QLogic Corporation

# GEM359
# Guardian Enclosure Management Controller

## Data Sheet

## Features

- Compliance with *SCSI Accessed Fault Tolerant Enclosures* (SAF-TE) specification, version 1.00 and addendum
- Compliance with *SCSI-3 Enclosure Services Command Set* (SES) draft, version 8.0b
- Compliance with *Intelligent Platform Management Interface* (IPMI), version 1.0
- Low Voltage Differential (LVD) SCSI interface
- SCSI-3 compatible
- Two small form factor (SFF)-8067 interfaces for Fibre Channel applications
- Two $I^2C$ interfaces for connectivity to $I^2C$ devices such as a temperature sensor, NVRAM, and the Intelligent Platform Management Bus (IPMB)
- Embedded Universal Asynchronous Receiver/Transmitter (UART), 16550 compatible, provides a serial port that can be used as a debug port
- Up to 14 drive slots supported
- 59 general purpose input/output pins
  - ❒ 39 bidirectional pins
  - ❒ 20 dedicated output pins
- Four fan tachometer inputs for fan speed monitoring
- Three Pulse Width Modulator (PWM) outputs for fan speed control
- Automatic notification of environmental failure
- Watchdog and heartbeat timers
- 144-pin Low profile Quad Flat Pack (LQFP)
- GEM configuration utility software provided
- Firmware is provided for the following interfaces (contact QLogic for availability):
  - ❒ SCSI accessed fault-tolerant enclosures (SAF-TE)
  - ❒ SCSI-3 enclosure services (SES)
  - ❒ Intelligent platform management interface (IPMI) and Intelligent Platform Management Bus (IPMB)
  - ❒ Fan tachs and PWMs
- Evaluation boards available

## Product Description

The GEM359 is the latest addition to QLogic's enclosure management product line. Designed as a complete chassis management controller for SCSI and Fibre Channel enclosures, the highly integrated GEM359 monitors all aspects of a server's backplane or storage enclosure. The chip provides in-band SAF-TE and SES management through the SCSI interface or from the SFF-8067 (ESI) ports on Fibre Channel drives. The GEM359 also supports the IPMI specification by providing management data to a baseboard management controller through the IPMB.

Users can implement the GEM359 for a variety of applications, from a simple *hot swap* or SCSI drive backplane controller in a server to a full-featured chassis management controller for a storage subsystem. The advanced feature set allows management of the hot swap drives and monitors all the environmental and control functions of the chassis or backplane.

The GEM359 has 59 input and output pins that allow extensive user customization. These pins allow users to define the number of drive slots (up to 14), power supplies, temperature sensors, door locks, and other components specific to the design. In addition, the GEM359 supports fan tachometer inputs and pulse width monitor outputs, providing the system with specific fan monitoring and control. To monitor other characteristics, the GEM359 can control the status LEDs and set thresholds on temperatures and fan speeds.

To minimize development time, QLogic supplies the user with the GEM Configuration Utility. This easy to use, menu driven software tool configures various GEM359 parameters, which eliminates the need to customize the code for most applications.

