



Intel® Server Board SE7520BD2

Technical Product Specification

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Enterprise Platforms and Services Division - Marketing

Revision History

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12/10/2003	0.5	Conversion from generic hardware spec to Intel® Server Board SE7520BD2 specific spec
02/09/2004	0.75	Updated NIC components, mixed processor support, SCSI mirroring support, and CMOS clear.
03/31/2004	1.0	Correct DIMM SMBus address Updated BIOS setup menu Updated Error reporting and handling Updated Board Jumper Blocks
06/14/2004	1.1	Updated Block Diagrams
11/15/2004	1.2	Updated several references and specified details. Added MTBF data. Removed incorrect references to PXH-D. Added details on the SE7520BD2-V SKU. Added schemated for the SE7520BD2-V SKU. Added EM64T data. Added mBMC sensors table. Updated Block Diagrams and Power Budget.
02/07/2005	1.3	Added fan pin-outs. Updated BIOS menus. Added motherboard identification section. Added current errata as Appedix A.
March 2005	2.0	Update to include DDR2 SKUs
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1. Introduction

1.1 Purpose

This Intel® Server Board SE7520BD2 Technical Product Specification (TPS) provides technical details on the functional architecture and feature set of the server board.

1.2 Audience

This document is intended for technical personnel requiring a technical overview of the Server Board SE7520BD2. Familiarity with the personal computer, Intel® server architecture, Intel® processor architecture, memory technologies and the Peripheral Component Interconnect (PCI) local bus architecture is assumed.

1.3 Document Outline

This document is composed of the following chapters:

- Chapter 1: Introduction
- Chapter 2: Product Overview
- Chapter 3: Board Architecture
- Chapter 4: BIOS
- Chapter 5: Platform Management Architecture
- Chapter 6: Error Reporting and Handling
- Chapter 7: Connector Pin-outs and Jumper Blocks
- Chapter 8: Environmental Specifications
- Chapter 9: Other Useful Information

1.4 Additional Technical Documentation

For additional information on the Server Board SE7520BD2, consult the following documents:

- *Intel® Server Board SE7520BD2 with DDR Memory Specification Update*
- *Intel® Server Board SE7520BD2 with DDR2 Memory Specification Update*
- *Intel® Server Board SE7520BD2 Tested Hardware and Operating System List*
- *Intel® Server Chassis SC5300 Technical Product Specification*
- *Intel® Server Chassis SC5300 Chassis Power Supply Specification*

1.5 Board Usage Disclaimer

Intel Corporation server baseboards contain a number of high-density VLSI and power delivery components that need adequate airflow to cool. Intel's own chassis are designed and tested to meet the intended thermal requirements of these components when the fully integrated system is used together. It is the responsibility of the system integrator that chooses not to use Intel developed server building blocks to consult vendor datasheets and operating parameters to determine the amount of airflow required for their specific application and environmental conditions. Intel Corporation cannot be held responsible if components fail or the server board does not operate correctly when used outside any of its published operating or non-operating limits.

2. Product Overview

The Server Board SE7520BD2 is an Intel® Architecture (IA) 32-based server board capable of supporting dual Intel® Xeon™ processors. Board partitioning is optimized for general purpose (GP)-pedestal design. The platform is based on the Intel® E7520 chipset and incorporates several new high-speed buses and signaling architectures.

2.1 Server Board Feature Set

The Server Board SE7520BD2 supports the following feature set:

- IA-32 server platform, based on the Intel E7520 chipset
- Dual 800MT/s Intel® Xeon™ processors 200MHz FSB
- Six DDR Stacked Registered DIMM memory sockets supporting ECC memory (two memory channels with three DIMMs per channel)
or
Eight DDR2 Stacked Registered DIMM memory sockets supporting ECC memory (two memory channels with four DIMMs per channel)
- Supports Intel® 82801ER I/O Controller Hub (ICH5R), interfaced with an Intel® E7520 Memory Controller Hub (MCH) via Hub Interface 1.5
- Supports PXH PCI-X* bridge, interfaced with the MCH via x8 PCI Express* Interface PCI-X 2.0 133MHz slot
- Two PCI-X 1.0 100MHz slots
- One PCI Express x8 slot (unpopulated on product code SE7520BD2V)
- One PCI Express x8 slot (actual x4 plumbing to a x8 physical connector)
- Marvell* Yukon 88E8050 10/100/1000 LAN, interfaces with the MCH via x1 PCI Express interface
- Intel® 82541PI supporting 10/100/1000 LAN, interface with the ICH5 via PCI 32/33 bus
- LPC server I/O
- One 5V PCI 32/33 slot
- Onboard dual-channel Ultra320 SCSI controller, interfaces with the PXH via 100MHz Mode 1 PCI-X bus
- Onboard single-channel Ultra320 SCSI controller (SCSI connector B is unpopulated on product codes SE7520BD2V and SE7520BD2VD2).
- Onboard PCI ATI* RAGE* XL video controller
- Three USB 2.0 ports at the rear (only on product codes SE7520BD2 and SE7520BD2SCSI)
or
Two USB 2.0 ports at the rear (product code SE7520BD2V and all DDR2 product codes)
- Two USB 2.0 ports at the front
- Dual SATA Interface
- Single ATA-100 interface

- Two serial ports
 - One back panel connector
 - One front panel connector
- One floppy connector
- Redundant fan speed control for the Intel® Server Chassis SC5300, LX version.

2.2 DDR Server Board

The following figure provides a high-level illustration of the Server Board SE7520BD2.with DDR memory (product codes SE7520BD2, SE7520VD2SCSI, SE7520BD2V).

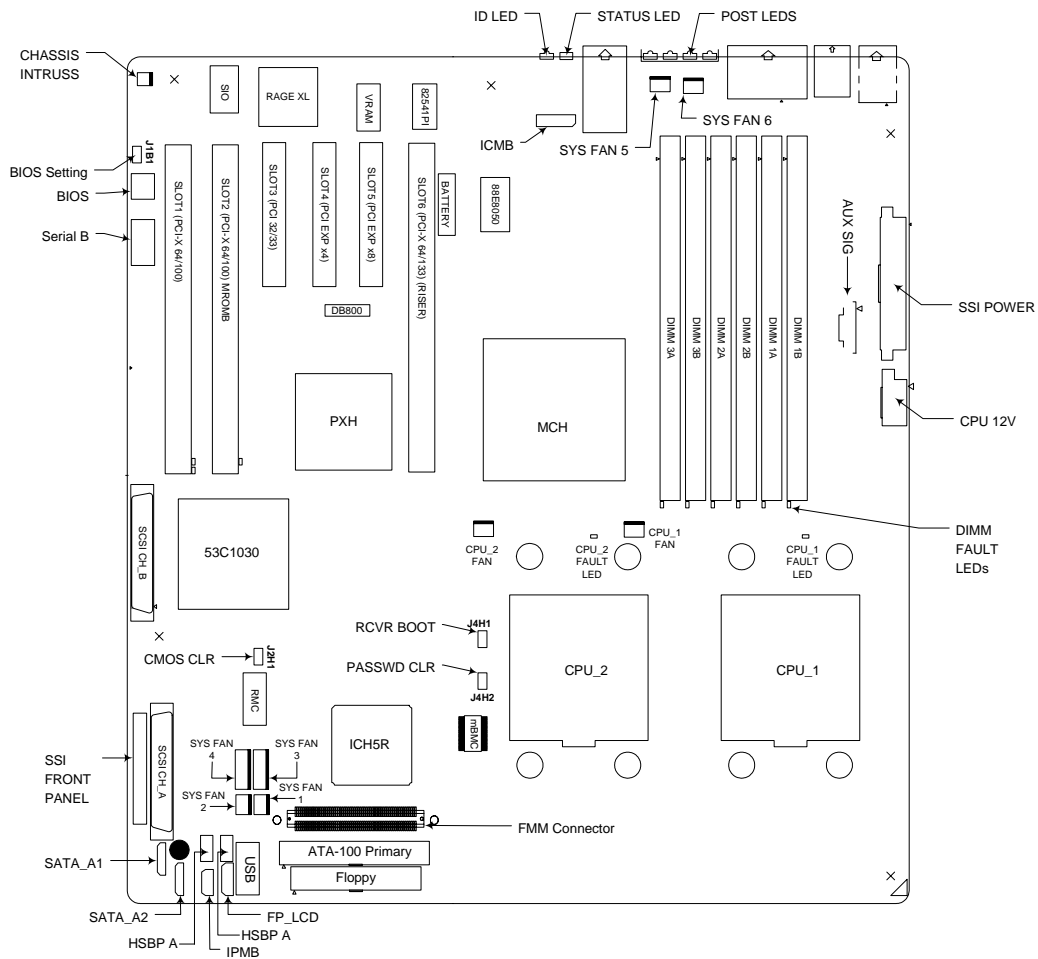


Figure 1. Intel® Server Board SE7520BD2 with DDR Memory

2.3 DDR2 Server Board

The following figure provides a high-level illustration of the Server Board SE7520BD2 with DDR2 memory (product codes SE7520BD2SATAD2, SE7520VD2SCSID2, SE7520BD2V2).

