USER'S GUIDE

LSI53C040 Enclosure Services Processor SAF-TE Firmware

Version 2.1

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This document describes the LSI Logic LSI53C040 Enclosure Services Processor SAF-TE Firmware and will remain the official reference source for all revisions/releases of this product until rescinded by an update. This guide is intended for use with the SAF-TE Firmware C1 source code release and meets the criteria set within the LSI Logic Software Release Procedure.

To receive product literature, visit us at http://www.lsilogic.com.

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Preface

This book is the primary reference and user's guide for the SAF-TE firmware for the LSI53C040 Enclosure Services Processor.

Audience

This document assumes that you have some familiarity with current and proposed SCSI, SAF-TE, and enclosure design standards. For background information, please contact:

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Scope of this Manual

This user's guide discusses LSI Logic firmware for the SAF-TE protocol. User's guides for the SES/8067 and SES/SCSI protocol are available separately.

Organization

This user's guide is intended to assist enclosure system designers who wish to integrate the LSI53C040 device and the LSI Logic SAF-TE firmware into an enclosure design. It assumes a thorough understanding of the components and services that will be provided in the enclosure design, and familiarity with the SAF-TE standard. For more information on background material that may provide information on these subjects, please refer to the list of references in the Preface of this document.

This document has the following chapters:

- Chapter 1, **Introduction**, gives an introduction to the LSI53C040 device.
- Chapter 2, **SAF-TE Command Implementation**, gives information on the LSI Logic implementation of the SAF-TE command set.
- Chapter 3, **Configuration Data and the Configuration Utility**, describes the firmware configuration utility and the data structures that hold the specific information on the components and services in the enclosure.

Revision Record

Date	Version	Remarks
9/98	1.0	Final version.
4/99	2.0	Document converted to LSI format.
12/00	2.1	All product names changed from SYM to LSI.

Contents

Tables

Chapter 1
Introduction

This chapter describes the LSI53C040 SAF-TE Firmware User's Guide and includes these topics:

1.1 SAF-TE Firmware Overview

The LSI53C040 is an enclosure services processor with 28 programmable, multipurpose IO (MPIO) pins for enclosure monitoring and 24 programmable, multipurpose IO pins for visual LED indicators (MPLED). The LSI53C040 firmware includes configuration data tables that allow the user to map specific monitoring functions to each of these pins, so that the firmware can be adapted to any enclosure environment.

The LSI53C040 firmware uses the SCSI Accessed Fault-Tolerant Enclosures (SAF-TE) protocol to detect drive presence; condition a slot for drive insertion or removal; and monitor enclosure services such as the fan, power supply, door lock, alarm, and slot drive power. The firmware also includes a configuration program that maps specific enclosure monitoring functions to each MPLED/MPIO pin, to allow the user to customize the firmware to a specific enclosure environment.

1.2 General Description

The LSI53C040 SAF-TE firmware controls an 80C32 microcontroller core in the LSI53C040 device. This microcontroller is compatible with the Intel MCS 51 family. It runs independently in interrupt mode.

The LSI53C040 SAF-TE firmware contains three major architectural components, each implementing a separate IO interface to the chip. The SCSI block governs the SCSI interface and implementation of all the SCSI commands used to send data packets to the host. The Two-Wire Serial (TWS) interface block manages all transfers over the TWS buses in the LSI53C040, including the firmware downloading and monitoring of TWS peripherals connected to the bus. The multipurpose pin control block manages the user-selected features and functions enabled with the MPLED and MPIO pins.

1.3 Firmware Features

This section lists the firmware features:

- Compliant with SAF-TE Specification Revision 1.00 dated April 14, 1997
- Support for Read Buffer commands
  - Read Enclosure Configuration (00h)
  - Read Enclosure Status (01h)
  - Read Device Slot Status (03h)
  - Read Global Flags (05h)
- Support for Write Buffer commands
  - Write Device Slot Status (10h)
  - Perform Slot Operation (12h)
  - Send Global Flags (15h)
- Programmable Enclosure Configuration Monitoring
  - Up to 14 device slots
  - Up to 6 fans and 6 power supplies (each with single or dual input status)
  - Up to 15 binary temperature sensors (single input status)
  - Up to 4 integer temperature sensors (TWS)
  - Optional Ready Device for Use (slot power control) and Prepare Device for Insertion/Removal output signals
  - Programmable Vendor, Product, and Enclosure ID

  - Host Controllable Door Lock and Speaker Options
  - Selection of zero, one, or two LEDs per device slot
  - Global LEDs option for enclosure, drive, and array status
- TWS interface peripheral support
  - LM75 National Semiconductor 2-Wire Serial digital temperature sensor and thermal watchdog
  - DS1621 Dallas Semiconductor 2-Wire Serial digital thermometer and thermostat
  - LM78 fan, power supply, and temperature monitoring
- Select from one of 11 SCSI IDs (7–0, or three high SCSI IDs)
  - Capable of monitoring up to 11 SCSI data lines during SCSI ID selection

Chapter 2
SAF-TE Command Implementation

This chapter documents the SAF-TE commands supported by the LSI53C040, and the default firmware settings or user requirements for each command. The topics in this chapter are:

Please note that the LSI53C040 only supports LUN 0 at this time.

2.1 SCSI Commands

This section provides detailed information about various commands that can be used in conjunction with the LSI53C040 SAF-TE Processor.

- Table 2.1 provides information about the Inquiry command Response Data.
- Table 2.2 provides information about the Read Buffer command.
- Table 2.3 provides information about the Request Sense command.
- Table 2.4 and Table 2.5 provide information about the Write Buffer command.

2.1.1 Inquiry

The host uses the Inquiry command to request parameter information from the enclosure. Table 2.1 shows the response data format from the Inquiry command.

Table 2.1 Inquiry Command Response Data

Byte	Bit	Description	Returned Value/ Notes
Byte 0	7-5	Peripheral Qualifier	000b if LUN 0 (the only valid LUN) is selected 011b if LUN 0 is not selected
	4-0	Peripheral Device Type	03h (SCSI Processor Device) if LUN 0 (the only valid LUN) is selected 1Fh (No device type) if LUN 0 is not selected
Byte 1	7-0	00h	Returns 00h
Byte 2	7-3	0	0
	2-0	ANSI Approved Version	02h – Compliance with ANSI SCSI-2 specification
Byte 3	7-4	0	0
	3-0	Response Data Format	02h – Format defined in ANSI SCSI-2 specification
Byte 4	7-0	Additional Length	36h = 54 bytes
Byte 5	7-0	Reserved	Returns 00h
Byte 6	7-0	Reserved	Returns 00h
Byte 7	7-0	00h	Returns 00h
Bytes 8–15	7-0	Vendor Identification	8-byte ASCII string defined in the configuration program

Table 2.1 Inquiry Command Response Data (Cont.)

Byte	Bit	Description	Returned Value/ Notes
Bytes 16-31	7-0	Product Identification	16-byte ASCII string defined in the configuration program.
Bytes 32-35	7-0	Firmware Revision Level	Returns a four-byte ASCII string representing the current SAF-TE firmware revision level.
Bytes 36-42	7-0	Enclosure Unique Identifier	Returns a seven-byte ASCII ID number as defined in the configuration program
Byte 43	7-0	Channel Identifier	Returns a single ASCII character as defined in the configuration program
Bytes 44-49	7-0	SAF-TE Interface Identification String	ASCII string of SAF-TE
Bytes 50-53	7-0	SAF-TE Specification Revision Level	ASCII string of 1.00

2.1.2 Read Buffer

The Read Buffer command is used to receive data from the LSI53C040 SAF-TE Processor. The data returned is dependent upon the content of the SAF-TE operation code field. These commands are included:

- Read Enclosure Configuration (SAF-TE operation code 00h)
- Read Enclosure Status (01h)
- Read Device Slot Status (04h)
- Read Global Flags (05h)

The format of these commands is described in Table 2.2 below. The mode field is 01h to indicate that a SAF-TE command is being sent. The transfer length is dependent upon which SAF-TE data is being returned.

