select **Delete Hot Spare** and then press **C**.

3. Select **Save changes then exit this menu** to commit the changes.  
The configuration utility will pause while the global hot spare is being removed.

---

## 3.5 Other Configuration Tasks

This section explains how to do other tasks related to configuring and maintaining IM and IME volumes.

### 3.5.1 Viewing Volume Properties

Follow these steps to view the properties of volumes:

1. In the SAS BIOS CU, select an adapter from the Adapter List. Select the **RAID Properties** option.

The properties of the current volume are displayed. If a global hot spare is defined, it is also listed.

Note: If you create one volume using SAS disks, another volume using SATA disks, and a global hot spare disk, the hot spare disk will only appear when you view the volume that has the same type of disks as the hot spare disk.

2. If two volumes are configured, press **Alt+N** to view the other array.
3. To manage the current array, select the **Manage Array** item and press **Enter**.

### 3.5.2 Synchronizing an Array

The Synchronize Array command forces the firmware to resynchronize the data on the mirrored disks in the array. It is seldom necessary to use this command, because the firmware automatically keeps the mirrored data synchronized during normal system operation. When you use this command, one disk of the array is placed in the *Degraded* state until the data on the mirrored disks has been resynchronized.

Follow these steps to force the synchronization of a selected array:

1. Select **Synchronize Array** on the Manage Array screen.
2. Press **Y** to start the synchronization, or **N** to cancel it.

### 3.5.3 Activating an Array

An array can become inactive if, for example, it is removed from one controller or computer and moved to another one. The “Activate Array” option allows you to reactivate an inactive array that has been added to a system. This option is only available when the selected array is currently inactive.

Follow these steps to activate a selected array

1. Select **Activate Array** on the Manage Array screen.
2. Press **Y** to proceed with the activation, or press **N** to abandon it.

After a pause, the array will become active.

Note: If there is a global hot spare disk on the controller to which you have moved the array, the firmware checks when you activate the array to determine if the hot spare is compatible with the new array. An error message appears if the disks in the activated array are larger than the hot spare disk or if the disks in the activated array are not the same type as the hot spare disk (SATA versus SAS).

### 3.5.4 Deleting an Array

**CAUTION:** Before deleting an array, be sure to back up all data on the array that you want to keep.

Follow these steps to delete a selected array:

1. Select **Delete Array** on the Manage Array screen.
2. Press **Y** to delete the array.

After a pause, the firmware deletes the array. If there is another remaining array and a global hot spare disk, the firmware checks the hot spare disk to determine if it is compatible with the remaining array. If the hot spare disk is not compatible (too small or wrong disk type) the firmware deletes it also.

Note: After a volume has been deleted, it cannot be recovered. When a RAID 1 volume is deleted, the data is preserved on the primary disk. The master boot records (MBR) of

other disks in the array are deleted. For other RAID types, the master boot records of all disks are deleted.

### 3.5.5 Locating a Disk Drive, or Multiple Disk Drives in a Volume

You can use the SAS BIOS CU to locate and identify a specific physical disk drive by flashing the drive's LED. You can also use the SAS BIOS CU to flash the LEDs of all the disk drives in a RAID volume. There are several ways to do this:

- When you are creating an IM or IME volume, and a disk drive is set to **Yes** as part of the volume, the LED on the disk drive is flashing. The LED is turned off when you have finished creating the volume.
- You can locate individual disk drives from the SAS Topology screen. To do this, move the cursor to the name of the disk in the Device Identifier column and press **Enter**. The LED on the disk flashes until the next key is pressed.
- You can locate all the disk drives in a volume by selecting the volume on the RAID Properties screen. The LEDs flash on all disk drives in the volume.

Note: The LEDs on the disk drives will flash as described above if the firmware is correctly configured and the drives or the disk enclosure supports disk location.

### 3.5.6 Selecting a Boot Disk

You can select a boot disk in the SAS Topology screen. This disk is then moved to scan ID 0 on the next boot, and remains at this position. This makes it easier to set BIOS boot device options and to keep the boot device constant during device additions and removals. There can be only one boot disk.

Follow these steps to select a boot disk:

1. In the SAS BIOS CU, select an adapter from the Adapter List.
2. Select the **SAS Topology** option.

The current topology is displayed. If the selection of a boot device is supported, the bottom of the screen lists the Alt+B option. This is the key for toggling the boot device. If a device is currently configured as

the boot device, the Device Info column on the SAS Topology screen will show the word "Boot."

3. To select a boot disk, move the cursor to the disk and press **Alt+B**.
4. To remove the boot designator, move the cursor down to the current boot disk and press **Alt+B**. This controller will no longer have a disk designated as boot.
5. To change the boot disk, move the cursor to the new boot disk and press **Alt+B**. The boot designator will move to this disk.

Note: The firmware must be configured correctly in order for the Alt+B feature to work.



# Chapter 4

## Integrated Striping (IS)

### Overview

---

This chapter provides an overview of the LSI Logic Integrated Striping (IS) feature. It includes these sections:

- [Section 4.1, "Introduction," page 4-1](#)
  - [Section 4.2, "IS Features," page 4-2](#)
  - [Section 4.3, "IS Description," page 4-2](#)
  - [Section 4.4, "Integrated Striping Firmware," page 4-4](#)
  - [Section 4.5, "Fusion-MPT Support," page 4-5](#)
- 

## 4.1 Introduction

The LSI Logic Integrated Striping (IS) feature is useful for applications that require the faster performance and increased storage capacity of striping. The low-cost IS feature has many of the advantages of a more expensive RAID striping solution. A single IS logical drive may be configured as the boot disk or as a data disk.

The IS feature is implemented with controller firmware that supports the Fusion-MPT Interface. IS provides better performance and more capacity than individual disks, without burdening the host CPU. The firmware splits host I/Os over multiple disks and presents the disks as a single logical drive. In general, striping is transparent to the BIOS, the drivers, and the operating system.