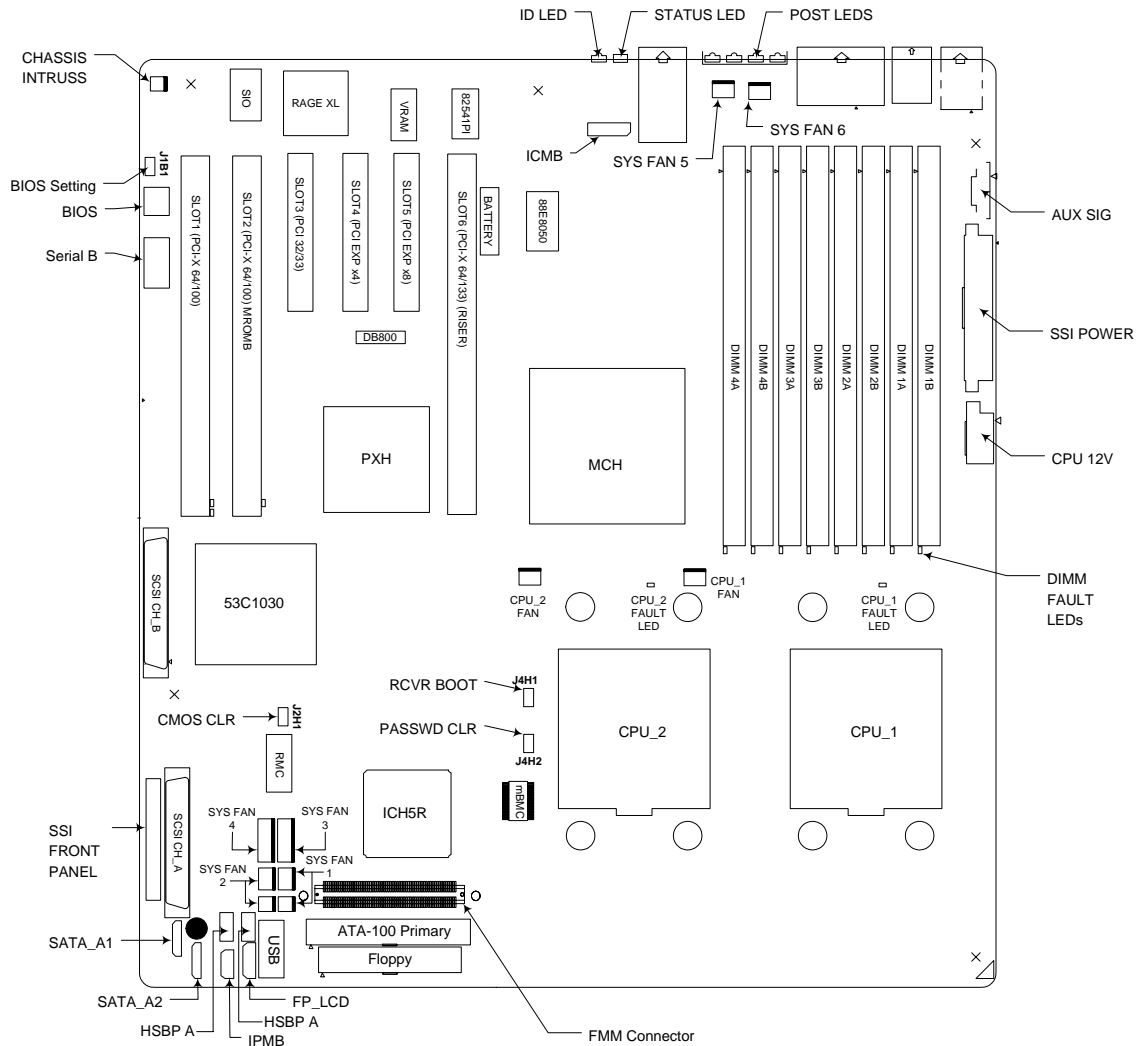


Figure 2. Intel® Server Board SE7520BD2 with DDR2 Memory

2.4 Server Board Layout

Figure 3 illustrates the functional blocks of the Server Board SE7520BD2 and the plug-in modules that the server board supports.