Table 2.2 Read Buffer Data Format

Bit # => / Byte #	7	6	5	4	3	2	1	0
0	SCSI Operation Code (3Ch)							
1	Logical Unit Number			Reserved		Mode (01h)		
2	SAF-TE Operation Code							
3	00h							
4	00h							
5	00h							
6	00h							
7	Transfer Length MSB							
8	Transfer Length LSB							
9	00h							

2.1.3 Request Sense

Table 2.3 gives the sense key information supported by the LSI53C040 SAF-TE firmware.

Table 2.3 Sense Key Information

Sense Key	ASC	ASCQ	Error Condition
00h			No Sense, No Error Condition
05h			Illegal Request
	20h	00h	Invalid Command Operation Code
	24h	00h	Invalid Field in CDB
	25h	00h	Logical Unit not Supported
	26h	02h	Invalid SEP Command in Write Buffer Data Packet
06h			Unit Attention
	29h	00h	Power-On, Reset, or Bus Device Reset Occurred
	3Fh	01h	Microcode Changed
09h			Vendor-Specific
	80h	FFh	Code Load Busy
	80h	00h	Code Load Idle
	80h	01h	Code Load Busy Writing
	80h	02h	Code Load Success
	80h	03h	Code Load Failure Bad Address
	80h	04h	Code Load Failure Bad Checksum
	80h	05h	Code Load NVM Write Failure

2.1.4 Send Diagnostic

This command is treated as a no operation and returns the status of GOOD.

2.1.5 Test Unit Ready

This command is implemented according to the SAF-TE specification.

2.1.6 Write Buffer

The Write Buffer command is used to send SAF-TE commands to the LSI53C040 SAF-TE Processor. These commands are included:

- Write Device Slot Status (10h)
- Perform Slot Operation (12h)
- Send Global Flags (15h)

The format of these commands is described in Table 2.4 below. The mode field is 01h to indicate that a SAF-TE command is being sent. The transfer length is dependent upon which SAF-TE command is being sent.

Table 2.4 Write Buffer Data Format

Bit # => / Byte #	7	6	5	4	3	2	1	0
0	SCSI Operation Code (3Bh)							
1	Logical Unit Number			Reserved		Mode (01h)		
2	00h							
3	00h							
4	00h							
5	00h							
6	00h							
7	Transfer Length MSB							
8	Transfer Length LSB							
9	00h							

The Write Buffer command is also used to update the SAF-TE firmware (stored in TWS Flash ROM). When used to upload firmware, the Write Buffer command format appears as follows:

Table 2.5 Write Buffer Data Format (Updating SAF-TE Firmware)

Bit # => / Byte #	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Logical Unit Number			Reserved		Mode (04h)		
2	00h							
3	Flag Byte							
4	Buffer Offset MSB							
5	Buffer Offset LSB							
6	00h							
7	Transfer Length MSB							
8	Transfer Length LSB							
9	00h							

The Mode field is 04h to indicate that SAF-TE firmware is being sent.

The Flag Byte can be one of the following values:

- 00h - upload firmware
- FDh - reset the LSI53C040 to run the new firmware
- FEh - upload firmware complete; update Flash ROM tables to use the new firmware
- FFh - request status of firmware upload; returned via next SCSI Request Sense command

The transfer length and buffer offset fields are used only when the Flag Byte is zero. When the Flag Byte is nonzero, the transfer length and

buffer offset fields must contain zeros. The transfer length is a number between 02h and 4001h, indicating how much data (including a 1-byte checksum) is being transferred. The buffer offset is a number between 00h and 3FFFh, indicating which locations in the Flash ROM are to be updated.

2.2 SAF-TE Read Buffer Commands

This section provides detailed information about the Read Enclosure Configuration, Read Enclosure Status, Read Device Slot Status, and Read Global Flags commands.

2.2.1 Read Enclosure Configuration (00h)

The application agent sends this command to the LSI53C040 to inquire about the number and type of system components in the enclosure. The LSI53C040 determines and returns this information based on the enclosure settings the user defines in the configuration program. At present, no vendor specific bytes are returned. Table 2.6 shows the return values:

Table 2.6 Read Enclosure Configuration Return Values

Byte	Bits	Field Description	Notes
0	7-0	Number of Fans (f)	Defined in Configuration Utility
1	7-0	Number of Power Supplies (p)	Defined in Configuration Utility
2	7-0	Number of Device Slots (d)	Defined in Configuration Utility
3	7-0	Door Lock Installed	Defined in Configuration Utility
4	7-0	Number of Temperature Sensors (t)	Defined in Configuration Utility
5	7-0	Audible Alarm	Defined in Configuration Utility

Table 2.6 Read Enclosure Configuration Return Values (Cont.)

6	7	Celsius/Fahrenheit	Defined in Configuration Utility
	6-4	Reserved	
	3-0	Number of Thermostats	Defined in Configuration Utility
7 through 62	7-0	Reserved	Returns 00h
63	7-0	Number of Vendor Specific Bytes (v)	Returns 00h
64 through xx	7-0	Vendor Specific	Not supported

2.2.1.1 Fans (f)

This field contains the binary representation of the number of fans in the enclosure. This information reserves the appropriate number of bytes in the Read Enclosure Status field. The user defines this number in the configuration program.

2.2.1.2 Power Supplies (p)

This field contains the binary representation of the number of power supplies in the enclosure. This information reserves the appropriate number of bytes in the Read Enclosure Status field. The user defines this number in the configuration program.

2.2.1.3 Device Slots (d)

This field contains the binary representation of the number of available device slots in the enclosure. This information reserves the appropriate number of bytes in the Read Enclosure Status field. The user defines this number in the configuration program.

2.2.1.4 Door Lock

This field indicates whether the enclosure has a door lock. If there is no door lock, this field is 0. If a door lock is present, this field is 1. The user defines this field in the configuration program.

2.2.1.5 Number of Temperature Sensors (t)

This field contains the binary representation of the number of integer temperature sensors. This information reserves the appropriate number

of bytes in the Read Enclosure Status field. This type of sensor will be connected to one of the TWS buses to transfer this integer value to the LSI53C040. The DS1621 is one example. If the user does not select the DS1621, the LM75, or the LM78 in the TWS device port mapping section of the firmware configuration program, then it is assumed that no integer temperature sensors are attached.

2.2.1.6 Audible Alarm

This field indicates whether the enclosure has a speaker. If there is no speaker, this field is 0. If a speaker is present, this field is 1. The user defines this field in the configuration program.

2.2.1.7 Celsius/Fahrenheit

This field indicates whether the integer temperatures (if there are any) are reported in degrees Fahrenheit or Celsius. The user makes this selection in the configuration program. A value of 1 indicates Celsius, and a value of 0 indicates Fahrenheit.

2.2.1.8 Number of Thermostats

This field indicates the number of binary temperature monitors. The user defines this field in the configuration program.

2.2.2 Read Enclosure Status (01h)

The LSI53C040 processor returns the operational status of the these components in the enclosure:

- Fans
- Power supplies
- Slot SCSI IDs
- Door locks
- Speakers
- Integer temperatures
- Binary temperatures

Table 2.7 shows the read enclosure status return values.

Spaces after "f" and "-".

Table 2.7 Read Enclosure Status Return Values

Byte	Field Description	Notes
0	Fan 0 Status	Returns either: 00h Fan is operational 01h Fan is malfunctioning 02h Fan is not installed 80h unknown status, or status not reportable
f-1	Fan f-1 Status	Same as above
f	Power Supply 0 Status	Returns either: 00h Power Supply is operational and on 01h Power Supply is operational and off 10h Power Supply is malfunctioning and commanded on 11h Power Supply is malfunctioning and commanded off 20h Power Supply is not present 21h Power Supply is present 80h unknown status, or status not reportable
f + p - 1	Power Supply p-1 Status	Same as above
f + p	Device Slot 0 SCSI ID	Returns binary encoded value of the SCSI ID
f + p + d - 1	Device Slot d-1 SCSI ID	Same as above
f + p + d	Door Lock Status	Returns either: 00h Door is currently locked 01h Door is currently unlocked, or door lock not installed 80h Unknown status, or status not reportable
f + p + d + 1	Speaker Status	Returns either: 00h Speaker is currently off or no speaker installed 01h Speaker is currently on
f + p + d + 2	Temperature 0	Returns the integer value (0-255) of the DS1621 or LM75 temp sensor. Additionally, if no sensor is installed, no bytes are dedicated.
f + p + d + t + 1	Temperature t-1	Same as above.
f + p + d + t + 2	Temperature Out of Range Flags 1	Sets the ETA (bit 7) if temperature alert or 0 if no alert. See Section 2.2.2.7, “Temperature Out Of Range,” page 2-15.