The SAS BIOS CU is used to configure IS volumes, which can consist of two to eight disks.

**Note:** Integrated Mirroring and Integrated Striping volumes can be configured on the same LSI logic SAS controller.

---

## 4.2 IS Features

Integrated Striping supports the following features:

- Support for volumes with two to eight drives
- Support for two IS volumes, with up to 10 drives total, on a controller. An IS volume can also be combined with an IM or IME volume.

Note: Currently available LSI Logic SAS controllers support a maximum of eight drives. All drives in a volume must be connected to the same SAS controller.

- Presents a single virtual drive to the OS for each configured volume
- Support for both SAS and SATA drives, although the two types of drives cannot be combined in one volume
- Fusion-MPT architecture
- Easy-to-use SAS BIOS configuration utility
- Error notification
- Use of metadata to store volume configuration on disks
- OS-specific event log
- Error display inside the Fusion-MPT BIOS
- SES status LED support for drives used in IS volumes

---

## 4.3 IS Description

The IS feature writes data across multiple disks instead of onto one disk. This is accomplished by partitioning each disk's storage space into 64 Kbyte stripes. These stripes are interleaved round-robin, so that the combined storage space is composed alternately of stripes from each disk.

For example, as shown in [Figure 4.1](#), segment 1 is written to disk 1, segment 2 is written to disk 2, segment 3 is written to disk 3, and so on. When the system reaches the end of the disk list, it continues writing data at the next available segment of disk 1.

**Figure 4.1 Integrated Striping Example**

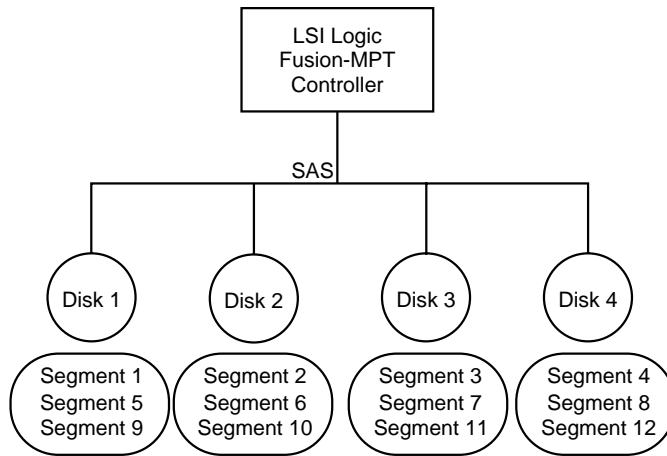
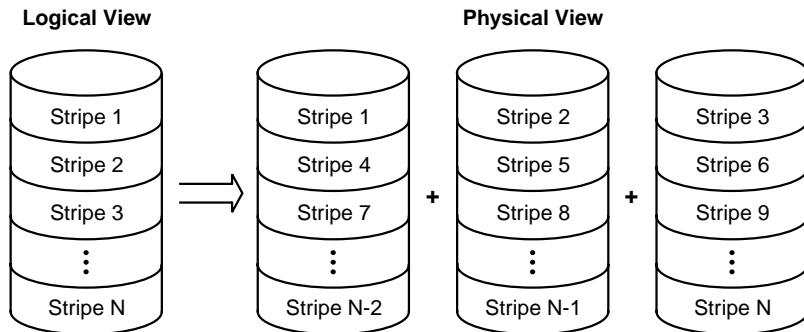


Figure 4.2 shows a logical view and a physical view of Integrated Striping configuration.

**Figure 4.2 Integrated Striping - Logical and Physical Views**



The primary advantage of IS is speed, because it transfers data to or from multiple disks at once. However, there is no data redundancy; therefore, if one disk fails, that data is lost.

---

## 4.4 Integrated Striping Firmware

This section describes features of the LSI Logic Integrated Striping (IS) firmware.

### 4.4.1 Host Interface

The IS host interface uses the Message Passing Interface, as described in the *Fusion-MPT Message Passing Interface Specification*, including Integrated Striping. Through the Fusion-MPT interface, the host operating system has access to the logical IS drive as well as the physical disks.

### 4.4.2 Metadata Support

The firmware supports metadata, which describes the IS logical drive configuration stored on each member disk. When the firmware is initialized, each member disk is queried to read the stored metadata to verify the configuration. The usable disk space for each IS member disk is adjusted down to leave room for this data.

### 4.4.3 SMART Support

The IS firmware enables Mode 6 SMART on the IS member disks. Mode 6 SMART requires each physical disk to be polled at regular intervals. If a SMART ASC/ASCQ code is detected on a physical IS disk, the firmware processes the SMART data, and the last received SMART ASC/ASCQ is stored in non-volatile memory. The IS volume does not support SMART directly, since it is just a logical representation of the physical disks in the volume.

### 4.4.4 Disk Write Caching

Disk write caching is disabled by default on all IS volumes.

---

## 4.5 Fusion-MPT Support

The BIOS uses the LSI Logic Fusion-MPT interface to communicate to the SAS controller and firmware to enable Integrated Striping. This includes reading the Fusion-MPT configuration to gain access to the parameters that are used to define behavior between the SAS controller and the devices connected to it. The Fusion-MPT drivers for all supported operating systems implement the Fusion-MPT interface to communicate with the controller and firmware.



# Chapter 5

## Creating Integrated Striping Volumes

---

This chapter describes how to create Integrated Striping (IS) volumes using the LSI Logic SAS BIOS Configuration Utility (SAS BIOS CU). The chapter includes these topics:

- [Section 5.1, “IS Configuration Overview,” page 5-1](#)
  - [Section 5.2, “Creating IS Volumes,” page 5-2](#)
  - [Section 5.3, “Creating a Second IS Volume,” page 5-4](#)
  - [Section 5.4, “Other Configuration Tasks,” page 5-5](#)
- 

### 5.1 IS Configuration Overview

You can use the SAS BIOS CU to create multiple IS volumes, with up to 10 drives total on an LSI Logic SAS controller. Each volume can have from 2 to 8 drives. Disks in an IS volume must be connected to the same LSI Logic SAS controller, and the controller must be in the BIOS boot order.