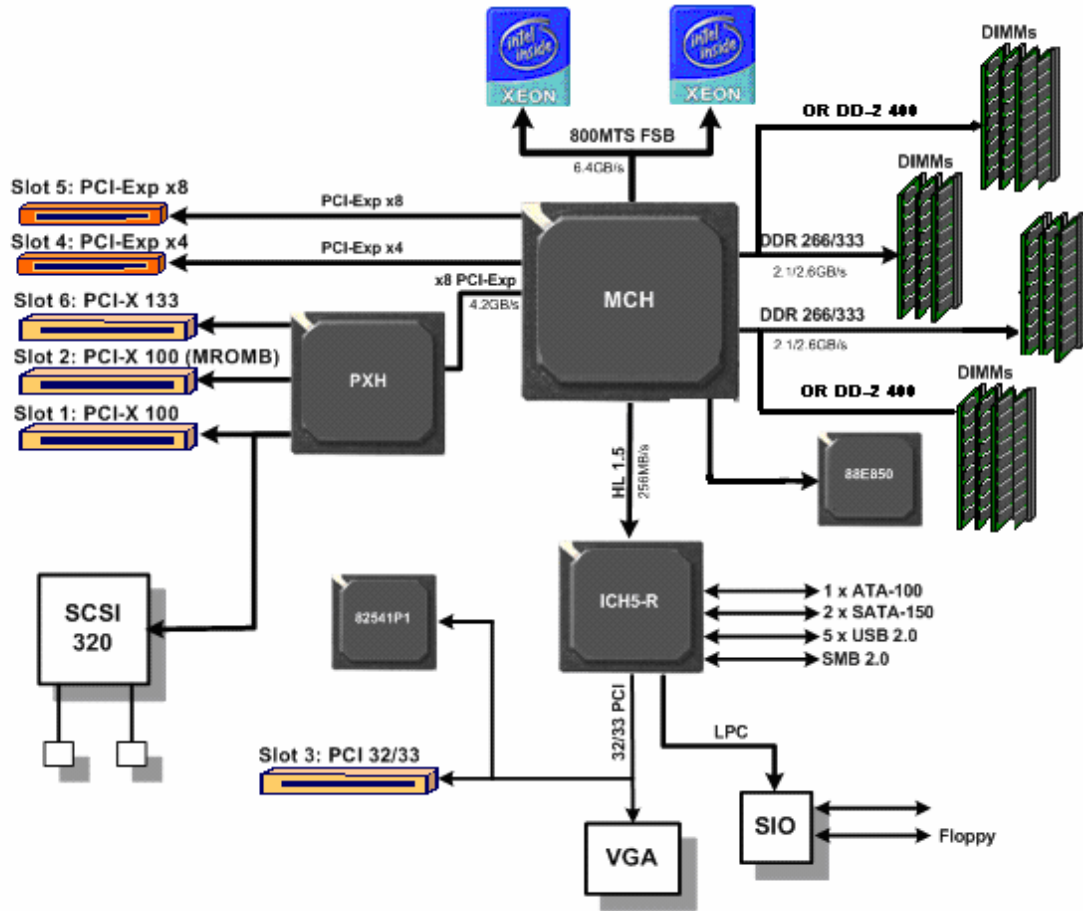


Figure 3. Product Code SE7520BD2SCSI System Block Diagram

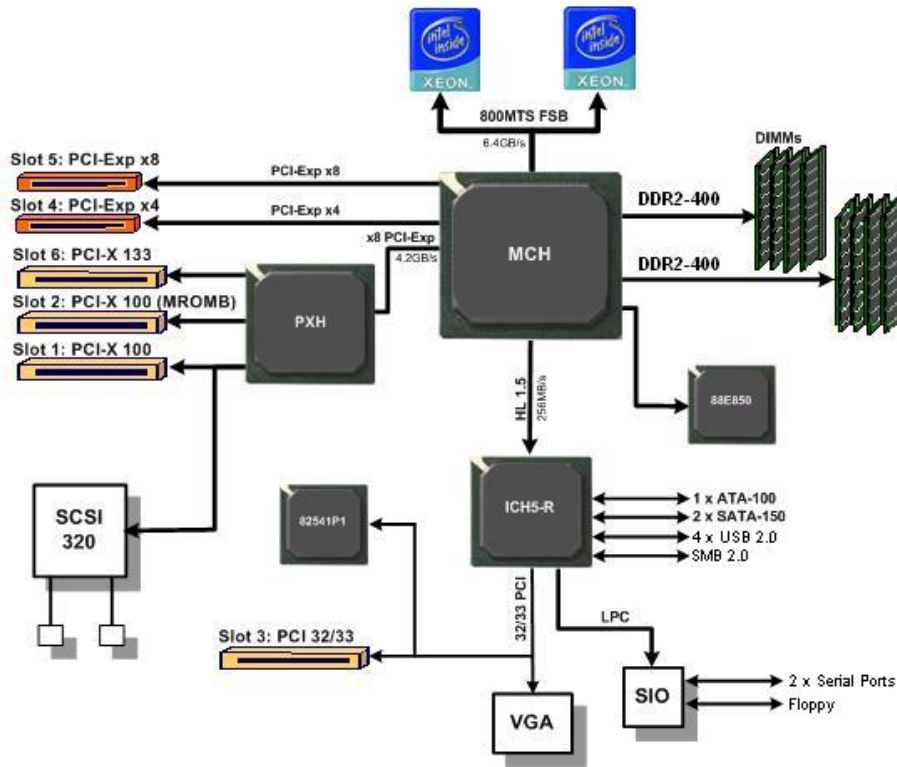


Figure 4. Product Code SE7520BD2SCSID2 System Block Diagram

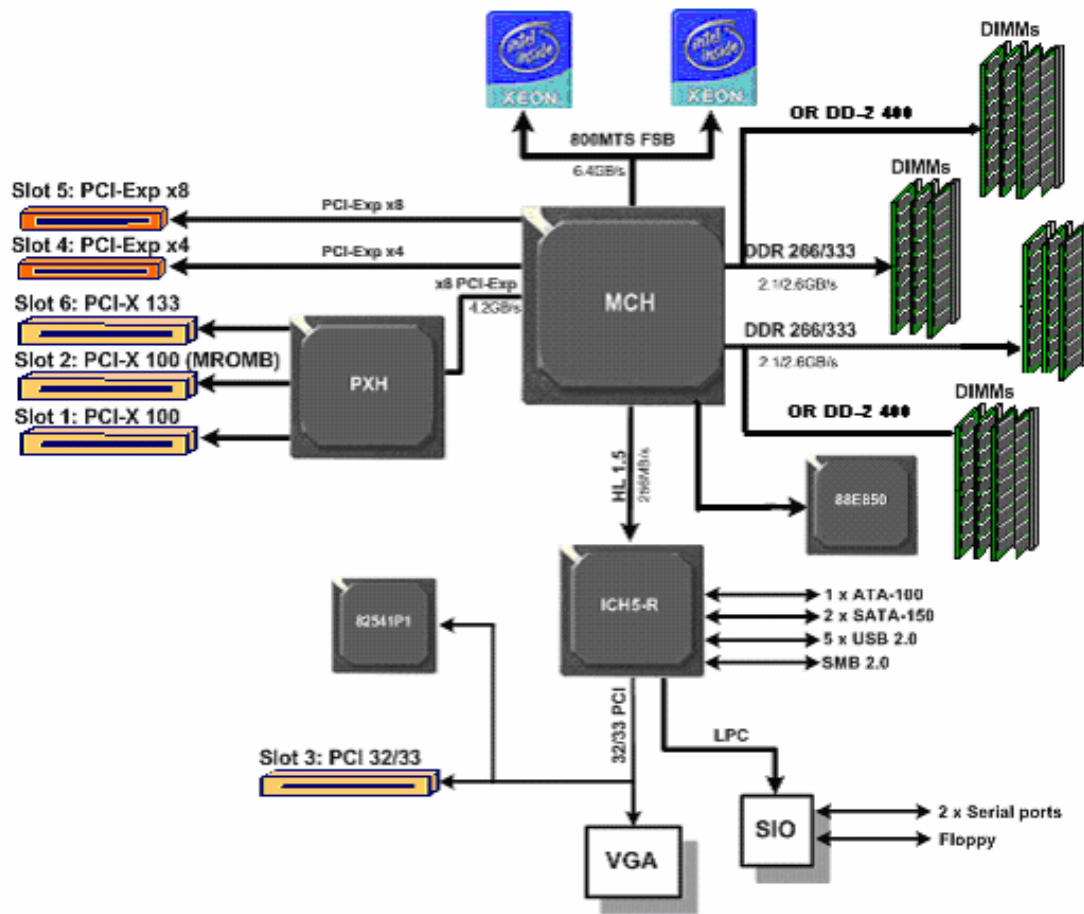


Figure 5. Product Code SE7520BD2 System Block Diagram

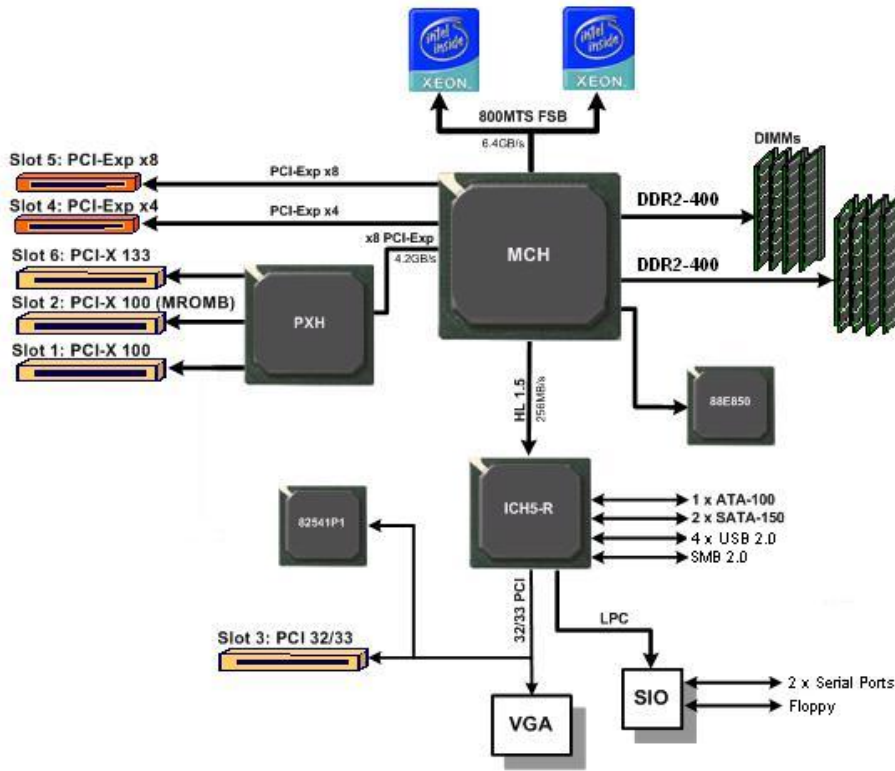


Figure 6. Product Code SE7520BD2SATAD2 System Block Diagram

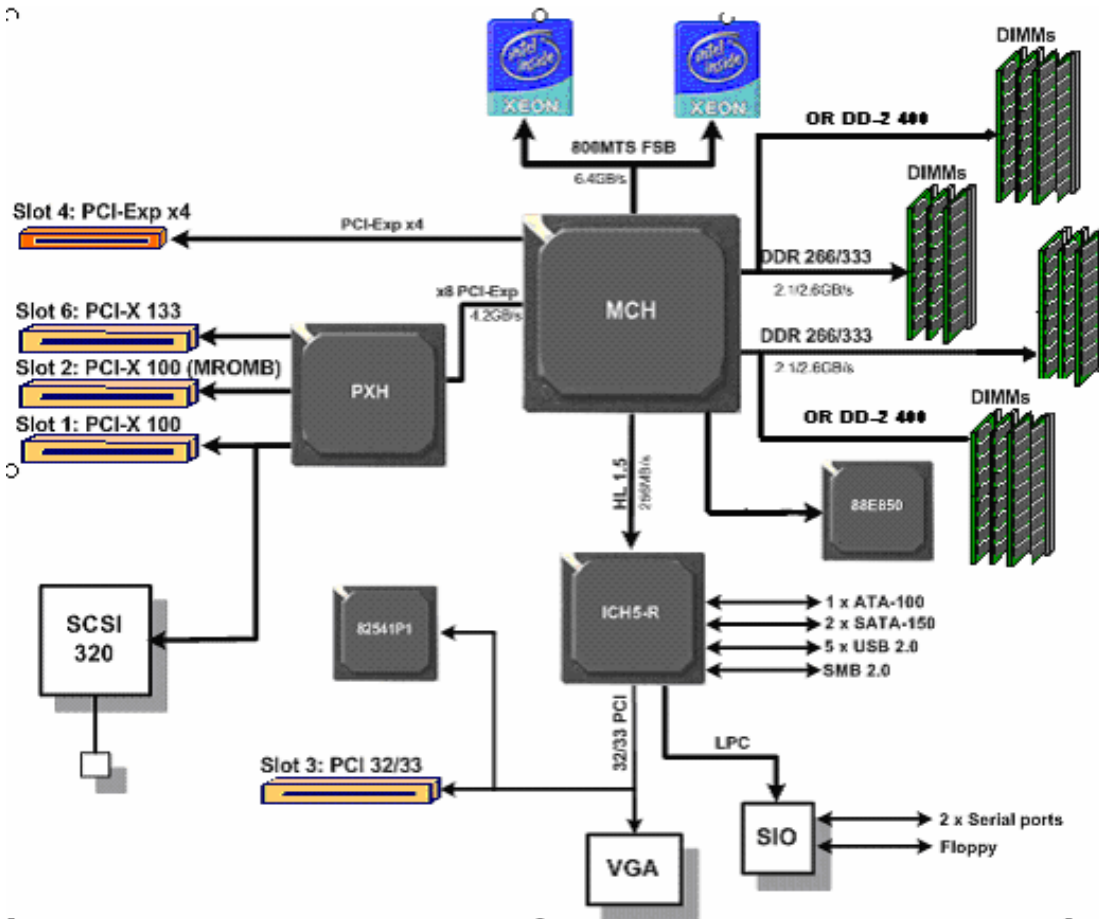


Figure 7. Product Code SE7520BD2V System Block Diagram

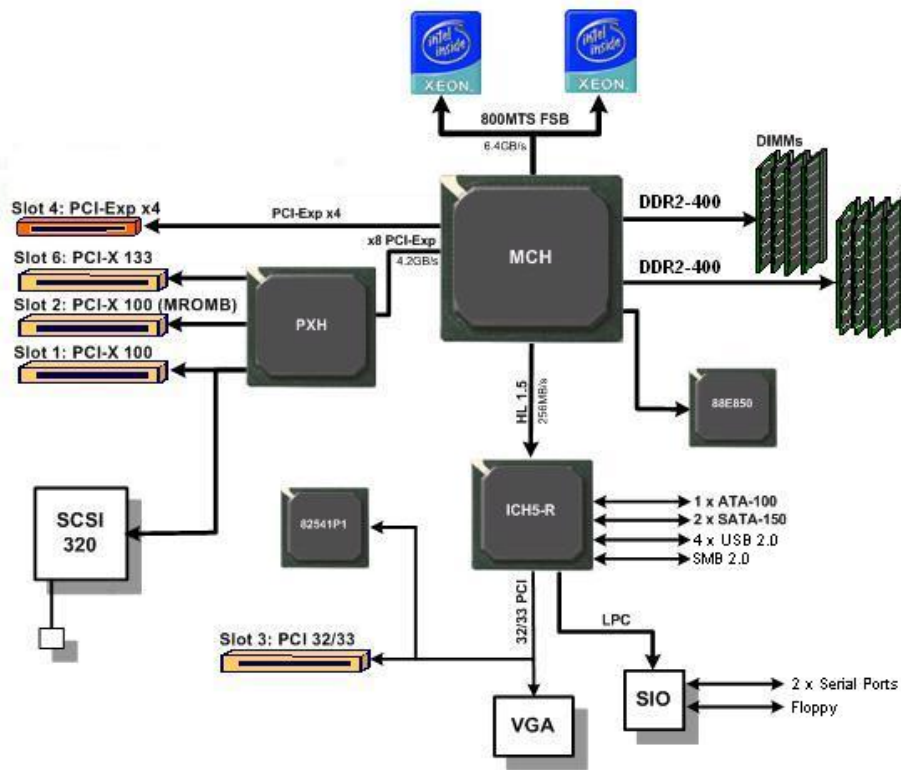


Figure 8. Intel® Server Board SE7520BD2VD2 System Block Diagram

2.5 Identifying the Version of an Intel® Server Board

The version of an Intel server board can be determined by decoding the last three digits of the board part number.

Example: C44686-703 The number following the “-“ is as follows:

- 7 = Fabrication (FAB) Number
- 03 = Revision 3.

The board part number can be found on the server board. The board part number can also be determined by using Intel® Server Management or by checking the System Management Sub-menu in BIOS Setup (see Section 3.2.8.1).

2.6 Chipset Overview

The architecture of the Server Board SE7520BD2 is designed around the Intel® E7520 chipset. The chipset consists of three components, which together are responsible for providing the interface between all major sub-systems found on the server board, including the processor, memory, and I/O sub-systems. These three components are:

- Memory Controller Hub (MCH)
- I/O Controller Hub (ICH5R)
- Intel® 6700PXH 64-bit Hub (PXH)

The MCH is configured to support the following interfaces:

- CPU Front Side Bus at 200MHz operation using AGTL+ (Assisted Gunner Transceiver Logic) signaling, 4x 64 bit data bus at 6.4GB/s.