Table 2.7 Read Enclosure Status Return Values (Cont.)

f + p + d + t + 3	Temperature Out of Range Flags 2	See Section 2.2.2.7, "Temperature Out Of Range," page 2-15.
f + p + d + t + 4	Number of Vendor Specific Bytes	00h
f + p + d + t + 5	Vendor Specific	Not supported

2.2.2.1 Fan Status

For each fan in the enclosure, the configuration program defines whether the fan status is determined by either one or two input MPIO pins, or by an LM78. The Read Enclosure Configuration (00h) command indicates whether fans are attached. If no fans are attached, this field is truncated from the Read Enclosure Status return values shown in Table 2.7. Based upon the input status, the LSI53C040 will return values. Table 2.8 shows these values:

Table 2.8 Fan Status Return Values

Value	Status
00h	Fan is operational
01h	Fan is malfunctioning
02h	Fan is not installed
80h	Unknown status, or status not reportable

The configuration program maps what response above should be returned for a single-bit input pattern of 0 or 1 and for a dual-input bit pattern of 00, 01, 10, or 11, or by the value read from the LM78.

2.2.2.2 Power Supply Status

For each power supply in the enclosure, the configuration program has defined whether the power supply status is determined by either one or two input MPIO pins, or by an LM78. The Read Enclosure Configuration (00h) command indicates whether power supplies are present. If no power supplies are present, this field is truncated from the Read

Enclosure Status return values shown in Table 2.7. Based upon the status, the LSI53C040 will return values. Table 2.9 shows these values:

Table 2.9 Power Supply Status Return Values

Value	Status
00h	Power Supply is operational and on
01h	Power Supply is operational and off
10h	Power Supply is malfunctioning and commanded on
11h	Power Supply is malfunctioning and commanded off
20h	Power Supply is not present
21h	Power Supply is present
80h	Unknown status, or status not reportable

The configuration program maps what response above will be returned for a single-input bit pattern of 0 or 1 and for a dual-bit input pattern of 00, 01, 10, or 11, or by the value read from the LM78.

2.2.2.3 Device Slot SCSI ID

A SCSI ID (integer ID) is reported for each device slot in the enclosure. The configuration program maps what SCSI ID is assigned to each device slot. The SCSI ID is reported even if the drive is not present in a slot.

2.2.2.4 Door Lock Status

The state of one MPIO pin determines the door lock status. If the user has defined a host-controllable or a monitorable door lock in the configuration program, the LSI53C040 will return values. Table 2.10 shows these values:

Table 2.10 Door Lock Status Return Values

Value	Status
00h	Door is currently locked
01h	Door is currently unlocked or no door lock installed
80h	Unknown status, or status not reportable

The configuration program maps what response above should be returned for single-input bit pattern of 0 or 1. If no door lock is defined, the LSI53C040 will return 01h.

2.2.2.5 Speaker Status

The state of one MPIO pin determines the speaker status. If the user has defined the speaker status in the configuration program, the LSI53C040 will return values. Table 2.11 shows these values:

Table 2.11 Speaker Status Return Values

Value	Status
00h	Speaker is currently off (or no speaker installed)
01h	Speaker is currently on

The configuration program maps what response above will be returned for a single-bit input pattern of 0 or 1. If speaker is not defined, the LSI53C040 will return 00h.

2.2.2.6 Temperature

The integer (0 to 255) value of a temperature sensor(s) in degrees Fahrenheit or Celsius determines the temperature status. It is assumed that this type of sensor will be connected to one of the TWS buses as

the means for transferring this integer value to the LSI53C040. The DS1621 is one example. The Read Enclosure Configuration (00h) command indicates whether a temperature sensor is attached. If no temperature sensors are attached, this field is truncated from the Read Enclosure Status return values shown in Table 2.7. The default state for this is field is 0. This field returns 255 if an error has occurred.

2.2.2.7 Temperature Out Of Range

This status returns whether an abnormal temperature has been detected on any thermostat hardware that only returns a binary value. Since up to 15 thermostat temperature sensors can be attached to the enclosure, up to 15 MPIO pins would be required.

A value of 1 on any of the dedicated MPIO pins indicates an abnormal temperature, and the corresponding flag will be set. When a value of 1 occurs on any of the dedicated MPIO pins, the ETA bit will be set (bit 7) in the Temperature Out of Range Flags 1 byte.

2.2.3 Read Device Slot Status (04h)

This command returns information on the current state of each device/slot. The field that follows the device status bytes is a one-byte field and indicates the number of Vendor Specific bytes to follow. This field will always be zero. Four bytes are associated with each device slot. Table 2.12 summarizes each of those bytes.

Table 2.12 Read Device Slot Status Command Return Values

Byte	Bit	Description	Notes
Byte 0	0	No Error Flag	Returns value as set by Write Device Slot Status command
	1	Device Faulty Flag	Returns value as set by Write Device Slot Status command
	2	Device Rebuilding Flag	Returns value as set by Write Device Slot Status command
	3	In Failed Array Flag	Returns value as set by Write Device Slot Status command
	4	In Critical Array Flag	Returns value as set by Write Device Slot Status command
	5	Parity Check Flag	Returns value as set by Write Device Slot Status command
	6	Predicted Fault Flag	Returns value as set by Write Device Slot Status command
	7	No Drive Flag	Returns value as set by Write Device Slot Status command
Byte 1	0	Hot Spare Flag	Returns value as set by Write Device Slot Status command
	1	Rebuild Stopped Flag	Returns value as set by Write Device Slot Status command
	2-7	Reserved	Returns 00h
Byte 2	0-7	Reserved	Returns 00h
Byte 3	0	(Slot) Device Inserted Flag	Returns either: 0 – no device inserted in slot 1 – device inserted in slot
	1	(Slot) Prepared for Insertion/Removal Flag	Returns either: 0 – device power is on (slot not ready for insertion/removal) 1 – device power is off (slot ready for insertion/removal)
	2	(Slot) Prepared for Operation Flag	Returns either: 0 – device power is off (slot not prepared for operation) 1 – device power is on (slot prepared for operation)
	3-7	Reserved	Returns 00h

Table 2.13 lists the default slot status value that are set at power-on or reset.

Table 2.13 Power-On/Reset Default Slot Status

Value	Status
Byte 0	01h
Byte 1	00h
Byte 2	00h
Byte 3	02h

2.2.3.1 Device Inserted Bit

If the Device Present option was selected in the configuration program, this field returns current state of whether or not a drive is installed in the device slot.

2.2.3.2 Prepared for Insertion/Removal

Setting this bit indicates the slot is ready for drive insertion or removal. It is the complement of the Prepared for Operation bit. See Section 2.3.2, "Perform Slot Operation (12h)," for when this bit is set.

2.2.3.3 Prepared for Operation

This bit indicates that a drive has been inserted in a slot and is ready for operation. It is the complement of the Ready for Insertion/Removal bit. See Section 2.3.2, "Perform Slot Operation (12h)," for when this bit is set.

2.2.4 Read Global Flags (05h)

The Read Global Flags command is used to read from the LSI53C040 the most recent state of the global flags received in the Send Global Flags command (refer to Table 2.18). Sending this command will not modify the state of any global flag. Table 2.14 lists the return values for the Read Global Flags command.

Table 2.14 Read Global Flag Bytes

Byte	Bit	Global Bit Descriptions	LSI53C040 Action
Byte 0 (Global Flag 1)	0	Audible Alarm Control	Drives/Monitors an MPIO pin connected to an alarm signal (1 for on, 0 for off)
	1	Global Failure Indication	Drives LED
	2	Global Warning Indication	Drives LED
	3	Enclosure Power	Not Implemented
	4	Cooling Failure	Not Implemented
	5	Power Failure	Not Implemented
	6	Drive Failure	Drives LED
	7	Drive Warning	Drives LED
Byte 1 (Global Flag 2)	0	Array Failure	Drives LED
	1	Array Warning	Drives LED
	2	Enclosure Lock	Drives/Monitors an MPIO pin connected to a door lock
	3	Identify Enclosure	Drives LED
	4-7	Reserved	
Byte 2 (Global Flag 3)	0-7	Reserved	
Bytes 3–15		Reserved	

2.3 SAF-TE Write Buffer Commands

This section provides detailed information about the Write Device Slot Status, Perform Slot Operation, and Send Global Flags commands.