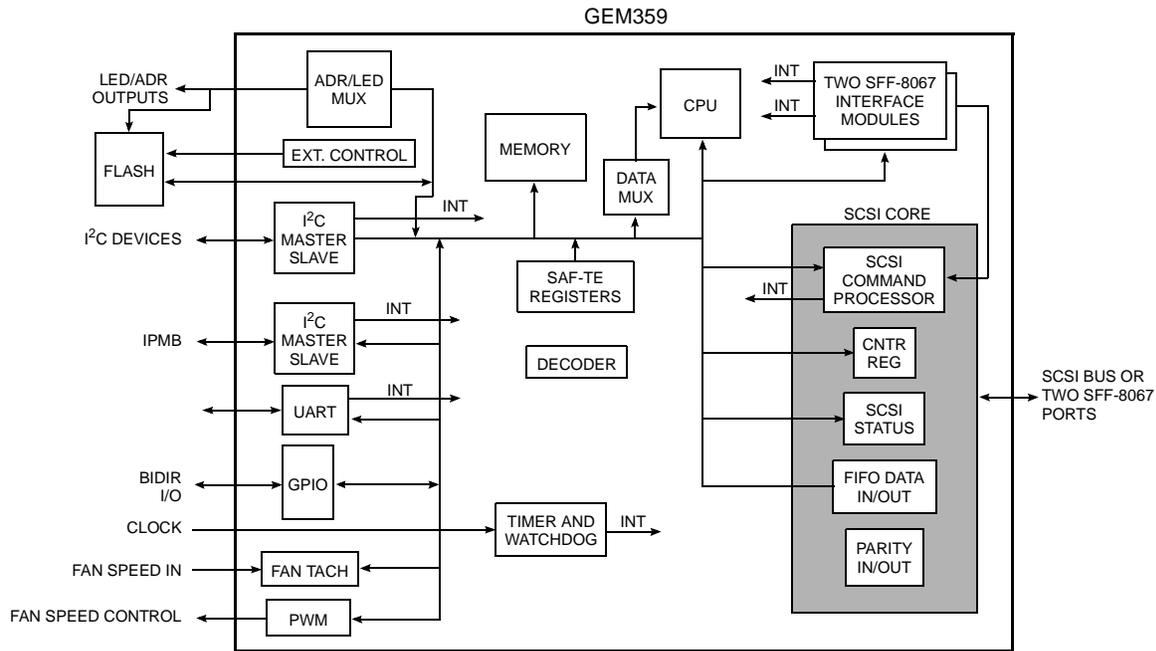The GEM359 block diagram is illustrated in figure 1.