- Dual memory channels supporting registered 72-bit data ECC DIMMs for DDR266/333 or DDR2-400. DDR bandwidth of 2.13/2.6GB/s per channel giving 4.26GB/s for both.
- Three PCI Express x8 interfaces with aggregate bandwidth of 4GB/s interfaces to PXH and other onboard devices. Each of these interfaces can be configured as two independent x4 interfaces.
- Hub Interface 1.5, 8 bits, 66MHz, 266MB/s interface to the ICH5R.
- Debug support through XDP (Extended Debug Port) connector.
- RASUM support through memory features and SMBus debug port access.

2.6.1 Memory Controller Hub (MCH)

The MCH uses a 1077-ball FC-BGA package in which it integrates four main functions:

- Front Side Bus
- Memory controller
- PCI Express controller
- Hub Link controller

2.6.2 Front Side Bus (FSB)

The Intel E7520 MCH supports either single or dual population of the Intel® Xeon™ processor. The MCH supports a base system bus frequency of 200MHz. The address and request interface is double-pumped at 400MHz while the 64-bit data interface (+ parity) is quad-pumped to 800MHz. This provides a matched system bus address and data bandwidths of 6.4GB/sec.

The newest generation of Intel® Xeon™ processors for dual-processor (DP) servers and workstations is based on the Intel® NetBurst™ microarchitecture. These processors follow the Intel® Xeon™ processor line, and are similarly backward compatible, while adding several performance enhancing architectural and microarchitectural features. They also have larger L2 caches than the previous generation.

2.6.3 MCH Memory Sub-System

2.6.3.1 DDR MCH Memory Sub-System

The MCH provides an integrated memory controller for direct connection to two channels of registered DDR266 or DDR333 memory (stacked or unstacked). The peak theoretical memory data bandwidth using DDR266 technology is 4.26GB/s. The peak theoretical memory data bandwidth using DDR333 technology is 5.33GB/S.