2.3.1 Write Device Slot Status (10h)

This command informs the LSI53C040 of the state of each slot and activates device status LEDs. In general, the Write Device Slot Status is set by the RAID controller or host since it knows the status of the devices

in each slot. Three bytes are associated with each device slot. Bytes 1, 2, and 3 contain the desired state for the device in slot 0; Bytes 4, 5, and 6 contain the desired state for the device in slot 1, etc. Table 2.15 summarizes these bytes and the associated actions of the LSI53C040.

Table 2.15 Write Device Slot Status Flag Bytes

Byte	Bit	State	Bit Descriptions	LSI53C040 Action
Byte 0			Operation Code (10h)	
Byte n + 0	0	00	No Error Flag	Drives fault light LED(s) according to blink pattern
	1	03	Device Faulty Flag	Drives fault light LED(s) according to blink pattern
	2	04	Device Rebuilding Flag	Drives fault light LED(s) according to blink pattern
	3	05	In Failed Array Flag	Drives fault light LED(s) according to blink pattern
	4	06	In Critical Array Flag	Drives fault light LED(s) according to blink pattern
	5	07	Parity Check Flag	Drives fault light LED(s) according to blink pattern
	6	08	Predicted Fault Flag	Drives fault light LED(s) according to blink pattern
	7	09	No Drive Flag	Drives fault light LED(s) according to blink pattern
Byte n + 1	0	10	Hot Spare Flag	Drives fault light LED(s) according to blink pattern
	1	11	Rebuild Stopped Flag	Drives fault light LED(s) according to blink pattern
	2-7		Reserved	
Byte n + 2	0-7		Reserved	

Note: Byte numbers for the Write Device Slot Status Flags are determined by using “n” = device slot number. Therefore, the above information repeats for each device slot specified.

The LSI53C040 will drive zero, one, or two LEDs for each device slot, depending on the option chosen in the configuration program. Table 2.16 shows the current default settings for each bit description in the Write Device Slot Status command for both the one-LED and two-LED options:

Table 2.16 Default LED Settings for Write Device Slot Status Flags

State	Bit Description	One-LED Option	Two-LED Option	
			LED 1	LED 2
0	Default/ Nothing to Report	Off	Off	Off
1	Prepare for insertion/removal	Off	On	On
2	Prepare for operation	On	Off	Slow
3	Device Faulty	Slow	On	Off
4	Device Rebuilding	Slow	Off	Fast
5	In Failed Array	Slow	Fast	On
6	In Critical Array	Slow	Slow	Off
7	Parity Check operation	Slow	On	Off
8	Predicted Fault Failure	Slow	Fast	Off
9	No drive inserted	Off	On	Fast
10	Hot Spare	Off	Fast	Fast
11	Rebuild Stopped	Slow	Off	On
12	Identify Slot	Fast	Slow	Fast

The bit descriptions are shown in increasing priority order. If more than one bit is set by the Write Device Slot Status command, the bit with the highest priority dictates the LED blink pattern.

2.3.2 Perform Slot Operation (12h)

This command performs specific operation on an intended device slot. In compliance with the SAF-TE specification, only one of these bits should be set at a time (Table 2.17).

Table 2.17 Perform Slot Operation Flags

Byte	Bit	Bit Descriptions	Action
0		Operation Code (12h)	
1		Slot Number	
2	0	Prepare for Operation Flag	Controls power to a device slot 0 – Turn slot power off 1 – Turn slot power on
	1	Prepare for Insertion/Removal Flag	Controls power to a device slot 0 – Turn slot power on 1 – Turn slot power off
	2	Identify Flag	Drives LED(s) according to blink pattern
	3-7	Reserved	
3–63		Reserved	

2.3.2.1 Prepare for Operation

This bit is set by the host to indicate that a drive has been inserted in a slot and is made ready for operation (that is, powered on). If the Ready Device for Use option is selected in the configuration program, the assigned MPIO pin is asserted to turn slot power on.

These conditions apply if the Device Present option is chosen in the configuration program:

- If a device is present in the slot, and this bit is set, power is turned on (via MPIO pin). The Prepared for Operation bit is set and the Ready for Insertion/Removal bit is cleared in the Read Device Slot Status command.
- If a device is not present in the slot, and this bit is set, power is not turned on. The Ready for Insertion/Removal bit is set and the Prepared for Operation bit is cleared in the Read Device Slot Status command.

These conditions apply if the Device Present option is not chosen in the configuration program:

Power is applied to the slot, the Prepared for Operation bit is set, and the Ready for Insertion/Removal bit is cleared in the Read Device Slot Status command.

2.3.2.2 Prepare for Insertion/Removal

This bit is set by the host to indicate that the slot is made ready for drive insertion or removal (that is, powered off). If the Prepare Device for Insertion/Removal option is selected in the configuration program, the assigned MPIO pin is asserted to turn slot power off.

These conditions apply if the Device Present option is chosen in the configuration program:

- If a device is present in the slot, and this bit is set, power is turned off (via MPIO pin). The Prepared for Operation bit is cleared and the Ready for Insertion/Removal bit is set in the Read Device Slot Status command.
- If a device is not present in the slot, and this bit is set, power remains off. The Ready for Insertion/Removal bit is set and the Prepared for Operation bit is cleared in the Read Device Slot Status command.

These conditions apply if the Device Present option is *not* chosen in the configuration program:

Power is turned off, the Prepared for Operation bit is cleared, and the Ready for Insertion/Removal bit is set in the Read Device Slot Status command.

2.3.2.3 Identify

This bit drives an external LED(s) according to the blink pattern for the specific device slot. If one LED is chosen, the Identify Slot bit is set to the fast blink rate. If two LEDs are chosen, the LED1 bit is set to the slow blink rate and the LED2 bit is set to the fast blink rate.

2.3.3 Send Global Flags Command (15h)

This command is used to send commands that apply to the enclosure. The Read Global Flags command (Table 2.14) reads the current state of the global flags sent with this command:

Table 2.18 Send Global Flag Bytes

Byte	Bit	Global Bit Descriptions	LSI53C040 Action
Byte 0		Operation Code (15h)	
Byte 1 (Global Flag 1)	0	Audible Alarm Control	Drives/Monitors an MPIO pin connected to an alarm signal (1 for on, 0 for off)
	1	Global Failure Indication	Drives LED
	2	Global Warning Indication	Drives LED
	3	Enclosure Power	Not Implemented
	4	Cooling Failure	Not Implemented
	5	Power Failure	Not Implemented
	6	Drive Failure	Drives LED
	7	Drive Warning	Drives LED
Byte 2 (Global Flag 2)	0	Array Failure	Drives LED
	1	Array Warning	Drives LED
	2	Enclosure Lock	Drives/Monitors an MPIO pin connected to a door lock
	3	Identify Enclosure	Drives LED
	4-7	Reserved	
Byte 3 (Global Flag 3)	0-7	Reserved	

2.3.3.1 Audible Alarm Control

This bit is set to sound an alarm. If a controllable alarm is selected in the configuration program, setting this bit sounds the alarm. The alarm is turned off by clearing this bit.

2.3.3.2 Global Failure and Warning Indication

These bits are set to indicate a global failure or warning condition. If the Global Enclosure Status LED option is selected in the configuration program, setting of either the Global Failure or Warning Indication bits drives the assigned LED as shown in Table 2.19:

Table 2.19 Global Failure/Global Warning LED Options

Global Failure	Global Warning	LED
0	0	Off
0	1	Slow
1	0	Fast
1	1	On

2.3.3.3 Drive Failure and Warning

These bits are set to indicate a drive failure or warning condition. If the Global Drive Status LED option is selected in the configuration program, setting of either the Drive Failure or Warning Indication bits drives the assigned LED as shown in Table 2.20:

Table 2.20 Drive Failure/Drive Warning LED Options

Drive Failure	Drive Warning	LED
0	0	Off
0	1	Slow
1	0	Fast
1	1	On

2.3.3.4 Array Failure and Warning

These bits are set to indicate an array failure or warning condition. If the Global Array Status LED option is selected in the configuration program, setting of either the Drive Failure or Warning Indication bits drives the assigned LED as shown in Table 2.21:

Table 2.21 Array Failure/Array Warning LED Options

Array Failure	Array Warning	LED
0	0	Off
0	1	Slow
1	0	Fast
1	1	On

2.3.3.5 Enclosure Lock

This bit is set to lock the enclosure. If a lock is selected in the configuration program, setting this bit locks the enclosure. The enclosure is unlocked by clearing this bit.