Although you can use disks of different size in IS volumes, the smallest disk determines the “logical” size of each disk in the volume. In other words, the excess space of the larger member disk is not used. Usable disk space for each disk in an IS volume is adjusted down to leave room for metadata. Usable disk space may be further reduced to maximize the ability to interchange disks in the same size classification. The supported stripe size is 64 Kbytes.

Refer to [Section 4.2, “IS Features,”](#) for more information about Integrated Striping volumes.

---

## 5.2 Creating IS Volumes

The SAS BIOS CU is part of the Fusion-MPT BIOS. When the BIOS loads during boot and you see the message about the Setup Utility, press **Ctrl-C** to start it. After you do this, the message changes to:

Please wait, invoking SAS Configuration Utility...

After a brief pause, the main menu of the SAS BIOS CU appears. On some systems, however, the following message appears next:

LSI Logic Configuration Utility will load following initialization!

In this case, the SAS BIOS CU will load after the system has completed its power-on self test.

Follow the steps below to configure an Integrated Striping (IS) volume with the SAS BIOS CU. The procedure assumes that the required controller(s) and disks are already installed in the computer system. You can configure both IM and IS volumes on the same SAS controller.

1. On the Adapter List screen of the SAS BIOS CU, use the arrow keys to select a SAS adapter.
2. Press **Enter** to go to the Adapter Properties screen, shown in [Figure 5.1](#).

**Figure 5.1 Adapter Properties Screen**

```
LSI Logic MPT Setup Utility    v6.01.03.00
Adapter Properties -- SAS1068

Adapter                      SAS1068
PCI Slot                     03
PCI Address(Bus/Dev/Func)    03:00:00
MPT Firmware Revision        00.03.23.00-IT
SAS Address                   500605B0:0000C580
Status                        Enabled
Boot Order                    1
Boot Support                  [Enabled BIOS & OS]

RAID Properties

SAS Topology

Advanced Adapter Properties

Esc = Exit Menu      F1/Shift+l = Help
Enter = Select Item  -/+ = Change Item
```

3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** on the screen and press **Enter**.
4. When you are prompted to select a volume type, select **Create IS Volume**.

The Create New Array screen shows a list of disks that can be added to a volume.

5. Move the cursor to the “RAID Disk” column. To add a disk to the volume, change the “No” to “Yes” by pressing the + key, – key, or space bar. As disks are added, the Array Size field changes to reflect the size of the new volume.

There are several limitations when creating an IS (RAID 0) volume:

- All disks must be either SATA (with extended command set support) or SAS (with SMART support).
- Disks must have 512-byte blocks and must not have removable media.
- There must be at least 2 and no more than 8 drives in a valid IS volume. Hot spare drives are not allowed.

Figure 5.2 shows an IS volume configured with two drives.

**Figure 5.2 Create New Array Screen**

```
LSI Logic MPT Setup Utility      v6.01.03.00
Create New Array -- SAS1068

    Array Type:                      IS
    Array Size(MB)                   70032

Slot  Device Identifier              RAID  Hot   Drive   Pred   Size
Num                                     Disk  Spr   Status Fail   (MB)
  1  MAXTOR ATLAS15K2_36SAS BG34    [Yes] [No]   Ok     ---   35074
  2  MAXTOR ATLAS15K2_36SAS BG34    [Yes] [No]   Ok     ---   35074
  8  MAXTOR ATLAS15K2_36SAS BG34    [No]  [No]   Ok     ---   35074
 11  MAXTOR ATLAS15K2_36SAS BG34    [No]  [No]   Ok     ---   35074

Esc = Exit Menu      F1/Shift+l = Help
Space/+/- = Select disk for array or hot spare    C = Create array
```

- When the volume has been fully configured, press **C** and then select **Save changes then exit this menu** to commit the changes. The configuration utility will pause while the array is being created.

Note: Integrated Striping does not provide any data protection in the event of disk failure. It is primarily used to increase speed.

---

## 5.3 Creating a Second IS Volume

The LSI Logic SAS controllers allow you to configure two IS volumes, or an IS volume and an IM or IME volume. If one volume is already configured, and if there are available disk drives, there are two ways to add a second volume. The first is as follows:

- In the configuration utility, select an adapter from the Adapter List. Select the **RAID Properties** option.

This will display the current volume.

2. Press **C** to create a new volume.
3. Continue with step 4 of [Section 5.2, “Creating IS Volumes,”](#) to create a second IS volume.

The other way in which to add a second volume is as follows:

1. On the Adapter List screen, use the arrow keys to select an LSI Logic SAS adapter.
2. Press **Enter** to go to the Adapter Properties screen, shown in [Figure 5.1](#).
3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** and press **Enter**.
4. Continue with step 4 of the IS creation procedure in the previous section to create a second volume.

---

## 5.4 Other Configuration Tasks

This section explains how to do other tasks related to configuring and maintaining IS volumes.

### 5.4.1 Viewing IS Volume Properties

Follow these steps to view the properties of IS volumes:

1. In the configuration utility, select an adapter from the Adapter List. Select the **RAID Properties** option.  
The properties of the current volume are displayed.
2. If more than one volume is configured, press **Alt+N** to view the next array.
3. To manage the current array, press **Enter** when the **Manage Array** item is selected.

### 5.4.2 Activating an Array

An array can become inactive if, for example, it is removed from one controller or computer and moved to another one. The “Activate Array” option allows you to reactivate an inactive array that has been added to

a system. This option is only available when the selected array is currently inactive.

Follow these steps to activate a selected array.

1. Select **Activate Array** on the Manage Array screen.
2. Press **Y** to proceed with the activation, or press **N** to abandon it.  
After a pause, the array will become active.