When both DDR channels are populated and operating, they function in lock-step mode. For the Intel E7520 MCH, the maximum supported DDR266 memory size is 32GB. However, the Server Board SE7520BD2 has six DIMM sites, which limits this maximum memory size to 24GB. The maximum supported memory for DDR333 is 16GB.

2.6.3.2 DDR2 MCH Memory Sub-System

The MCH provides an integrated memory controller for direct connection to two channels of registered DDR2-400 memory (stacked or unstacked). The peak theoretical memory data bandwidth using DDR2-400 technology is 6.4GB/s.

When both memory channels are populated and operating, they function in lock-step mode. On the Intel® Server Board SE7520BD2, the maximum supported DDR2-400 memory configuration is 16GB.

2.6.3.3 DDR and DDR2 MCH Memory Sub-System RASM Features

The Intel E7520 MCH memory interface provides several RASUM (Reliability, Availability, Serviceability, Usability and Manageability) features, including:

- Memory mirroring that allows for two copies of all data in the memory subsystem (one on each channel) to be maintained.
- Memory sparing that allows for one DIMM per channel to be held in reserve and brought on-line if another DIMM in the channel becomes defective. DIMM sparing and memory mirroring are mutually exclusive of one another.
- Hardware periodic memory scrubbing, including demand scrub support.
- Retry on uncorrectable memory errors.
- Intel® x4 Single Device Data Correction (SDDC) for memory error detection and correction of any number of bit failures in a single x4 memory device.

2.6.4 PCI Express*

The Intel E7520 MCH is the first Intel chipset to support the PCI Express* high-speed serial I/O interface for superior I/O bandwidth. The scalable PCI Express interface complies with the *PCI Express* Interface Specification, Rev 1.0a*. The MCH provide three x8 PCI Express interfaces, each with a maximum theoretical bandwidth of 4GB/s.

The Intel E7520 MCH is a root class component as defined in the *PCI Express Interface Specification, Rev 1.0a*. The PCI Express interfaces of the MCH support connection to a variety of bridges and devices compliant with the same revision of the *PCI Express Interface Specification, Rev 1.0a*. See the *Intel® Server Board SE7520BD2 Tested Hardware and OS List* for add-in cards tested with this server board.

2.6.5 Hub Interface

The MCH interfaces with the Intel® 82801ER I/O Controller Hub 5-R (ICH5R) via a dedicated Hub Interface supporting a peak bandwidth of 266MB/s using a x4 base clock of 66MHz.

2.7 Processor Subsystem

The Server Board SE7520BD2 is designed to support one or two Intel® Xeon™ processors with frequencies starting at 2.8 GHz. These newer generation processors use 90-nanometer technology and an 800MHz front side bus.

Note: Previous generations of the Intel® Xeon™ processor are not supported on the Server Board SE7520BD2.

When two processors are installed, both must be of identical revision, core voltage, cache size, and bus/core speed. When only one processor is installed, it must be in the socket labeled “CPU1” and the other socket must be empty. The support circuitry on the server board consists of the following:

- Dual 604-pin zero insertion force (ZIF) processor sockets
- Processor host bus AGTL+ support circuitry
- Reset configuration logic
- Processor module presence detection logic
- BSEL detection capabilities
- CPU signal level translation
- CEK CPU retention support

Table 1. Processor Support Matrix

Processor Family	Package Type	FSB Frequency	Technology	Frequency	Cache Size	Support
Intel® Xeon™	FC-mPGA4	667MHz		2.8 GHz	1024KB	No
Intel Xeon	FC-mPGA4	800MHz	90 nM	2.8 GHz	1024KB	Yes
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.0 GHz	1024KB	Yes
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.2 GHz	1024KB	Yes
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.4 GHz	1024KB	Yes
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.6 GHz	1024KB	Yes
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.0 GHz	2048KB	Yes ¹
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.2 GHz	2048KB	Yes ¹
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.4 GHz	2048KB	Yes ¹
Intel Xeon	FC-mPGA4	800MHz	90 nM	3.6 GHz	2048KB	Yes ¹

Note:

1. DDR boards need BIOS P07 or greater to support the Intel® Xeon™ processor with 2MB L2 cache.

The Server Board SE7520BD2 is designed to provide up to 120A per processor. Processors with higher current requirements are not supported.

2.7.1.1 Mixed Processor Steppings

For optimum system performance, only identical processors should be installed in a system. Processor steppings can be mixed in a system if there is no more than a 1-stepping difference in all processors installed. If the installed processors are more than 1-stepping apart, an error (8080 through 8183) is logged in the System Event Log (SEL) and an error (01298000 through 01298003) is reported to the Management Module. Acceptable mixed steppings are not reported as errors.

2.7.1.2 Mixed Processor Models

Processor models cannot be mixed in a system. If this condition is detected, an error (8196) is logged in the SEL.

2.7.1.3 Mixed Processor Families

Processor families cannot be mixed in a system. If this condition is detected, an error (8194) is logged in the SEL.

2.7.1.4 Mixed Processor Cache Sizes

If the installed processors have mixed cache sizes, error 8192 will be logged in the SEL and error 196 is reported to the Management Module. The size of all cache levels must match between all installed processors. Mixed cache processors are not supported.

2.7.1.5 Microcode

IA-32 processors have the capability of correcting specific errata through the loading of an Intel-supplied data block (microcode update). The BIOS is responsible for storing the update in nonvolatile memory and loading it into each processor during POST. The BIOS performs all the recommended update signature verification prior to storing the update in the Flash.

2.7.1.6 Processor Cache

The BIOS enables all levels of processor cache as early as possible during POST. There are no user options to modify the cache configuration, size or policies. All detected cache sizes are reported in the SMBIOS Type 7 structures. The largest and highest level cache detected is reported in BIOS Setup.

2.7.1.7 Hyper-Threading Technology

Intel® Xeon™ processors support Hyper-Threading Technology. The BIOS detects processors that support this feature and enables the feature during POST. BIOS Setup provides an option to selectively enable or disable this feature. The default behavior is enabled.

The BIOS creates additional entries in the ACPI MP tables to describe the virtual processors. The SMBIOS Type 4 structure shows only the physical processors installed.

2.7.2 Multiple Processor Initialization

IA32 processors have a microcode-based BSP-arbitration protocol. On reset, all of the processors compete to become the bootstrap processor (BSP). If a serious error is detected during a Built-in Self-Test (BIST), that processor will not participate in the initialization protocol. A single processor that successfully passes BIST is automatically selected by the hardware as the BSP and starts executing from the reset vector (F000:FFF0h). A processor that does not perform the role of BSP is referred to as an application processor (AP).

The BSP is responsible for executing the BIOS power-on self-test (POST) and preparing the machine to boot the operating system. At boot time, the system is in virtual wire mode and the BSP alone is programmed to accept local interrupts (INTR driven by programmable interrupt controller (PIC) and non-maskable interrupt (NMI)). For single processor configurations, the system is put in the virtual wire mode, which uses the local APIC of the processor.

As a part of the boot process, the BSP wakes each AP. When awakened, an AP programs its Memory Type Range Registers (MTRRs) to be identical to those of the BSP. All APs execute a halt instruction with their local interrupts disabled. The System Management Mode (SMM) handler expects all processors to respond to an SMI. If the BSP determines that an AP exists that is a lower-featured processor or that has a lower value returned by the CPUID function, the BSP will switch to the lowest-featured processor in the system.

2.7.3 Processor VRD

The Server Board SE7520BD2 has two Voltage Regulator Downs (VRDs) providing the appropriate voltages to the installed processors. Each VRD is compliant with the VRD 10.1 specification and is designed to support current and next generation Intel® Xeon™ processors that require up to a sustained maximum of 105A and peak support of 120A.

The server board supports the Flexible MotherBoard (FMB) for all Intel® Xeon™ processors with respect to current requirements and processor speed requirements. FMB is an estimation of the maximum values the processors will have over their lifetime. The value is only an estimate and actual specifications for future processors may differ. Currently, the demand per FMB is a sustained maximum of 105 Amps and a peak support of 120 Amps.