2.3.3.6 Identify Enclosure

This bit is set to drive any global enclosure identify signal.

2.4 Unsupported SAF-TE Commands

The unsupported SAF-TE commands are:

- Read Usage Statistics (02h)
- Read Device Insertions (03h)
- Set SCSI ID (11h)
- Set Fan Speed (13h)
- Activate Power Supply (14h)

Chapter 3
Configuration Data and the Configuration Utility

This chapter describes the Configuration Utility and includes these topics:

3.1 Using the Configuration Utility

The LSI53C040 SAF-TE firmware includes a configuration utility (`config.exe`) that maps specific enclosure monitoring functions to the MPIO and MPLED pins and sets up operating parameters for the specific enclosure environment. Also included with the firmware, are the `bootload.hex` file and the `safte.hex` file. The configuration utility is a DOS-based program that asks the designer a series of questions about the enclosure design. The program uses this information to create an Intel-compatible hex file called `config.hex`. The user concatenates the `config.hex` file with the Intel-compatible SAF-TE firmware file (`safte.hex`) into a file called *`safcon`*`.hex`. This creates the image to be placed in the TWS flash memory device for downloading to the LSI53C040.

Table 3.1 shows the files associated with the configuration utility:

Table 3.1 Configuration Utility Files

File Name	Description
config.exe	The main configuration program (the first element of the firmware) provided by LSI Logic. It displays the questions one at a time, beginning with general questions and progressing to more detailed questions about desired MPIO/MPLED pin assignments for the enclosure environment.
bootload.hex	The second element of the firmware provided by LSI Logic. This file contains the bootloader, which is used only if the designer selects the download option addressed in the first question of the configuration utility.
loader.hex	The hex output of config.exe. The designer concatenates this file with the bootload.hex firmware binary file into a file called *boot*.hex (or whatever the designer wishes to call this file), which is the image that is placed on the TWS memory device and downloaded to the LSI53C040. Refer to Section 3.3, "After Running the Configuration Utility," page 3-21 about using DOS commands to concatenate files.
safte.hex	The third element of the firmware provided by LSI Logic. This file is an Intel hex file which contains the SAF-TE firmware.
config.hex	The hex output of config.exe. The designer concatenates this file with the safte.hex firmware binary file into a file called *safcon*.hex, (or whatever the designer wishes to call this file), which is the image that is placed on the TWS memory device and downloaded to the LSI53C040. Refer to Section 3.3, "After Running the Configuration Utility," page 3-21 about using DOS commands to concatenate files.
myinput.txt	The designer can create this file with a text editor using the answers from the questions asked in the configuration program. After this file is first created, the designer can change some of the values submitted to the configuration program, by editing this file and running it, instead of manually stepping through all of the questions in config.exe. Just run config.exe again, redirecting the input to the configuration utility to a file called *myinput*.txt, and redirecting the output of the configuration utility to a file called *myinput*.log using the DOS command: config<*myinput*.txt>*myinput*.log.
myinput.log	When the file *myinput*.txt is used in the DOS command: config<*myinput*.txt>*myinput*.log, the resulting file (*myinput*.log) contains a summary of all the questions answered, as well as a summary of any errors in the input file. When the program runs to completion, the *myinput*.log file also contains a summary of the data structure sizes and the Enclosure ID field.

To start the configuration program, type `config` at the DOS prompt in the directory where the `config.exe` program resides. Before you start the program the first time, be aware of the following items:

- The configuration program cannot be stopped and restarted once you begin. If you exit the program, you will have to start over from the beginning.
- The program does not allow you to scroll back and view previous answers after they scroll off of the screen.
- The program requires at least 10 minutes for a novice user to enter data, depending on how many devices and options your enclosure supports.
- Some of the questions require Yes/No responses, others have field size limits, or other limits or expectations for the type of response you give. The program does not allow you to assign an MPIO or an MPLED pin to more than one function. If you make one of these errors, the program re-prompts you for a different response. In some cases additional information displays, such as the required format for pin assignments, either after an incorrect answer or after you press ENTER. The program aborts after about 20 incorrect responses to a specific question.

To run the configuration program as quickly as possible, have the following information ready when you start:

- SCSI ID for the LSI53C040 and each device slot in your system.
- Desired SCSI Bus High bits assignments for SCSI High ID 2, SCSI High ID 1, and SCSI High ID 0.
- Vendor ID, Product ID, Enclosure ID, and Channel Identifier.
- A list of MPIO and MPLED pins mapped to desired features and devices in the enclosure.
- A list of TWS devices and their respective bus numbers and addresses.
- Power-on configuration options (see page 3-17).

The *LSI53C040 Enclosure Services Processor Technical Manual* describes many of the MPIO and MPLED pins and other device features in detail, and may be a useful reference as you run the configuration program.

3.1.1 *Myinput*.txt File

The designer can create the *myinput*.txt file using a simple text editor while answering the questions in the config.exe program. This file then contains a plain text summary of the responses entered for the most recent running of the config.exe program. The *myinput*.txt file can then be edited to change individual answers without the user having to step manually through config.exe all over again.

Since the *myinput*.txt file is a plain text file, any information can be commented as long as the line length is not exceeded. This file does not support line wrapping or carriage returns. If you enter new data, make sure it is in a format identical to that requested by the configuration program. The program looks for the proper number of fields (1, 2, or 3, with fields separated by a space) to answer each question; thus, any further information is considered to be comments.

For your convenience, an example of this text file follows. It does not include all the answers to the questions contained within the Configuration Utility. The ellipsis indicate more entries would be added based on your system's configuration requirements.

```
---begin---
n          code load
n          parity checking
eight---
sixteen.........
seven__
+
10        SCSI id2
9         SCSI id1
8         SCSI id0
1         SCSI id
0         fast blink value
3         slow blink value
n         controllable speaker?
y         monitorable speaker?
y         controllable door lock?

...
1024      length of download
---end---
```

3.2 Questions in the Configuration Utility

Table 3.2 through Table 3.4 explain some of the questions in the configuration utility. You may see slightly different questions, or you may not see all of these, depending on the type of system environment you specify in the general questions section. Italicized text provides additional information regarding the various questions asked and does not appear in the configuration utility program.

Table 3.2 General Questions

Question	Explanation/Required Input
Welcome to the 53C040 SafTe configuration program!	
First, some general questions:	
The `config.exe` program opens with the following two questions.	
Do you want to support microcode updates over the SCSI bus?	Enter `y` or `n`.
Do you want to support parity changes on the SCSI bus?	Enter `y` or `n`.
The following information uniquely identifies a specific enclosure. This information is reflected in the response data from an INQUIRY command.	
Enter text for Vendor ID to be returned in the SCSI INQUIRY command (8 characters).	Enter an 8-character ASCII string to identify the product vendor.
Enter text for Product ID to be returned in the SCSI INQUIRY command (16 characters).	Enter a 16-character ASCII string to specify the product ID.
Enter text for Enclosure ID to be returned in the SCSI INQUIRY command (7 characters).	Enter a 7-character ASCII string to specify a specific enclosure.
Enter text for Channel ID to be returned in the SCSI INQUIRY command (1 character).	Enter a 1-character ASCII character to specify the Channel ID.
The LSI53C040 has three LVD SCSI High ID pins (SHID[2:0] ±). These pins may be connected to any of the SCSI data signals from data bit 8 through 15. This enables the LSI53C040 SCSI core to respond to selection as a device with an ID greater than 7. The following questions assign specific SCSI data signals to each of the SHID pins.	
Which bit of the high byte of the SCSI data bus will the LSI53C040 see as bit SCSI High ID 2?	Enter a number between 8 and 15.

Table 3.2 General Questions (Cont.)