*Figure 1.  GEM359 Block Diagram*

## Applications

Figure 2 illustrates the GEM359 in a typical SCSI application. Figure 3 illustrates the GEM359 in a typical Fibre Channel application.
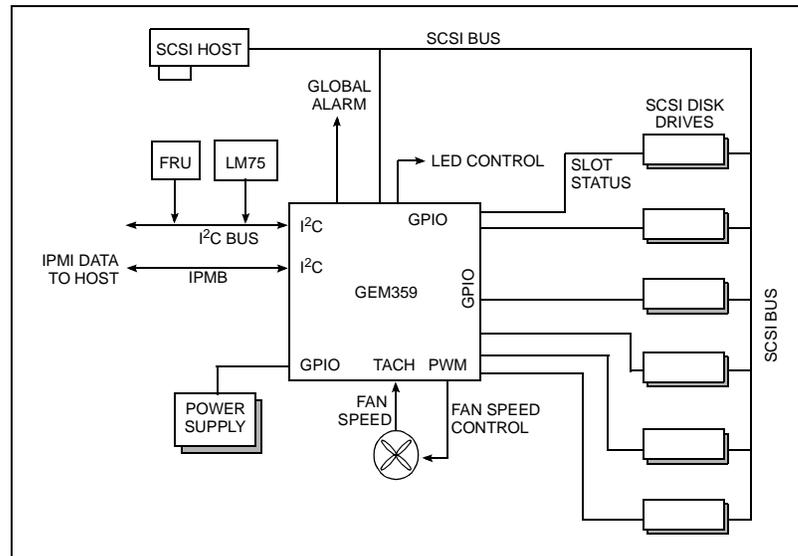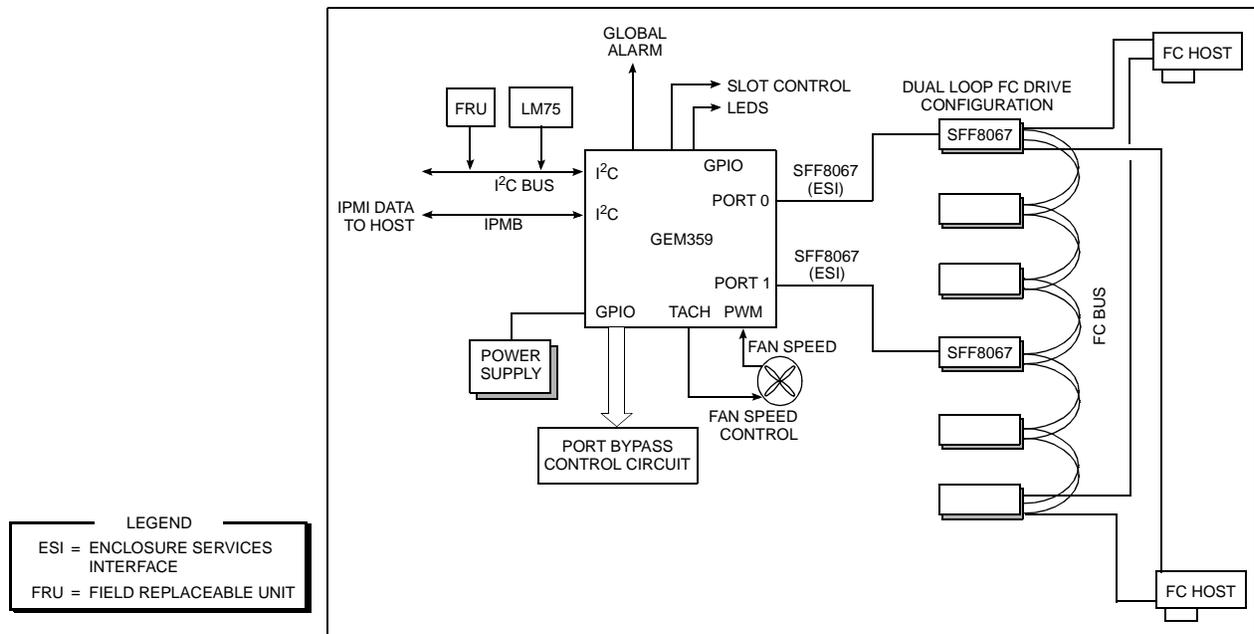


*Figure 2.  GEM359 SCSI Application*

*Figure 3. GEM359 Fibre Channel Application*

## IPMI Application

Users can easily integrate the GEM359 into systems that support the IPMI specification. Internal server backplanes typically utilize the GEM359 as a hot swap controller that uses one of the $I^2C$ interfaces as an intelligent platform management bus (IPMB). The IPMB connects to the servers' baseboard management controller (for example, QLogic's Zircon chip), as shown in figure 4.
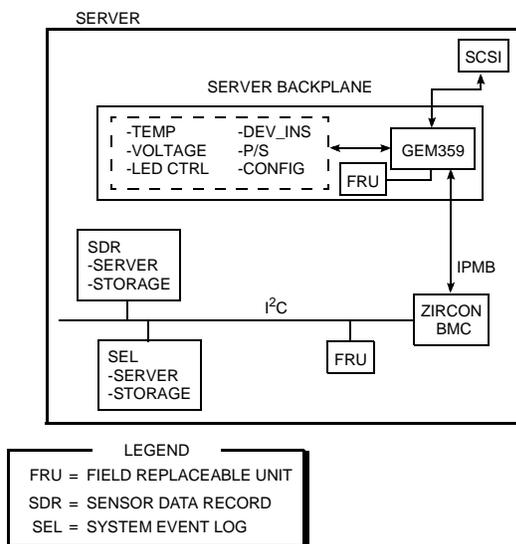


*Figure 4. Hot Swap Controller*

## GEM Configuration Utility

The menu-driven, Windows NT and Windows 2000 compatible GEM configuration utility allows the user to configure the GEM359 to meet the requirements of their system, all without writing a single line of code. This tool performs various functions, including updating the flash ROM and configuring all the GPIOs. The GEM configuration utility allows users to specify a variety of options, including:

- Number of device slots
- SCSI or Fibre Channel ID of each slot
- Number of fans, power supplies, temperature sensors
- Upper and lower temperature thresholds
- Audible alarm and door lock installed

This complete solution provided by QLogic reduces development costs and improves time to market for new and future systems.