2.7.4 Reset Configuration Logic

The BIOS determines the processor stepping, cache size, etc., through the CPUID instruction.

All processors in the system must operate at the same frequency, have the same cache size, and have the same voltage identification (VID). No mixing of product families is supported. Processors run at a fixed speed and cannot be programmed to operate at a lower or higher speed.

2.7.5 Processor Module Presence Detection

Logic is provided on the server board to detect the presence and identity of installed processors. In dual-processor configurations, the onboard mini Baseboard Management Controller (mBMC) must read the processor VID bits for each processor before turning on the VRD. If the VIDs of the two processors are not identical, then the BMC will not turn on the VRD.

The following circuit is designed to ensure that three criteria are met prior to enabling the embedded VRD:

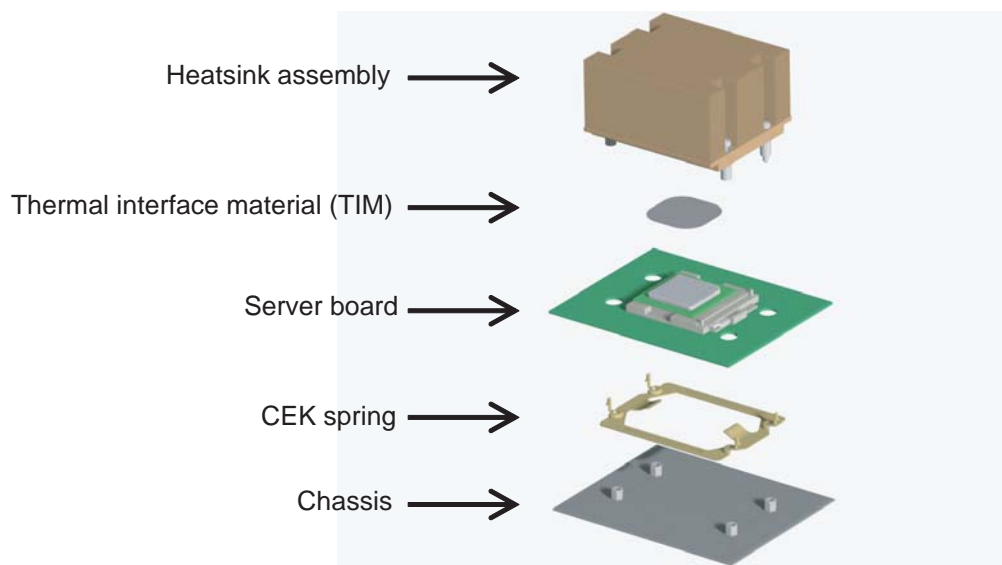
- Ensure that in a UP configuration, the end agent CPU (P1) is installed
- Disable older-generation Intel® Xeon™ processors from running in the system. This prevents possible damage to the MCH
- Ensure in a DP configuration that both processors support the same FSB frequency

2.7.6 GTL2006*

The GTL2006* is a 13-bit translator designed for 3.3V to GTL/GTL+ translations to the system bus. The translator incorporates all the level shifting and logic functions required to interface between the processor subsystem and the rest of the system.

2.7.7 Common Enabling Kit (CEK) Design Support

The server board has been designed to comply with Intel's Common Enabling Kit (CEK) processor mounting and heatsink retention solution. The server board as shipped from Intel's factory will ship with a CEK spring snapped onto the bottom side of the board beneath each processor socket. The CEK spring is removable allowing for the use of non-Intel heatsink retention solutions.



2.7.8 Process fan Variable Speed Control

The Intel® Xeon™ boxed processor with 2MB L2 cache with active heatsink solution ships with a heatsink fan that has a 4-pin harness. See the figure below. All DDR2 versions of the Server Board SE7520BD2 ship with the 4-pin CPU fan headers. This enables the fan speed to be controlled to reduce system acoustics when an active heatsink solution is used.

DDR versions of the Server Board SE7520BD2 ship with the 3-pin CPU fan header. Any change to this will be communicated with a Product Change Notification (PCN). Both the Intel® Xeon™ boxed processor with 2MB L2 cache and the Intel® Xeon™ boxed processor with 1MB L2

cache active heatsink solutions can be used of both 3-pin and 4-pin CPU fan header but there will be no variable fan speed control when a 4-pin fan is used on a 3-pin header.

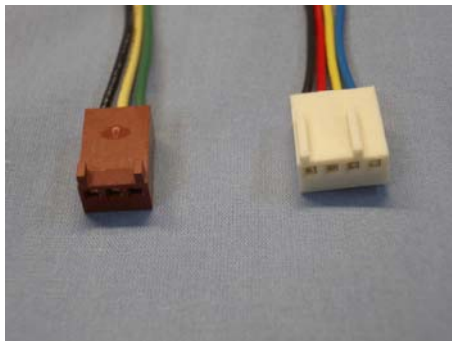


Figure 9. 3-pin and 4-pin Heatsink Fan Harnesses

2.8 Memory Sub-System

The DDR versions of the Server Board SE7520BD2 support both DDR266 and DDR333 memory. For these server boards, there are two DDR channels (channels A and B) from the MCH, each supporting three DIMM slots.

The DDR2 versions of the server board support DDR2-400 memory. For these server boards, there are two DDR2 channels (channels A and B) from the MCH, each supporting four DIMM slots.

The channels for each version of the server board can be configured to operate in dual-channel or single-channel mode. The MCH chipset requirements dictate that certain memory population rules have to be followed depending on the type of memory and the number of loads per memory channel.

The DDR server boards automatically detect the appropriate speed for the memory bus based on these rules, and sets the bus to 266 or 333 MT/s. DDR DIMMs are described as single-rank (s/r) or dual-rank (d/r). To equate loads and DIMM rank, the MCH considers a single-rank DIMM to be one load and a dual-rank DIMM to be two loads.

DIMM population starts from slot 1, the slot that is furthest from the MCH. The following table lists the numbering of the DIMM slots. The silkscreen labels are located next to each DIMM connector.

Table 2. Memory Bank Labels

Intel® Server Board SE7520BD2 Memory DIMM	Bank
J7B1 (DIMM 3A), J7B2 (DIMM 3B)	3
J7B3 (DIMM 2A), J8B1 (DIMM 2B)	2
J8B2 (DIMM 1A), J8B3 (DIMM 1B)	1

2.8.1 DDR266 Memory

For a DDR266 installation, six loads per channel are allowed on the Server Board SE7520BD2, although the Intel E7520 chipset supports eight loads. This means that for both single- and dual-rank DIMMs, the test setups previously listed can be populated with no further considerations. The test setups assume dual-channel operation. The maximum memory that can be populated is 24GB, after 4GB DIMMs are available.

2.8.2 DDR333 Memory

For a DDR333 installation, four loads per memory channel are allowed. This is a limitation of the data duty cycle of the higher frequency. This means that for both single/dual-rank DIMMs, the test setups previously listed must be populated according to the following table for each memory channel. The test setups assume dual-channel operation. Empty slots are also noted. The maximum memory that can be populated is 16GB, after 4GB DIMMs are available.

TSOP DDR333 DIMMs are not supported due to memory timing violations. Based on this, the Server Board SE7520BD2 supports only DDR333 memory in the BGA package.

2.8.3 DDR266 and DDR333 Memory Population

The following diagram identifies the memory bank locations on the server board.