Question	Explanation/Required Input
Which bit of the high byte of the SCSI data bus will the LSI53C040 see as bit SCSI High ID 1?	Enter a number between 8 and 15.
Which bit of the high byte of the SCSI data bus will the LSI53C040 see as bit SCSI High ID 0?	Enter a number between 8 and 15. If you accidentally enter the same ID value more than once, the program will return to the beginning of these questions, so you have the opportunity to start over rather than being forced to select only from the remaining choices.
What SCSI ID do you want for the SAF-TE processor?	Enter a number between 0 and 15. Based upon your SCSI Data signal assignments above, you can assign a SCSI ID between 0 and 15 to the LSI53C040. **Note:** If the ID selected here is not possible based on your answers to the previous three questions, the program starts over at the beginning of the previous three questions.

Table 3.2 General Questions (Cont.)

Question	Explanation/Required Input
Four possible slow blink rates and four possible fast blink rates are available in the LSI53C040. The following questions assign specific rates for slow and fast blink rates. LEDs indicate various conditions such as identify slot or device faulty. See the LED blink pattern section for default blink settings.	
Prepare to enter fast and slow blink rates: Blink rates are proportional to input clock frequency. Fast and slow blink rates can be set from 0 to 3. A blink rate of 2 is twice as fast as a blink rate of 3. A blink rate of 1 is twice as fast as a blink rate of 2. The fast blink rates are 4 times as fast as the slow blink rates. Fast blink rates of 2 and 3 are the same as slow blink rates of 0 and 1. Which of the 4 possible blink rates would you like for the fast blink rate (0 is the fastest, 3 is the slowest)?	The blink rates are proportional to the input clock frequency. See the "System Registers," chapter in the *LSI53C040 Enclosure Services Processor Technical Manual* for example blink rates based on a 20 MHz or a 40 MHz clock. **Comparative Blink Rates** *Fast Blink Designator* / *Slow Blink Designator* / *Blink Rate* 0 / - / 32 x BR 1 / - / 16 x BR 2 / 0 / 8 x BR 3 / 1 / 4 x BR - / 2 / 2 x BR - / 3 / BR
Which of the 4 possible blink rates would you like for the slow blink rate (0 is the fastest, 3 is the slowest)?	
The following information determines how many MPIO/MPLED pins to allocate for the number of speakers, door locks, fans, power supplies, device slots, and temperature devices in a specific enclosure, as well as Global Flags.	
Is there a controllable speaker?	Enter y or n.
Is there a monitorable speaker?	This question appears only if you replied no to the question about a controllable speaker. Enter y or n.
Is there a controllable door lock?	Enter y or n.
Is there a monitorable door lock?	This question appears only if you replied no to the question about a controllable door lock. Enter y or n.
Is there a Global Identify Enclosure LED?	Enter y or n. If yes, this will drive an LED to the identify enclosure signal. (Send Global Flags command).

Table 3.2 General Questions (Cont.)

Question	Explanation/Required Input
Is there a Global Enclosure Status LED?	Enter y or n. If yes, this will drive an LED to indicate an error condition of global failure or global warning (Send Global Flags command).
Is there a Global Drive Status LED?	Enter y or n. If yes, this will drive an LED to indicate a drive error condition of drive failure or drive warning (Send Global Flags command).
Is there a Global Array Status LED?	Enter y or n. If yes, this will drive an LED to indicate an array error condition of array failure or array warning (Send Global Flags command).

Table 3.3 Enclosure Components Questions

Question	Explanation
These questions relate to HOW MANY various elements are in the enclosure.	
How many fans supplying a single wire input do you want to support?	Enter the number of fans in the enclosure that have one MPIO pin assigned for status. This allows up to two states to be determined for fan status. Up to six fans can be specified.
How many fans supplying a dual wire input do you want to support?	Enter the number of fans in the enclosure that have two MPIO pins assigned for status. This allows up to four states to be determined for fan status. Up to six fans can be specified.
How many power supplies supplying a single wire input do you want to support?	Enter the number of power supplies in the enclosure that have one MPIO pin assigned for status. This allows up to two states to be determined for power supply status. Up to six power supplies can be specified.
How many power supplies supplying a dual wire input do you want to support?	Enter the number of power supplies in the enclosure that have two MPIO pins assigned for status. This allows up to four states to be determined for power supply status. Up to 6 power supplies can be specified.
How many device slots do you want to support?	Enter the number of drive slots that the enclosure can support. Up to three MPIO pins and as many as two LEDs will be assigned for each drive slot. Up to 14 slots can be specified.

Table 3.3 Enclosure Components Questions (Cont.)

Question	Explanation
How many temperature inputs supplying a single wire input do you want to support?	Enter the number of temperature sensors that return a binary signal (under/over preset threshold) in the enclosure. One MPIO pin is assigned for each of these temperature sensors. Up to 15 temperature inputs can be specified.
How many temperature inputs with 2-wire serial (TWS) input do you want to support?	Enter the number of temperature sensors in the enclosure that will be read over the TWS interface. This information is used to determine the number of integer temperature fields returned by the Read Enclosure Status command. Up to four TWS temperature inputs can be specified.
How many LM78 parts [max 1 per 2-wire serial (TWS) bus] do you want to support?	Enter `0`, `1`, or `2`.

Table 3.4 Pin Assignment Questions

Question	Explanation
More detailed questions are asked based on your previous input.	
The following questions assign specific MPIO and MPLED pins according to the questions answered above. Below are the specific pin assignments for each MPIO and MPLED pin. The MPIO and MPLED banks are organized as follows: Pin Type Bank Pins Available MPIO 0 7-0 MPIO 1 7-0 MPIO 2 7-0 MPIO 3 3-0 MPLED 0 7-0 MPLED 1 7-0 MPLED 2 7-0 *The format of your answers should be:* `IO[space]bank number[space]pin number` *(for MPIO pins)* ***Example:*** IO 3 1 `LED[space]bank number[space]pin number` *(for MPLED pins)* ***Example:*** LED 2 2 *The MPLED pins can be used for general IO as well as LED functions if your design does not use all available MPLED pins. The MPIO pins cannot be used for LED functions, however, because they do not support blinking.*	
Enter input (output) pin to be used for door lock:	Enter the MPIO pin for the door lock signal.
Enter input (output) pin to be used for speaker:	Enter the MPIO pin for the speaker/alarm.

Table 3.4 Pin Assignment Questions (Cont.)

Question	Explanation
Enter input (output) pin to be used for Global Identify Enclosure LED:	Enter the MPLED pin for the global enclosure identification LED.
Enter input (output) pin to be used for Global Enclosure Status LED:	Enter the MPLED pin for the global enclosure status LED.
Enter output pin to be used for Global Drive Status LED:	Enter the MPLED pin for the global drive status LED.
Enter output pin to be used for Global Array Status LED:	Enter the MPLED pin for the global array status LED.
Enter input pin to be used for single input fan # x:	Enter the MPIO pin for each single input fan specified above. This question repeats for the number of single input fans specified.
Enter input pin to be used for dual input fan #x MSB:	Enter the MPIO pin for the MSB for each dual input fan specified above. Enter the MPIO pin for the LSB for each dual input fan specified above. These two questions repeat for the number of dual input fans specified.
Enter input pin to be used for dual input fan #x LSB:	
Enter input pin to be used for single input power supply #x:	Enter the MPIO pin for each single input power supply specified above. This question repeats for each single input power supply specified.
Enter input pin to be used for dual input power supply #x MSB:	Enter the MPIO pin for the MSB for each dual input power supply specified above. Enter the MPIO pin for the LSB for each dual input power supply specified above. These questions repeat for each dual input power supply specified.
Enter input pin to be used for dual input power supply #x LSB:	
How many LED outputs do you want to support per device slot?	Enter `0`, `1`, or `2` to specify the number of LEDs to drive for each device slot specified above.
Will there be a Device Present input signal for each device?	Enter `y` or `n` to indicate whether you want to detect when a device has been inserted or removed from its slot. This will assign one MPIO pin to each device slot supported.

Table 3.4 Pin Assignment Questions (Cont.)