### 5.4.3 Deleting an Array

**CAUTION:** Before deleting an array, be sure to back up all data on the array that you want to keep.

Follow these steps to delete a selected array:

1. Select **Delete Array** on the Manage Array screen.
2. Press **Y** to delete the array, or press **N** to abandon the deletion.  
After a pause, the firmware deletes the array.

**Note:** Once a volume has been deleted, it cannot be recovered. The master boot records of all disks are deleted.

### 5.4.4 Locating a Disk Drive, or Multiple Disk Drives in a Volume

You can use the SAS BIOS CU to locate and identify a specific physical disk drive by flashing the drive's LED. You can also use the SAS BIOS CU to flash the LEDs of all the disk drives in a RAID volume. There are several ways to do this:

- When you are creating an IS volume, and a disk drive is set to **Yes** as part of the volume, the LED on the disk drive is flashing. The LED is turned off when you have finished creating the volume.
- You can locate individual disk drives from the SAS Topology screen. To do this, move the cursor to the name of the disk in the Device Identifier column and press **Enter**. The LED on the disk flashes until the next key is pressed.
- You can locate all the disk drives in a volume by selecting the volume on the RAID Properties screen. The LEDs flash on all disk drives in the volume.

Note: The LEDs on the disk drives will flash as described above if the firmware is correctly configured and the drives or the disk enclosure supports disk location.

### 5.4.5 Selecting a Boot Disk

You can select a boot disk in the SAS Topology screen. This disk is then moved to scan ID 0 on the next boot, and remains at this position. This makes it easier to set BIOS boot device options and to keep the boot device constant during device additions and removals. There can be only one boot disk.

Follow these steps to select a boot disk:

1. In the SAS BIOS CU, select an adapter from the Adapter List.
2. Select the **SAS Topology** option.

The current topology is displayed. If the selection of a boot device is supported, the bottom of the screen lists the Alt+B option. This is the key for toggling the boot device. If a device is currently configured as the boot device, the Device Info column on the SAS Topology screen will show the word "Boot."

3. To select a boot disk, move the cursor to the disk and press **Alt+B**.
4. To remove the boot designator, move the cursor down to the current boot disk and press **Alt+B**. This controller will no longer have a disk designated as boot.
5. To change the boot disk, move the cursor to the new boot disk and press **Alt+B**. The boot designator will move to this disk.

Note: The firmware must be configured correctly in order for the Alt+B feature to work.



# Appendix A

## Using the CFGGEN IR Configuration Utility

---

This appendix describes how to use the CFGGEN IR Configuration Utility to create Integrated Mirroring (IM), Integrated Mirroring Enhanced (IME) and Integrated Striping (IS) volumes. CFGGEN is a command line utility that runs in the DOS, Linux, EFI, and Windows Pre-Installation (WinPE) environments. CFGGEN is a minimally interactive program that can be executed from a command line prompt or a shell script. The result from invoking this utility is communicated via the program status value that is returned when the program exits.

CFGGEN can be used to create IM, IME, and IS storage configurations on both SCSI controllers and SAS controllers. As noted in this Appendix, some CFGGEN commands work only with SAS controllers, in the EFI environment.

The appendix includes these topics:

- [Section A.1, “Hardware and Software Requirements”](#)
- [Section A.2, “CFGGEN Interface Description”](#)
- [Section A.3, “CFGGEN Commands”](#)

Note: CFGGEN is intended for use *only in the manufacturing environment*. End users can use the BIOS-based configuration utility to create IM and IS volumes. (See [Chapter 3, “Creating Integrated Mirroring Volumes”](#) and [Chapter 5, “Creating Integrated Striping Volumes”](#).)

---

## A.1 Hardware and Software Requirements

The CFGGEN IR Configuration Utility runs on any Intel IA-32 or IA64 compatible platform. It will work with any SCSI, SATA, or SAS device that is compliant with existing SCSI standards. CFGGEN supports the following LSI Logic controllers:

- LSI53C1020 and LSI53C1030 SCSI controllers (DOS, Linux, and WinPE environments only)
- SAS1064/1064E and SAS1068/1068E SAS controllers (DOS, Linux, EFI, and WinPE environments)

The supported versions of CFGGEN are as follows:

### DOS Version –

CFGGEN will run in any environment that is fully DOS compatible and has at least 640 Kbytes of memory. The system BIOS must support 32-bit BIOS services, including the PCI BIOS services. CFGGEN uses these services to locate the controller and its interface registers. CFGGEN must be able to directly access the controller chip's interface registers.

Note: You *cannot* run CFGGEN in a virtual DOS window from within Windows.

### EFI Version –

CFGGEN will run in any environment that is fully EFI compatible. Currently, this includes only the SAS controllers listed above.

### Linux Version –

CFGGEN is a statically linked Linux application. Static linking prevents any library version compatibility problems that might stop CFGGEN from working with a specific release or distribution of Linux. Version 3.02.04 or newer of the LSI `mptlinux` driver must be installed on the system. The required modules include `mptbase.o`, `mptscsih.o` and `mptctl.o`.

Caution: `mptbase.o`, `mptscsih.o` and `mptctl.o` must be loaded into the Linux kernel before CFGGEN will function correctly. They can be loaded using the Linux `modprobe` command.

## WinPE Version –

CFGGEN will run on a Windows Pre-Installation Environment (WinPE) and is statically compiled with the LSI MptLib Library (`MptLib.lib`). The WinPE environment must have the appropriate LSI Logic MPT Windows driver (Miniport or Storport) installed and loaded in order to recognize and communicate with the I/O controller.

The WinPE utility does not recognize an LSI53C1030 or LSI53C1020 controller, unless there is at least one device attached to the controller.