In addition, SES, SAF-TE, and IPMI firmware are planned for system designers needing a highly customized solution.

Figures 5 through 7 illustrate some of the configuration screens from the GEM utility. These figures show how the user can configure the GEM359 to meet the specific requirements of their applications by selecting the features that the device needs.
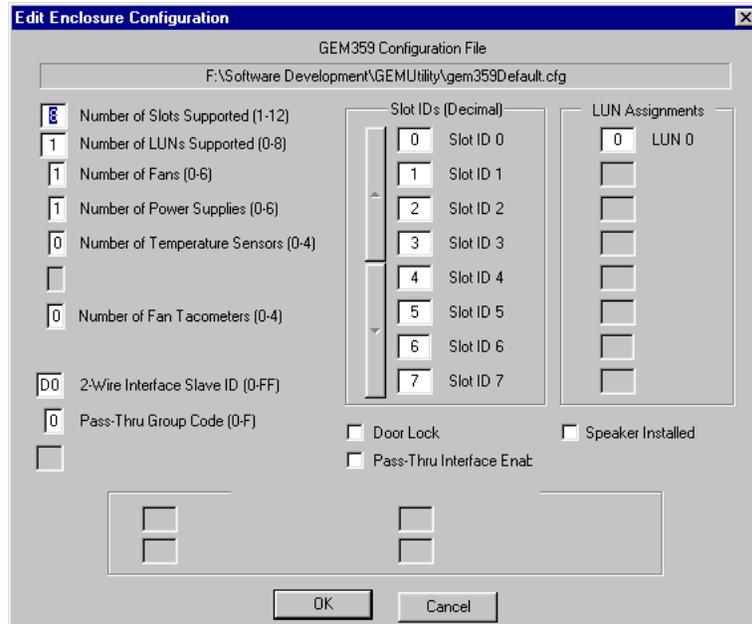


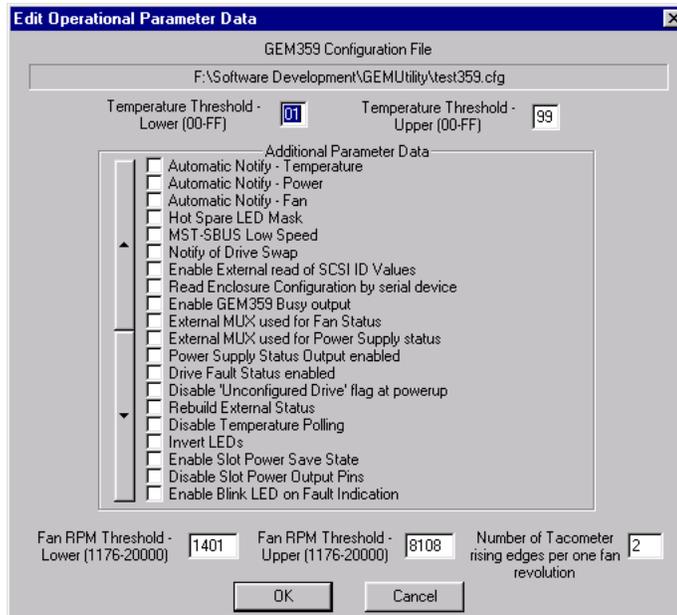*Figure 5. Edit Enclosure Configuration Screen*