Question	Explanation
Will there be a Ready Device for Use output signal for each device?	Enter y or n to indicate whether you want to control some specific operation for each device. One example would be to control power to a device slot. If yes, one MPIO pin is assigned to each device slot supported. The Prepare for Operation bit (Byte 2 bit 0) in the Perform Slot Operation Command, is used to activate this signal. This signal is the complement of the Prepare Device for Insertion/Removal output signal.
Will there be a Prepare Device for Insertion/Removal output signal for each device?	Enter y or n to indicate whether you want to control some specific operation for each device. Typically, only a Ready Device for Use output signal or Prepare Device for Insertion/Removal output signal will be chosen, but not both. If yes, one MPIO pin is assigned to each device slot supported. The Prepare for Insertion bit (Byte 2 bit 1) in the Perform Slot Operation Command is used to activate this signal. This signal is the complement of the Ready Device for Use output signal.
Do you want to override the LED patterns that display drive status?	Enter y or n. If you enter n, you accept the default LED settings shown in Table 3.5 on the next page. If you enter y, the program will prompt you with the questions shown in Table 3.6 on page 3-13. The format of your responses to those questions depends on how you responded to the previous question, “How many LED outputs do you want to support per device slot?”.

Table 3.5 shows the current default LED settings for each bit description in the Write Device Slot Status Command. The bit descriptions are shown in increasing priority order. If more than one bit is set by the Write Device Slot Status Command, the bit with the highest priority dictates the LED blink patterns.

Table 3.5 Default LED Settings for Write Device Slot Status Flags

State	Bit Description	One-LED Option	Two-LED Option	
			LED 1	LED 2
0	Default/ Nothing to Report	Off	Off	Off
1	Prepare for insertion/removal	Off	On	On
2	Prepare for operation	On	Off	Slow
3	Device Faulty	Slow	On	Off
4	Device Rebuilding	Slow	Off	Fast
5	In Failed Array	Slow	Fast	On
6	In Critical Array	Slow	Slow	Off
7	Parity Check operation	Slow	On	Off
8	Predicted Fault Failure	Slow	Fast	Off
9	No drive inserted	Off	On	Fast
10	Hot Spare	Off	Fast	Fast
11	Rebuild Stopped	Slow	Off	On
12	Identify Slot	Fast	Slow	Fast

Table 3.6 Selections for Custom LED Settings for Write Device Slot Status Flags

Question	Explanation
Answers to the following questions permit the designer to change the LED settings for the Write Device Slot Status Flags. These questions appear in the configuration utility only if the designer answers the previous question "Do you want to override the LED patterns that display drive status?" with a "yes" response. Table 3.5 shows the default settings for both the one and two-LED options. In this section, you will need to issue responses for each of the states 0 through 12. *Please specify one of:* *0 - for off 1 - for slow blink 2 - for fast blink 3 - for on*	
State 0 - Default/Nothing to Report: Off/0 Off/0 -	Enter new settings per the choices above after the dash (-). The format of your answers should be: **Two-LED option:** LED1[space]LED2 **Example:** 3 3 **One-LED option:** LED1 **Example:** 0
State 1 - Ready for Insertion/Removal: On/3 On/3 -	Enter new settings after the dash (-), per the choices above.
State 2- Prepare for Operation: Off/0 Slow/1 -	Enter new settings after the dash (-), per the choices above.
State 3 - Device Faulty: On/3 Off/0 -	Enter new settings after the dash (-), per the choices above.
State 4 - Device Rebuilding: Off/0 Fast/2 -	Enter new settings after the dash (-), per the choices above.
State 5 - In Failed Array: Fast/2 On/3 -	Enter new settings after the dash (-), per the choices above.
State 6 - In Critical Array: Slow/1 Off/0 -	Enter new settings after the dash (-), per the choices above.
State 7 - Parity Check Operation: On/3 Off/0 -	Enter new settings after the dash (-), per the choices above.
State 8 - Predicted Fault Failure: Fast/2 Off/0 -	Enter new settings after the dash (-), per the choices above.
State 9 - No Drive Inserted (Unconfigured Drive): On/3 Fast/2 -	Enter new settings after the dash (-), per the choices above.
State 10 - Hot Spare: Fast/2 Fast/2 -	Enter new settings after the dash (-), per the choices above.
State 11 - Rebuild Stopped: Off/0 On/3 -	Enter new settings after the dash (-)", per the choices above.
State 12 - Identify Slot: Slow/1 Fast/2 -	Enter new settings after the dash (-), per the choices above.

Table 3.7 Device Slot Operation Questions

Question	Explanation
What SCSI ID do you want associated with device slot x?	Enter the SCSI ID you want to associate with each device slot specified above. This question repeats for each device slot specified.
Enter output pin to be used for device slot x (SCSI ID y) LED MSB:	Enter the MPLED pin assignments for each device slot LED MSB and LSB specified above, using the format described at the beginning of Table 3.4. This pair of questions repeats for each device slot specified. **Note:** If only one LED is selected for each device slot in the previous questions, then only one MPLED pin is assigned here for each device slot (that is, not an MSB and an LSB).
Enter output pin to be used for device slot x (SCSI ID y) LED LSB:	
Enter input pin to be used for device slot x (SCSI ID y) Device Present:	Enter the MPIO pin assignment for device present status for each device slot specified above, using the format described at the beginning of Table 3.4. This question repeats for each device slot specified, if the user has answered “y” to the previous question, “Will there be a Device Present input signal for each device?”
Enter output pin to be used for device slot x (SCSI ID y) Ready Device:	Enter the MPIO pin assignment for device ready for each device slot specified above, using the format described at the beginning of Table 3.4. This question repeats for each device slot specified, if the user has answered “y” to the previous question, “Will there be a Ready Device for Use output signal for each device?”
Enter output pin to be used for device slot x (SCSI ID y) Remove/Insert Device:	Enter the MPIO pin assignment for device remove/insert for each device slot specified above, using the format described at the beginning of Table 3.4. This question repeats for each device slot specified, if the user has answered “y” to the previous question, “Will there be a Prepare Device for Insertion/Removal output signal for each device?”
Enter input pin to be used for single input temp alarm #x:	Enter the MPIO pin assignment for each binary temperature sensor specified above, using the format described at the beginning of Table 3.4. This question repeats for each single input temperature sensor specified.

Table 3.8 Status Signal Questions

<table>
<tr><td colspan="2">The questions covered in this Table assign specific fan, power supply, door lock, and speaker status to be returned in response to the Read Enclosure Status command for single and dual inputs.</td></tr>
<tr><td colspan="2">For each fan, enter one of the following responses for each input pattern:
Choose:
00h Fan is operational
01h Fan is malfunctioning
02h Fan is not installed
80h Unknown status, or status not reportable</td></tr>
<tr><td>Enter the Read Enclosure Status command's response for a single input fan with an input bit pattern of 0:</td><td rowspan="2">The input bit pattern is read from the LSI53C040 MPIO pin(s) assigned to this fan.

Note: These two questions are asked only if the user specifies in the previous questions that there are single-wire input fans in this enclosure.</td></tr>
<tr><td>Enter the Read Enclosure Status command's response for a single input fan with an input bit pattern of 1:</td></tr>
<tr><td>Enter the Read Enclosure Status command's response for a dual input fan with an input bit pattern of 00:</td><td rowspan="4">The input bit pattern is read from the LSI53C040 MPIO pin(s) assigned to this fan.

Note: These four questions are asked only if the user specifies in the previous questions that there are dual-wire input fans in this enclosure.</td></tr>
<tr><td>Enter the Read Enclosure status command's response for a dual input fan with an input bit pattern of 01:</td></tr>
<tr><td>Enter the Read Enclosure status command's response for a dual input fan with an input bit pattern of 10:</td></tr>
<tr><td>Enter the Read Enclosure status command's response for a dual input fan with an input bit pattern of 11:</td></tr>
<tr><td colspan="2">For each power supply, enter one of the following responses for each input pattern:
Choose:
00h Power supply is operational and on
01h Power supply is operational and off
10h Power supply is malfunctioning and commanded on
11h power supply is malfunctioning and commanded off
20h Power supply is not present
21h Power supply is present
80h Unknown status, or status not reportable</td></tr>
</table>

Table 3.8 Status Signal Questions (Cont.)