---

## A.2 CFGGEN Interface Description

CFGGEN uses a command line interface. Commands are formatted as follows:

```
cfggen <controller #> <command> <parameters>
```

The program name, controller number, command, and parameters fields must be separated by the ASCII space character. The format of the parameters is command specific, as described in [Section A.3, “CFGGEN Commands.”](#)

Information is passed between the user environment and CFGGEN via the command line, the standard output and standard error interfaces, and the program return value. The user can redirect the output streams as permitted by the operating environment. The program return value is returned to the user when the program exits. A value of 0 is returned if the command is successful. Otherwise, a value of 1 is returned.

---

## A.3 CFGGEN Commands

CFGGEN has the following commands:

- CREATE
- DEFAULTS (called *DELETE* in the EFI version)
- DISPLAY
- FORMAT

- HOTSPARE
- STATUS
- SETOFFLINE (DOS, Linux, and WinPE versions only)
- SETONLINE (DOS, Linux, and WinPE versions only)
- AUTO (EFI version only)
- DISABLEIR (EFI version only)
- ENABLEIR (EFI version only)
- LIST (EFI version only)

CFGGEN is not case sensitive. You can type CFGGEN commands and parameters in uppercase, lowercase, or a mixture of the two.

The following conventions are used in the command descriptions:

- Text in *italics* must be entered exactly as shown on the command line.
- Text surrounded by <> must be replaced with a required parameter.
- Text surrounded by [ ] may be replaced by an optional parameter.
- Parameters surrounded by {} must be entered one or more times, as is appropriate for the command being executed.
- The command line definition characters <>, [ ], and {} must not be entered on the command line.

### A.3.1 Common Command Line Parameters

This section describes CFGGEN command line parameters that are common to more than one command.

- **<controller #>**

The unique controller number of a *PCI function* found in the system, starting with controller # 0. For LSI Logic SCSI controllers, *PCI function* means SCSI bus. Therefore, the controller # is used to address a particular SCSI bus in the system. For example, CFGGEN assigns two controller numbers to an LSI53C1030 dual SCSI bus chip. It assigns one controller number to an LSI53C1020 single SCSI bus chip.

For the LSI Logic SAS1064/1064E and SAS1068/1068E controllers the controller # corresponds to a single SAS controller. For example,

in a system containing two SAS1068 controllers, controller # 0 references the first controller and controller # 1 references the other controller.

Valid controller number values are 0–255 (decimal).

- **<SCSI ID>**

The SCSI bus address of a peripheral device attached to an LSI Logic controller. The maximum value of *SCSI ID* depends on the type of I/O controller and the maximum number of devices supported by the OS for this controller.

Valid *SCSI ID* values are:

0–15 (decimal) per SCSI bus for LSI53C1020/1030 controllers

0–127 (decimal) per controller for SAS1064/1064E and SAS1068/1068E controllers

Note: With PBSRAM, the SAS1068/1068E controllers can support more than 128 devices.

- **<Enclosure:Bay>**

The Enclosure and bay/slot of a peripheral device attached to the bus. The argument must use a colon (:) as a separator and must follow the *enclosure:bay* format. This argument is only valid when used with the *bay* argument on the command line.

Valid numbers are 0–127 (decimal) for SAS1064/1064E and SAS1068/1068E controllers.

### A.3.2 CREATE Command

The CREATE command creates IM, IME, and IS volumes on the LSI53C1020/1030 and SAS1064/1064E and SAS1068/1068E controllers. The firmware and hardware limitations for these controllers determine the number of configurations that can be created.

When a disk drive is added to an IM, IME, or IS volume, its entire storage capacity may or may not be used, depending on drive capacity and volume capacity. For example, if you add a 36 Gbyte disk drive to a volume that only uses 9 Gbytes of capacity on each disk drive, the remaining 27 Gbytes of capacity on the disk drive is unusable.

The disk identified by the first SCSI ID on the command line is assigned as the primary disk drive when an IM volume is created. If the controller

is allowed to resync the disk drives, the data on the primary disk drive will be available when you access the newly created volume.

The following rules must be observed when creating IM, IME, and IS volumes and hot spare disks:

1. All disks that are part of a volume, including hot spares for that volume, must be on the same SAS controller or on the same SCSI bus (for SCSI controllers).
2. IM, IME, and IS volumes are supported.
3. A maximum of two IM, IME, or IS volumes per controller can be created.
4. The total number of disks in a volume, including hot spare disks, cannot exceed six for LSI53C1020/1030 controllers.
5. The total number of disks in a volume, including hot spare disks, cannot exceed eight for SAS1064/1064E and SAS1068/1068E controllers, and the total number of disks combined for two volumes cannot exceed ten. (Ten disks is a theoretical upper limit for the firmware; the SAS controller may actually support a lesser number of disks.)
6. An IM volume must have exactly two disks.
7. An IME volume can have a minimum of three disks and a maximum of six disks (for LSI53C1020/1030 controllers) or eight disks (for SAS controllers), as long as rules 4 and 5 are not violated.

### Command Line –

```
cfggen <controller #> create <volume type> <size>  
{<SCSI ID>} [qsync] [noprompt]
```

```
cfggen <controller #> create <volume type> <size> bay  
{<enclosure:bay>} [qsync] [noprompt]
```

### Parameters –

- <controller #> – Number of the SCSI bus or SAS controller targeted by this command.
- <volume type> – Volume type for the new volume to be created. Valid values are *IM* or *IME* or *IS*.

- `<size>` – Size of the RAID volume in Mbytes, or *MAX* for the maximum size available.
- *Bay* – This option indicates that *enclosure:bay* values are specified instead of SCSI ID values.
- `<SCSI ID>` – SCSI ID of a hard disk drive to be included in the RAID volume.
- `<enclosure:bay>` – The *enclosure:bay* value for the disk drive to be included in the RAID volume. These values can be obtained from the output of the *DISPLAY* command.
- *qsync* – If this optional parameter is specified, a quick synchronization of new volume will be performed. If the volume type is *IME* or *IS*, a quick synchronization is always performed even if *qsync* is not specified. A quick synchronization means that the first 32 Kbytes of the drives in the volume are cleared to 0.
- *noprompt* – Suppresses display of warnings and prompts.