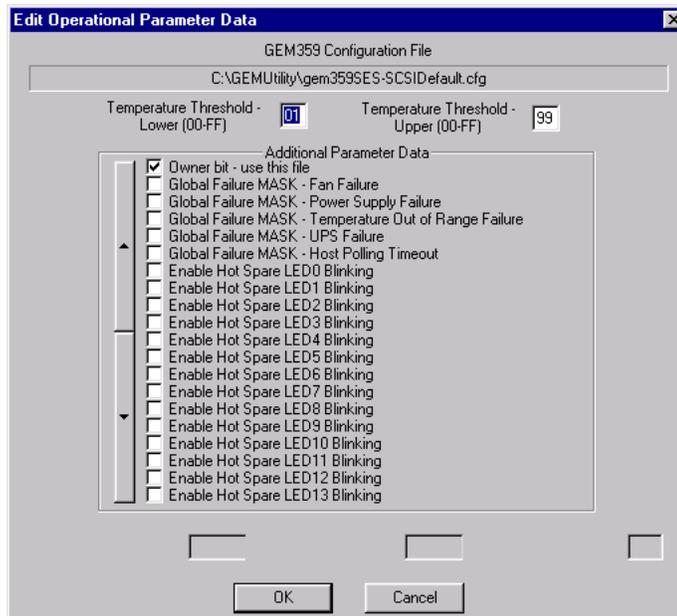*Figure 6. Edit Operational Parameter Data Screen (1 of 2)*



*Figure 7. Edit Operational Parameter Data Screen (2 of 2)*

# Hardware Functional Description

## SCSI Interface

The GEM359 SCSI interface has the following features:

- On-chip 48-mA and LVD SCSI transceivers
- LVD and single-ended SCSI operation (multimode) with a differential sense input that automatically selects the operating mode
- Eight-bit, asynchronous SCSI data transfers (in compliance with the SAF-TE specification)
- Wide SCSI addressing with hardware assignable SCSI IDs
- Multiple initiator support
- Two SFF-8067 ports for Fibre Channel implementations
- Fibre Channel loop identifiers are read from an external port or stored in the GEM359 configuration table.
- Ultra2 and Ultra3 compatible

## Tachometer Counters

The GEM359 tachometer counters have the following features:

- Four tachometer counter modules are incorporated to monitor the speed of up to four fans.
- Fan inputs can also be used as GPIO pins.

## Universal Asynchronous Receiver/Transmitter (UART)

The GEM359 UART can be used as a firmware debug port.

## I$^2$C Serial Bus

The GEM359 I$^2$C serial bus has the following features.

- System configuration can be read from an external EEPROM through the I$^2$C bus.
- Slot power status can be saved to an external EEPROM through the I$^2$C bus.
- Two independent master/slave I$^2$C interfaces are provided.
- 100K-bits and 400K-bits operations supported
- Multimaster arbitration and slave generated wait states supported
- Clock stretching supported
- I$^2$C interfaces incorporate eight-bit FIFO for data transfers
- Read/write pass-thru data port allows the host to communicate with I$^2$C devices external to the GEM359. (For example, an LCD display can be driven from the I$^2$C.)

## Pulse Width Modulator (PWM)

The GEM359 PWM has the following features:

- Three PWM outputs are provided for fan speed control or tone generation.
- The fan speed is set to 80 percent; if a fan fail or temperature out-of-range condition occurs, the fan speed is increased to 100 percent.
- PWM outputs are driven by open-drain, 6 mA pads that provide enough drive to control the fan speed logic.
- Unused PMW outputs can be assigned as GPIO pins.

## General Purpose Input/Output (GPIO)

The GEM359 has 59 individually programmable I/O pins with following features:

- 39 open-drain output, bidirectional pins
- 20 dedicated output pins
- Functions assigned using the GEM utility software (check for feature availability)
- Pins can monitor and/or control audible and visual indicators, door locks, power supplies, intrusion alert signals, port bypass control circuits, etc.