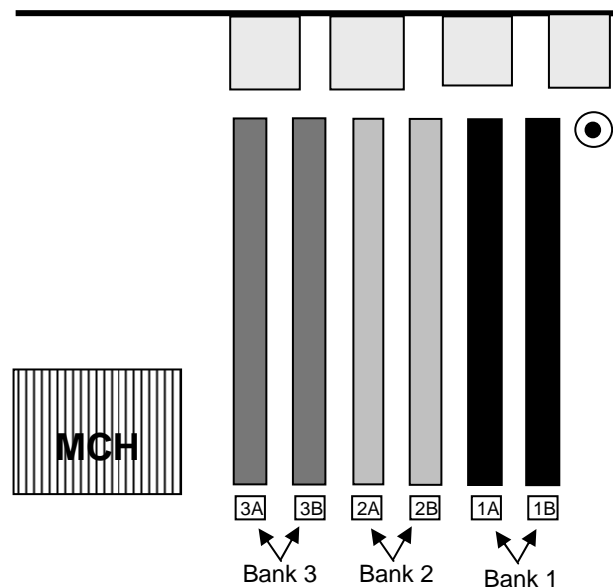


Figure 10. DDR DIMM Socket Configuration

Table 3. DDR266 Memory Population

DIMM Configuration	DIMM 1	DIMM 2	DIMM 3
One single-rank	Single-rank	Empty	Empty
One dual-rank	Dual-rank	Empty	Empty
Two single-rank	Single-rank	Single-rank	Empty
One dual-rank, One single-rank	Single-rank	Dual-rank	Empty
Two dual-rank	Dual-rank	Dual-rank	Empty
3 single-rank	Single-rank	Single-rank	Single-rank
One dual-rank, Two single-rank	Single-rank	Single-rank	Dual-rank
Two dual-rank, One single-rank	Single-rank	Dual-rank	Dual-rank
Three dual-rank	Dual-rank	Dual-rank	Dual-rank

Table 4. DDR333 Memory Population

DIMM Configuration	DIMM 1	DIMM 2	DIMM 3
One single-rank	Single-rank	Empty	Empty
One dual-rank	Dual-rank	Empty	Empty
Two single-rank	Single-rank	Single-rank	Empty
One dual-rank, one single-rank	Single-rank	Dual-rank	Empty
Two dual-rank	Dual-rank	Dual-rank	Empty
Three single-rank	Single-rank	Single-rank	Single-rank

2.8.4 DDR2-400 Memory

DDR2 versions of the Server Board SE7520BD2 support four single-ranked registered DDR2-400 DIMMs per channel, which provides a total of eight DIMMs. The maximum memory capacity supported is 16GB using eight modules of 1 Gbit DRAM technology devices.

Table 5. Supported DIMM Modules

Technology	Organization	DRAM Components / DIMM	Row / Column Address Bits
128Mb	4M X 8 X 4bks	8	12/10
	8M X 4 X 4bks	16	12/11
256Mb	8M X 8 X 4bks	8	13/10
	16M X 4 X 4bks	16	13/11
512Mb	16M X 8 X 4bks	8	14/10
	32M X 4 X 4bks	16	14/11
1Gb	32M X 8 X 8bks	8	14/10
	64M X 4 X 8bks	16	14/11

2.8.5 DDR2 DIMM Population Rules and Supported Configurations

The server board contains four banks of DIMMs: memory Bank 1 through memory Bank 4. Memory Bank 1, with DIMM sockets 1B and 1A, is located closest to the edge of the board. Moving in from the edge on the board are sockets for banks 2, 3, and 4 in order. Sockets associated with any given bank are located next to each other.

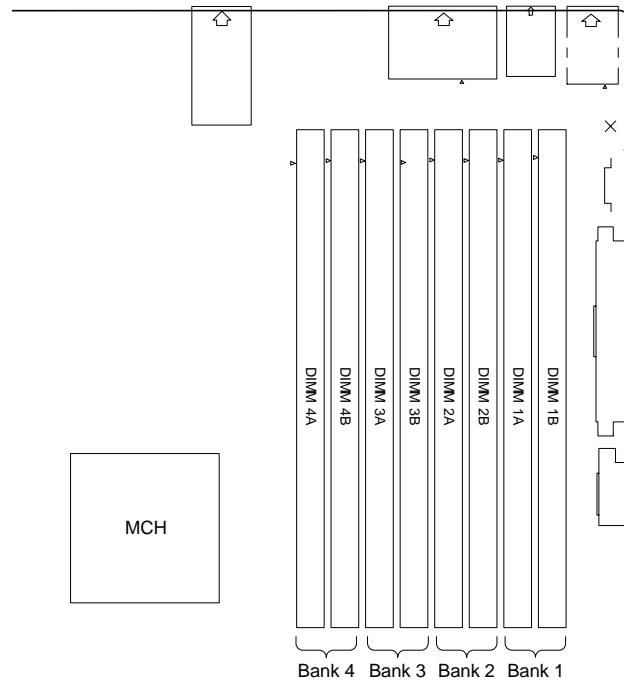


Figure 11. DIMM Socket Configuration

DIMM and memory configurations must adhere to the following:

- DDR2-400 registered ECC DIMM modules
- DIMM organization: x72 ECC
- Pin count: 240 pins
- DIMM capacity: 256MB, 512MB, 1GB, 2GB, 4GB DIMMs using current SDRAM densities
- Support up to 16GB of system memory capacity
- Support a maximum of four ranks per channel¹
- Serial PD: JEDEC Rev 2.0
- Voltage options: 1.8 V (VDD/VDDQ)
- Interface: SSTL2

¹ To populate eight DIMM modules on the board, all DIMMs must be single-rank. See the DIMM manufacturer specification to determine the number of ranks on the specific DIMM intended to be used.

- Two DIMMs must be populated in a bank for a x144 wide memory data path
- DIMMs must be populated beginning with the socket furthest away from the MCH (DIMM 1B and DIMM 1A)
- DIMMs must be identical within the same bank. For example, the DIMM in socket DIMM 1A must be identical to the DIMM in socket DIMM 1B)

2.8.6 Single-Channel Operation

The Server Board SE7520BD2 supports single-channel DIMM operation. This is where one DIMM is populated in slot 1 of either memory channel A or B. Population in other slots is not supported. The minimal size of memory that will be considered for this testing is 128MB. Single channel DIMM setups are not part of the test setups listed for the qualification process; however, they will be tested to ensure their functionality during all phases of the project.

2.8.7 ECC

The ECC used for DRAM provides Intel® SDDC x4 technology for x4 SDRAMs. DRAMs that are x8 use the same algorithm but will not have Intel® SDDC x4 technology, since at most only four bits can be corrected with this ECC.

The method provides more ECC bits so each ECC word can correct more than a single-bit failure. This is possible because different mathematical algorithms provide multiple-bit correction with the right number of data bits and ECC bits. For example, a 144-bit ECC word that consists of 128 data bits and 16 ECC bits can be used to correct up to 4-bit errors within certain bit fields of data. These four bits must be adjacent, not random. Even though the ratio of the ECC bits to data bits is the same as the previous example (16/128 vs. 8/64), the longer ECC word allows for a correction and detection algorithm that is more efficient.

2.8.7.1 DIMM Sparing Function

To increase fault tolerance, the MCH includes specialized hardware to support fail-over to a spare DIMM device in the event that a primary DIMM in use exceeds a specified threshold of runtime errors. One of the DIMMs installed per channel will not be used, but is kept in reserve. In the event of significant failures in a particular DIMM, the failing DIMM and its corresponding partner in the other channel (if applicable), will, over time, have its data copied over to the DIMM(s) held in reserve. When all the data has been copied to the reserve DIMM, the reserve DIMM(s) are put into service and the failing DIMM is removed from service. Only one sparing cycle is supported. If this feature is not enabled, then all DIMMs will be visible in normal address space.

Hardware additions for this feature include the implementation of a tracking register per DIMM to maintain a history of error occurrences, and a programmable register to hold the fail-over error threshold level. The operational model is straightforward: set the fail-over threshold register to a non-zero value to enable the feature, and if the count of errors on any DIMM exceeds that value, fail-over begins.

The tracking registers themselves are implemented in a way that they do not contain an absolute cumulative count of all errors since power-on. Instead, they contain an aggregate count of the number of errors received over a running time period. The rate for this is selectable by a DIMM software algorithm. It is possible to set the threshold to a value that will never be

reached by a “healthy” memory subsystem experiencing the rate of errors expected for the size and type of memory devices in use.

The fail-over mechanism is slightly more complex. Once fail-over has been initiated the MCH must execute every write twice; once to the primary DIMM, and once to the spare. (This requires that the spare DIMM be at least the size of the largest primary DIMM in use.) The MCH will also begin tracking the progress of its built-in memory scrub engine. Once the scrub engine has covered every location in the primary DIMM, the duplicate write function will have copied every data location to the spare. At that point, the MCH can switch the spare into primary use, and take the failing DIMM off-line.

This mechanism requires no additional software support until the threshold has been triggered to request a data copy because it is programmed in BIOS. Hardware detects the threshold initiating fail-over, and hardware escalates the occurrence of the event as directed (signal an SMI, generate an interrupt, or wait to be discovered via polling).