#### Program Return Value –

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: bad command line arguments or operational failure.

### A.3.3 DEFAULTS Command

Note: This command is called *DELETE* in the EFI version of CFGGEN.

The DEFAULTS (DELETE) command deletes any IM, IME, and IS volumes and hot spare drives created by the CREATE and HOTSPARE commands. No other controller configuration parameters are changed.

#### Command Line –

DOS, Linux, WinPE versions:

```
cfggen <controller #> defaults [noprompt]
```

EFI version:

```
cfggen <controller #> delete [noprompt]
```

### Parameters –

- `<controller #>` – Number of the SCSI bus or SAS controller targeted by this command.
- `noprompt` – Suppresses display of warnings and prompts.

### Program Return Value –

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: bad command line arguments or operational failure.

## A.3.4 DISPLAY Command

The DISPLAY command displays configuration information for the supported controllers (LSI53C1020/1030, SAS1064/1064E, SAS1068/1068E). The information includes controller type, firmware version, BIOS version, volume information, and physical drive information. An example of the information that will be output by this command is provided in Sample Output below.

Note: 1 Mbyte = 1,048,576 bytes. All sizes displayed in Mbytes are rounded down to the nearest Mbyte.

### Command Line –

```
cfggen <controller #> display [filename]
```

### Parameters –

- `<controller #>` – Number of the SCSI bus or SAS controller targeted by this command.
- `[filename]` – Optional valid filename to store output of command to a file.

### Program Return Value –

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: bad command line arguments or operational failure.

## Sample Output –

The following example shows the output of the CREATE command when used to create an IM configuration on a SAS1064/1064E or SAS1068/1068E controller.

**Note:** The format and content of the DISPLAY command output varies, depending on the CFGGEN version being used.

Read configuration has been initiated for controller 0

---

### Controller information

---

Controller type	: LSI1064/1068
BIOS version	: 6.05.05.00
Firmware version	: 0.07.01.00
SCSI channel description	: 1 Serial Attached SCSI
Initiator IDs (SCSI ID)	: 63
Maximum physical devices	: 62
Concurrent commands supported	: 511
Slot	: 1
Bus	: 2
Device	: 2
Function	: 0

---

### IR Volume information

---

IR volume 1

Status of volume	: Okay (OKY)
RAID level	: 1
Size (in MB)	: 34332
Physical hard disks (SCSI ID)	: 10 7

---

### Enclosure information

---

Enclosure #	: 1
Enlclosure WWN	: 12345678:ABCDABCD
Start Slot	: 1
Num Slots	: 4
Start SCSI ID	: 0

---

### Physical device information

---

Initiator at SCSI ID 63

Target on SCSI ID 7

Enclosure #	: 1
Slot #	: 1
Device is a Hard disk	
SCSI ID	: 7
State	: Online (ONL)
Size (in MB)/(in sectors)	: 34732/71132958
Manufacturer	: MAXTOR

```

Model Number           : ATLAS15K2_036SAS
Firmware Revision      : BG31
Serial No              : E204EY1K
Drive Type             : SAS
Target on SCSI ID 8
Enclosure #           : 1
Slot #                : 2
Device is a Hard disk
SCSI ID               : 8
State                 : Hot Spare (HSP)
Size (in MB)/(in sectors) : 35074/71833095
Manufacturer          : MAXTOR
Model Number          : ATLAS15K2_36SAS
Firmware Revision     : BG34
Serial No             : E207AY6K
Drive Type            : SAS
Target on SCSI ID 9
Enclosure #           : 1
Slot #                : 3
Device is a Hard disk
SCSI ID               : 9
State                 : Ready (RDY)
Size (in MB)/(in sectors) : 34732/71132959
Manufacturer          : MAXTOR
Model Number          : ATLAS15K2_036SAS
Firmware Revision     : BG31
Serial No             : E204ERCK
Drive Type            : SAS
Target on SCSI ID 10
Enclosure #           : 1
Slot #                : 4
Device is a Hard disk
SCSI ID               : 10
State                 : Online (ONL)
Size (in MB)/(in sectors) : 140299/287332383
Manufacturer          : MAXTOR
Model Number          : ATLAS15K2_147SAS
Firmware Revision     : BG34
Serial No             : E803YMCK
Drive Type            : SAS

```

Logical drive status values are as follows:

- Okay (OKY) – Volume is Active and drives are functioning properly. User data is protected if the volume is IM or IME.
- Degraded (DGD) – Volume is Active. User data is not fully protected due to a configuration change or drive failure.
- Rebuilding (RBLD) – Data resync or rebuild may be in progress.

- Inactive, Okay (OKY) – Volume is inactive and drives are functioning properly. User data is protected if the current RAID level is RAID 1 (IM) or RAID 1E (IME).
- Inactive, Degraded (DGD) – Volume is inactive and the user's data is not fully protected due to a configuration change or drive failure; a data resync or rebuild may be in progress.

Physical device status values are as follows:

- Online (ONL) – Drive is operational and is part of a logical drive.
- Hot Spare (HSP) – Drive is a hot spare that is available for replacing a failed drive in an array.
- Ready (RDY) – Drive is ready for use as a normal disk drive; or it is available to be assigned to a disk array or hot spare pool.
- Available (AVL) – Drive may or may not be ready, and it is not suitable for inclusion in an array or hot spare pool (i.e., it is not spun up, its block size is incorrect, or its media is removable).
- Failed (FLD) – Drive was part of a logical drive or was a hot spare drive, and it failed. It has been taken offline.
- Standby (SBY) – This status is used to tag all non-hard disk drive devices.

### A.3.5 FORMAT Command

The FORMAT command is used to perform a low-level format of a disk drive. The drive cannot be a hot spare drive or a member of an IM, IME, or IS volume.