# Software Functional Description

## SCSI Command Set

The following SCSI commands are supported:

- Inquiry
- Read Buffer
- Write Buffer
- Test Unit Ready
- Request Sense
- Send Diagnostic
- Receive Diagnostics
- Upload Firmware

## SAF-TE Command Set (Parallel SCSI Configurations)

The following SAF-TE commands for parallel SCSI are supported:

- Read Enclosure Configuration
- Read Enclosure Status
- Read Device Slot Status
- Read Global Flags
- Write Device Slot Status
- Perform Slot Operation
- Send Global Flags

### SES Command Set (Fibre Channel and SCSI Configurations)

The following SES pages are supported:

- 00h    Supported Diagnostics (parallel SCSI)
- 01h    Configuration
- 02h    Enclosure control
         Enclosure status
- 04h    String Out (download firmware and configuration)
         String In (upload configuration)

### IPMI Command Set

The following IPMI commands are supported:

- Global commands
- FRU commands
- Sensor commands
- Event commands

## Management Features

### GEM Utility Software

The GEM utility, a Windows 98, Windows NT, and Windows 2000 compatible application, provides the following features:

- Set pin assignments and operating configurations
- Download firmware to flash ROM
- Create, save, and download configuration files to the GEM controller
- Performs diagnostics: executes SCSI and SAF-TE commands on selected SCSI targets

## Enclosure Status Data

The following enclosure status data is provided:

- Device slot status:
    - Drive present
    - Slot address
    - Swap
    - Identify
    - Prepare for removal/insertion
    - Prepare for operation
    - Unconfigured drive

- Power supply status (present, failure)
- Fan status (present, failure)
- Temperature status (present, value, failure)
- Door lock status (present, unlocked/locked state)
- Audible alarm (on/off)
- UPS (present, failure) (SES)
- SCSI bus operating mode (single-ended, LVD, HVD)
- Vendor-unique status from external devices

## Control Functions

The following list summarizes the GEM359 control functions:

- LED on/off /flashing pattern
- Speaker on/off
- Enclosure temperature alert on/off
- Enclosure power on/off
- Slot locked or unlocked
- Uninterrupted power supply (UPS) enable and disable control (SES)
- Global alarm on/off
- Global fail on/off
- Bypass port (Fibre Channel) enable and disable control
- Upload configuration files and firmware
- Vendor-unique control

## Enclosure Configuration Parameters

The following parameters are user programmable:

- Number of device slots
- Number of fans
- Number of power supplies
- Number of temperature sensors
- Temperature threshold value
- Audible alarm installed
- Door lock installed
- UPS supported (SES)
- Product identifier
- Enclosure identifier
- SCSI channel identifier
- SCSI ID or Fibre Channel-Arbitrated Loop (FC-AL) ID of each device slot
- $I^2C$ pass-thru bus enable/disabled
- Automatic notification of global failure status can be enabled/disabled. A mask encoding is provided to the system designer to define a global failure condition, for example, that fans or power supplies have failed.
- $I^2C$ bus parameters
- GEM busy indicator

## Technical Specifications

- Power requirements:
    - 3.3 volts +/- 5%
    - 384 mA maximum
    - 60 mA standby

- Clock frequency of 25 MHz
- GPIO pins are 5-V tolerant.
- All status inputs are Schmitt trigger receivers.

- All status inputs can be asynchronous to the GEM359 clock.
- Requires an external eight-bit, nonvolatile memory device (E/PROM) of 64K or larger
- Intel or AMD/Fujitsu flash ROM algorithm supported
- National Semiconductor LM75 (or equivalent) temperature sensor supported
- 144-pin LQFP package

- Embedded CPU is reset at power up or optionally by a SCSI bus reset.
- Code memory is parallel – flash or EPROM.
- External 16-byte decodes for I/O (chip select pin: $\overline{\text{CPU\_STRB}}$)
- External interrupt supported
- Breakpoint registers incorporated
- Timer output provided