Enter the Read Enclosure status command's response for a single input power supply with an input bit pattern of 0:	The input bit pattern is read from the LSI53C040 MPIO pin(s) assigned to this power supply. **Note:** These two questions are asked only if the user specifies in the previous questions that there are single-wire input power supplies in this enclosure.
Enter the Read Enclosure status command's response for a single input power supply with an input bit pattern of 1:	
Enter the Read Enclosure status command's response for a dual input power supply with an input bit pattern of 00:	The input bit pattern is read from the LSI53C040 MPIO pin(s) assigned to this power supply. **Note:** These two questions are asked only if the user specifies in the previous questions that there are dual-wire input power supplies in this enclosure.
Enter the Read Enclosure status command's response for a dual input power supply with an input bit pattern of 01:	
Enter the Read Enclosure status command's response for a dual input power supply with an input bit pattern of 10:	
Enter the Read Enclosure status command's response for a dual input power supply with an input bit pattern of 11:	
For door lock, enter one of the following responses for each input pattern: Choose: 00h Door is currently locked 01h Door is currently unlocked, or door lock not installed 80h Unknown status, or status not reportable	
Enter the Read Enclosure status command's response for a single input door lock with an input bit pattern of 0:	The input bit pattern is read from the LSI53C040 MPIO pin(s) assigned to this door lock. **Note:** These two questions are asked only if the user specifies in the previous questions that there are single-wire input door locks in this enclosure.
Enter the Read Enclosure status command's response for a single input door lock with an input bit pattern of 1:	

Table 3.8 Status Signal Questions (Cont.)

For speaker, enter one of the following responses for each input pattern: Choose: 00h Speaker is currently off, or no speaker installed 01h Speaker is currently on	
Enter the Read Enclosure status command's response for a single input speaker with an input bit pattern of 0:	The input bit pattern is read from the LSI53C040 MPIO pin(s) assigned to this speaker. **Note:** These two questions are asked only if the user specifies in the previous questions that there are single-wire input speakers in this enclosure.
Enter the Read Enclosure status command's response for a single input speaker with an input bit pattern of 1:	

Table 3.9 TWS Bus Operation Questions

The following questions are for TWS bus operation.	
For each 2-wire serial bus, specify the bus speeds desired for operation: 0 - 2-wire serial 78 KHz, system 20 MHz 1 - 2-wire serial 312 KHz, system 20 MHz 2 - 2-wire serial 78 KHz, system 40 MHz 3 - 2-wire serial 312 KHz, system 40 MHz	
Please select the speed for the 2-wire serial bus number 0 relative to the system clock you are using:	Enter `0`, `1`, `2`, or `3`.
Please select the speed for the 2-wire serial bus number 1 relative to the system clock you are using:	Enter `0`, `1`, `2`, or `3`.
Do you want the temperature reported in the Read Enclosure Status command's response reported in: 0 - Fahrenheit, or 1 - Celsius?	Enter `0` or `1`.
How many 2 second intervals would you like between 2-wire serial input passes?	Specify the desired sampling period.

Table 3.9 TWS Bus Operation Questions (Cont.)

Please select the chip type for 2-wire serial (TWS) temperature sensor number x: 0 - National LM75 1 - Dallas 1621 2 - National LM78	These questions repeat for each 2-wire serial temperature sensor specified.
Which 2-wire serial (TWS) bus (0 or 1) will this chip be on?	
What address (0 to 7) will this chip be at?	
The following questions refer to the LM78 on TWS bus number x.	
These questions repeat for each serial bus specified.	
What value is to be used for the first fan divisor?	Enter 0, 1, 2, or 3. For more details regarding the operation of the LM78, please refer to the LM78 specification.
What value is to be used for the second fan divisor?	Enter 0, 1, 2, or 3. For more details regarding the operation of the LM78, please refer to the LM78 specification.
Will there be a fan connected to fan monitor number m?	Enter y or n. This question and the next one repeat for each fan connected to a monitor (m = 0, 1, or 2).
What is the highest value that indicates that the fan is functioning correctly?	Enter a number between 1 and 254.
Will there be a power supply connected to voltage monitor number n?	Enter y or n. This question and the next two repeat for each power supply connected to a voltage monitor (n = 0, 1, ..., 5, or 6).
What is the lowest value that indicates that the power supply is functioning correctly?	Enter a number between 1 and 254.
What is the highest value that indicates that the power supply is functioning correctly?	Enter a number between 1 and 254.

Table 3.10 Questions for Firmware Bootloader

The following questions are related to the hardware-based power-on serial ROM download, which loads and runs the firmware bootloader.	
All the remaining questions are asked only if the user replies "yes" to support microcode updates over the SCSI bus.	
On which 2-wire serial (TWS) bus (0 or 1) will this download happen?	A pull-up resistor on LSI53C040, pin A11 changes the serial ROM download from TWS port 0 to port 1. Note that the answer to this question must be consistent with the use of a pull-up resistor on pin A11.
What chip address (0 to 7) will the download be from?	LSI53C040 pins A10, A9, and A8 define the address from which the LSI53C040 will attempt the initial configuration download. Note that the answer to this question must be consistent with the use of a pull-up resistors on pin A10, A9, and A8. See the *LSI53C040 Enclosure Services Processor Technical Manual* for further information.
Do you want to use an LED to indicate bootload failures?	Enter y or n.
Select the LED bank (0-2).	The two questions are asked only if the user chooses to use an LED to indicate bootload failures, by answering “y” to the previous question.
Select the LED (0-7).	

Table 3.10 Questions for Firmware Bootloader (Cont.)

The following questions are related to the first SAF-TE firmware image that is loaded and run by the bootloader.	
On which 2-wire serial (TWS) bus (0 or 1) will this download happen?	A pull-up resistor on LSI53C040, pin A11 changes the serial ROM download from TWS port 0 to port 1. Note that the answer to this question must be consistent with the use of a pull-up resistor on pin A11.
What chip address (0 to 7) will the download be from?	LSI53C040 pins A10, A9, and A8 define the address from which the LSI53C040 attempts the initial configuration download. Note that the answer to this question must be consistent with the use of a pull-up resistors on pin A10, A9, and A8. See the *LSI53C040 Enclosure Services Processor Technical Manual* for further information.
What address will the download start from?	Please answer the question with a number from 0 to 32767 (The recommended default value is 0).
What length will the download be?	Please answer the question with a number from 1024 to 12192 (This value is equal to or greater than the number of bytes of the firmware program that is downloaded).
The following questions are related to the second SAF-TE firmware image that is loaded and run by the bootloader.	
On which 2-wire serial (TWS) bus (0 or 1) will this download happen?	A pull-up resistor on LSI53C040, pin A11 changes the serial ROM download from TWS port 0 to port 1. Note that the answer to this question must be consistent with the use of a pull-up resistor on pin A11.
What chip address (0 to 7) will the download be from?	LSI53C040 pins A10, A9, and A8 define the address from which the LSI53C040 attempts the initial configuration download. Note that the answer to this question must be consistent with the use of a pull-up resistors on pin A10, A9, and A8. See the *LSI53C040 Enclosure Services Processor Technical Manual* for further information.
What address will the download start from?	Please answer the question with a number from 0 to 32767 (The recommended default value is 0).
What length will the download be?	Please answer the question with a number from 1024 to 12192 (This value is equal to or greater than the number of bytes of the firmware program that is downloaded).

3.3 After Running the Configuration Utility

After you answer all questions, the utility creates the `config.hex` file, the `loader.hex` file, and provides the data structure sizes, as shown in the example below.

```
94.=   0x05E bytes of 256.=0x100 state machine data
       memory used

50.=   0x032 words of 300.=0x12C state machine program
       memory used

1194.= 0x4AA bytes used by the config_data structure
```

The Enclosure ID field of the SCSI Inquiry command is stored at offset

```
 61.=  0x03D from the start of the config_data structure
       which is at address

 64.=  0x04D which places the Enclosure ID field at
       address

125.=  0x07D
```

The program then returns to the DOS prompt. At this point, the `config.hex` file is ready to concatenate with the `safte.hex` file, and the `loader.hex` file is ready to concatenate with the `bootload.hex` file, using the following DOS commands:

```
copy  config.hex + safte.hex  safcon.hex
```

and

```
copy  loader.hex + bootload.hex  boot.hex
```

or refer to the *myinput*`.txt` file to see a summary of your answers.

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