**WARNING:** A low-level format erases all data on the hard disk drive. The FORMAT command cannot and should not be interrupted; doing so may result in irreparable damage to the hard disk drive.

Warning messages are displayed during the formatting, unless the *noprompt* option is included on the command line. If the user does not quickly respond to a series of prompts, the command is aborted. The answers are case sensitive and must be entered in upper case.

The FORMAT command does not complete and return to a shell prompt until the format operation is complete. This may take a long time for a large disk drive.

#### Command Line –

```
cfggen <controller #> format <SCSI ID> [noprompt]
```

```
cfggen <controller #> format bay <enclosure:bay> [noprompt]
```

#### Parameters –

- <controller #> – Number of the controller targeted by this command.
- *Bay* – This option indicates that *enclosure:bay* values are specified instead of SCSI ID values.
- <SCSI ID> – SCSI ID of the hard disk drive to be formatted.
- <enclosure:bay> – The *enclosure:bay* value for the disk drive to be formatted. These values can be obtained from the output of the DISPLAY command.
- *noprompt* – Suppresses display of warnings and prompts.

#### Program Return Value –

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: command failed.

### A.3.6 HOTSPARE Command

The HOTSPARE command creates a hot spare disk drive, which is added to hot spare pool 0. The number of disk drives in an IM, IME, or IS volume, including the hot spare disk cannot exceed six for LSI53C1020/1030 controllers and eight for LSI1064/1064E and LSI1068/1068E controllers. Only one hot spare disk can be created.

The capacity of the hot spare disk must be greater than or equal to the capacity of the smallest disk in the logical drive. An easy way to verify this is to use the DISPLAY command.

The following rules must be observed when creating hot spare disks:

1. A hot spare disk cannot be created unless at least one IM or IME volume is already created.
2. For LSI1064/1064E and LSI1068/1068E controllers, CFGGEN does not allow adding a hot spare disk of a type (SAS/SATA) that is different from the disk types in any of the volume.

#### Command Line –

```
cfggen <controller #> hotspare <SCSI ID>
```

```
cfggen <controller #> hotspare bay <enclosure:bay>
```

#### Parameters –

- <controller #> – Number of the SCSI bus or SAS controller targeted by this command.
- *Bay* – This option indicates that *enclosure:bay* values are specified instead of SCSI ID values.
- <SCSI ID> – SCSI ID of the drive targeted by this command.
- <enclosure:bay> – The *enclosure:bay* value for the disk drive to use for the new hot spare disk. These values can be obtained via the output of the DISPLAY command.

#### Program Return Value –

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: bad command line arguments or operational failure.

### A.3.7 STATUS Command

The STATUS command displays the status of any volume synchronization operation that is currently in progress on the controller. If no such operation is in progress, CFGGEN displays a message indicating this before it exits. The STATUS command adds the flag *Inactive* to the Volume State field, if the controller firmware marks the volume as Inactive.

#### Command Line –

```
cfggen <controller #> status
```

## Parameters –

- <controller #> – Number of the SCSI bus or SAS controller targeted by this command.

## Program Return Value –

0x00 SUCCESS: command completed successfully.  
0x01 FAILURE: command failed.

## Sample Output –

Here is an example of the status information returned when a volume resynchronization is in progress:

```
Background command progress status for controller 0...
IR Volume 1
  Current operation           : Synchronize
  Volume ID                  : 6
  Volume status               : Enabled
  Volume state                : Degraded
  Physical disk I/Os         : Not quiesced
  Volume size (in sectors)   : 70311936
  Number of remaining sectors : 68250624
  Percentage complete        : 2.93%
```

Here is an example of the status information returned when no background volume operation is in progress:

```
Background command progress status for controller 0...
IR Volume 1
  Current operation           : None
  Volume ID                  : 6
  Volume status               : Enabled
  Volume state                : Optimal
  Physical disk I/Os         : Not quiesced
```

The status fields in the data displayed can have the following values:

Current operation – *Synchronize* or *None*  
Volume status – *Enabled* or *Disabled*  
Volume state – *[Inactive] Optimal, Degraded* or *Failed*  
Physical disk I/Os – *Quiesced* or *Not quiesced*

### A.3.8 SETOFFLINE Command

Note: The SETOFFLINE command is supported by the DOS, Linux, and WinPE versions of CFGGEN only.

The SETOFFLINE command makes a physical disk in a volume offline. A physical disk that is taken offline changes its state to Failed (FLD), but the disk is still associated with the volume and therefore cannot be addressed by normal I/O requests. If a new disk replaces an offline disk, the new disk is automatically brought online. Otherwise, the disk remains offline until explicitly brought online by SETONLINE command.

#### Command Line –

```
cfggen <controller #> setoffline <SCSI ID>
```

#### Parameters –

- <controller #> – Number of the SCSI bus or SAS controller targeted by this command.
- <SCSI ID> – SCSI target ID of the drive targeted by this command.

#### Program Return Value –

0x00 SUCCESS: command completed successfully.  
0x01 FAILURE: command failed.

### A.3.9 SETONLINE Command

Note: The SETOFFLINE command is supported by the DOS, Linux, and WinPE versions of CFGGEN only.

The SETONLINE command brings a physical disk in a volume online, which is required only after the physical disk has been taken offline by the SETOFFLINE command. When a physical disk is brought online, the IOC synchronizes the volume.

#### Command Line –

```
cfggen <controller #> setonline <SCSI ID>
```

### Parameters –

- <controller #> – Number of the controller targeted by this command.
- <SCSI ID> – SCSI target ID of the drive targeted by this command.

### Program Return Value –

0x00 SUCCESS: command completed successfully.  
0x01 FAILURE: command failed.

## A.3.10 AUTO Command (EFI Version Only)

The AUTO command, which is currently supported only in the EFI version of CFGGEN, automatically creates an IM, IME, or IS volume on an LSI1064/1064E or LSI1068/1068E controller. The volume is created with the maximum number of disks available for use in the specified volume type. The main difference from the CREATE command is that with the AUTO command you do not specify SCSI ID values for disks to use in the volume. CFGGEN automatically creates the volume with the first usable disks it finds. Firmware and hardware limitations for the family of controllers limit the number of configurations that are possible.

When a disk drive is added to an IM, IME, or IS volume, its entire storage capacity may or may not be used, depending on drive capacity and volume capacity. For example, if you add a 36 Gbyte disk drive to a volume that only uses 9 Gbytes of capacity on each disk drive, the remaining 27 Gbytes of capacity on the disk drive are unusable.

When AUTO creates an IM volume, the first disk found is assigned as the primary disk drive. If the controller is allowed to resync the disk drives, the data on the primary disk drive will be available by accessing the newly created volume.

CFGGEN follows these rules when creating IM, IME, and IS volumes and hot spare disks with the AUTO command:

1. All disks that are part of a volume or a hot spares for a volume must be connected to the same controller.
2. IM, IME, and IS volumes are supported.
3. Only two volumes per controller can be created.

4. SAS and SATA drives cannot be mixed in a volume. With the AUTO command, all drives used must be the same type as the first available disk found.
5. The total number of disks in a volume, including hot spare disks, cannot exceed eight for LSI1064/1064E and LSI1068/1068E controllers, and the total number of disks combined for two volumes cannot exceed ten.
6. An IM volume must have exactly two disks.
7. An IME volume can have three to six/eight disks as long as rules 4 and 5 are not violated.

### Command Line –

```
cfggen <controller #> auto <volume type> <size>  
[qsync] [noprompt]
```

### Parameters –

- <controller #> – Number of the SAS controller targeted by this command.
- <volume type> – Volume type for the volume to be created. Valid values are *IM*, *IME* and *IS*.
- <size> – Size of the RAID volume in Mbytes, or *MAX* for the maximum size available.
- [*qsync*] – If this optional parameter is specified, a quick synchronization of new volume will be performed. If the volume type is *IME* or *IS*, a quick synchronization is always performed even if this option is not specified. A quick synchronization means that the first 32 Kbytes of the drives in the volume are cleared to 0.
- *noprompt* – Suppresses display of warnings and prompts.

### Program Return Value –

- 0x00 SUCCESS: command completed successfully.  
0x01 FAILURE: bad command line arguments or operational failure.

### A.3.11 DISABLEIR Command (EFI Version Only)

The DISABLEIR command, which is currently supported only in the EFI version of CFGGEN, disables Integrated RAID functionality on an LSI1064/1064E or LSI1068/1068E controller. This is done by setting the MPI\_IOUNITPAGE1\_DISABLE\_IR bit in the IO Unit 1 MPT Configuration Page.

If there are any existing IM, IME, or IS volumes when this command is run, the user is notified via an output message, no action is taken, and CFGGEN returns FAILURE. If Integrated RAID is already disabled when this command is run, CFGGEN returns SUCCESS.

#### Command Line –

```
cfggen <controller #> disableir
```

#### Parameters –

- *<controller #>* – Number of the SAS controller targeted by this command.

#### Program Return Value –

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: bad command line arguments or operational failure.

### A.3.12 ENABLEIR Command (EFI Version Only)

The ENABLEIR command, which is currently supported only in the EFI version of CFGGEN, enables Integrated RAID functionality on an LSI1064/1064E or LSI1068/1068E controller. This is done by clearing the MPI\_IOUNITPAGE1\_DISABLE\_IR bit in the IO Unit 1 MPT Configuration Page.

If there are any existing IM, IME, or IS volumes when this command is run, the user is notified via an output message, no action is taken, and CFGGEN returns SUCCESS. If Integrated RAID is already enabled when this command is run, CFGGEN returns SUCCESS.

#### Command Line –

```
cfggen <controller #> enableir
```

#### **Parameters –**

- <controller #> – Number of the SAS controller targeted by this command.

#### **Program Return Value –**

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: bad command line arguments or operational failure.

### **A.3.13 LIST Command (EFI Version Only)**

The LIST command, which is currently supported only in the EFI version of CFGGEN, displays a list of all controllers present in the system, along with their corresponding controller #.

#### **Command Line –**

*cfggen list*

#### **Parameters –**

None

#### **Program Return Value –**

0x00 SUCCESS: command completed successfully.

0x01 FAILURE: bad command line arguments or operational failure.



# Customer Feedback

---

We would appreciate your feedback on this document. Please copy the following page, add your comments, and fax it to us at the number shown.

If appropriate, please also fax copies of any marked-up pages from this document.

Important: Please include your name, phone number, fax number, and company address so that we may contact you directly for clarification or additional information.

Thank you for your help in improving the quality of our documents.

---

## Reader's Comments

Fax your comments to: LSI Logic Corporation  
Technical Publications  
M/S AF-198  
Fax: 408.433.4333

Please tell us how you rate this document: *Integrated RAID for SAS User's Guide*. Place a check mark in the appropriate blank for each category.

	Excellent	Good	Average	Fair	Poor
Completeness of information	_____	_____	_____	_____	_____
Clarity of information	_____	_____	_____	_____	_____
Ease of finding information	_____	_____	_____	_____	_____
Technical content	_____	_____	_____	_____	_____
Usefulness of examples and illustrations	_____	_____	_____	_____	_____
Overall manual	_____	_____	_____	_____	_____

What could we do to improve this document?

---

---

---

---

If you found errors in this document, please specify the error and page number. If appropriate, please fax a marked-up copy of the page(s).

---

---

---

Please complete the information below so that we may contact you directly for clarification or additional information.

Name \_\_\_\_\_ Date \_\_\_\_\_

Telephone \_\_\_\_\_ Fax \_\_\_\_\_

Title \_\_\_\_\_

Department \_\_\_\_\_ Mail Stop \_\_\_\_\_

Company Name \_\_\_\_\_

Street \_\_\_\_\_

City, State, Zip \_\_\_\_\_