A software routine must respond to the threshold detection and select a victim DIMM if multiple DIMMs have crossed the threshold prior to sparing invocation. Software must also initiate the memory copy.

Hardware isolates the “failed” DIMM once the copy has completed. The data copy is accomplished by address aliasing within the DDR control interface, thus it does not require reprogramming of the DRAM row boundary (DRB) registers, nor does it require notification to the operating system that anything has occurred in memory.

The memory mirroring feature and DIMM sparing are exclusive, only one may be activated during initialization. The selected feature must remain enabled until the next power-cycle. There is no provision in hardware to switch from one feature to the other without rebooting, nor is there a provision to “back out” of a feature once enabled without a full reboot.

2.8.7.2 Memory Mirroring

Memory mirroring provides a way for hardware to maintain two copies of all data in the memory subsystem. This means a hardware failure or uncorrectable error is no longer fatal to the system. When an uncorrectable error is encountered during normal operation, hardware retrieves the “mirror” copy of the corrupted data. No system failure occurs unless both the primary and mirrored copies of the same data are corrupt simultaneously. This is statistically very unlikely.

Mirroring is supported on dual-channel DIMM populations symmetric across both channels and within each channel. As seen in the following figure, potential mirroring pairs are DIMM 1A with DIMM 2B, or DIMM 1B with DIMM 2A. As a result, on the Server Board SE7520BD2 there are two supported configurations for memory mirroring:

- Four-DIMM population of completely identical devices (two per channel). DIMMs labeled 1A, 2A, 1B and 2B must be identical.

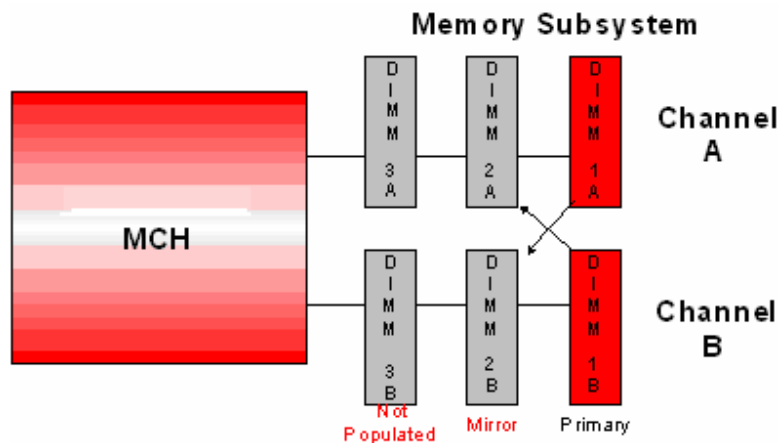


Figure 12. Memory Subsystem

These symmetry requirements are a result of the hardware mechanism for maintaining two copies of all main memory data while ensuring that each channel has a full copy of all data in preparation for fail-down to single-channel operation. Every write to memory is issued twice, once to the primary location and once to the mirror location. The data interleaved across the channel pair are swapped for the second write (1A is a copy of 2B, 1B is a copy of 2A, and so on.). The resulting memory image has two full copies of all data, with a complete copy available on each channel.

Hardware in the MCH tracks which DIMM slots are primaries, and which are mirrors, such that data may be internally realigned to correctly reassemble cache lines regardless of which copy is retrieved. There are four distinct cases for retrieval of the even and odd chunks of a cache-line of data:

- Interleaved dual-channel read to the primary DIMM with “even” data on channel A
- Interleaved dual-channel read to the mirror DIMM with “even” data on channel B
- Non-interleaved single-channel read pair to channel A with “even” data on the primary DIMM
- Non-interleaved single-channel read pair to channel B with “even” data on the mirror DIMM

When mirroring is enabled by the MCH configuration, the memory subsystem maintains two copies of all data as described above, and will retrieve requested data from either primary or mirror based on the state of system address bit 15 (SA[15]). BIOS may toggle which SA[15] polarity selects primary versus mirror via a configuration register bit setting. SA[15] was chosen because it is the lowest system address bit that is always used to select the memory row address across all DRAM densities and technologies supported by the MCH. The toggling of the primary read location based on an address bit will distribute request traffic across the primary and mirror DIMMs, thereby distributing the thermal image of the workload across all populated DIMM slots and reducing the chances of thermal-based memory traffic throttling.

In the “Mirrored” operating state, the occurrence of correctable and uncorrectable ECC errors are tracked and logged normally by the MCH, and escalated to system interrupt events as specified by the configuration register settings associated with errors on the memory subsystem. Counters implementing the “leaky bucket” function just described for on-line DIMM sparing track the aggregate count of single-bit and multiple-bit errors on a per DIMM basis.

2.8.8 I²C Bus

The system BIOS uses the I²C bus to retrieve DIMM information that is needed to program the MCH memory registers. These memory registers are required to boot the system.

The following table provides the I²C addresses for each DIMM slot.

Table 6. I²C Addresses for Memory Module SMB – DDR SKU’s

Device	Address
DIMM 3B	0xA8
DIMM 3A	0xA0
DIMM 2B	0xAA
DIMM 2A	0xA2
DIMM 1B	0xAC
DIMM 1A	0xA4

Table 7. I²C Addresses for Memory Module SMB – DDR2 SKU’s

Device	Address
DIMM 4B	0xA8
DIMM 4A	0xA0
DIMM 3B	0xAA
DIMM 3A	0xA2
DIMM 2B	0xAC
DIMM 2A	0xA4
DIMM 1B	0xAE
DIMM 1A	0xA6

2.9 PCI Sub-System

2.9.1 ICH5R PCI Interface

The Intel® 82801ER I/O Controller Hub (ICH5R) PCI interface is a multi-function device providing an upstream hub interface for access to several embedded I/O functions and features including:

- PCI Local Bus Specification, Revision 2.3 with support for 33MHz PCI operations.
- ACPI power management logic support
- Enhanced DMA controller, interrupt controller, and timer functions
- Integrated IDE controller supports Ultra ATA100/66/33
- Integrated SATA controller
- USB host interface with support for eight USB ports; four UHCI host controllers; one EHCI high-speed USB 2.0 host controller
- Integrated LAN controller
- Integrated ASF controller
- System Management Bus (SMBus) Specification, Version 2.0 with additional support for I²C devices
- Low Pin Count (LPC) interface
- Firmware Hub (FWH) interface support

Each function within the ICH5R has its own set of configuration registers. Once configured, each appears to the system as a distinct hardware controller sharing the same PCI bus interface.

2.9.1.1 PCI Interface

The ICH5R PCI interface provides a 33MHz, Revision 2.3 compliant implementation. All PCI signals are 5V tolerant, except for PME#. The ICH5 integrates a PCI arbiter that supports up to six external PCI bus masters in addition to the internal ICH5 requests.

On the Server Board SE7520BD2, this PCI interface is used to support one onboard PCI device, the ATI RAGE XL video controller, and one 5V PCI 32-bit / 33MHz slot.

2.9.1.2 IDE Interface (Bus Master Capability and Synchronous DMA Mode)

The fast IDE interface supports up to two IDE devices providing an interface for IDE hard disks and ATAPI devices. Each IDE device can have independent timings. The IDE interface supports PIO IDE transfers up to 16MB/s and Ultra ATA transfers up to 100MB/s. It does not consume any ISA DMA resources. The IDE interface integrates 16x32-bit buffers for optimal transfers. The ICH5R's IDE system contains two independent IDE signal channels. The SE7520BD2 board utilizes only one of these. They can be electrically isolated independently.

On the Server Board SE7520BD2, the primary bus is connected to the legacy IDE connector.

2.9.1.3 SATA Controller

The SATA controller supports two SATA devices, providing an interface for SATA hard disks and ATAPI devices. The SATA interface supports PIO IDE transfers up to 16 Mb/s and Serial ATA transfers up to 1.5 Gb/s (150MB/s). The ICH5R's SATA system contains two independent SATA signal ports. They can be electrically isolated independently. Each SATA device can have independent timings. They can be configured to the standard primary and secondary channels.

The Server Board SE7520BD2 supports two SATA connectors for internal hard disk drives. The ICH5 SATA RAID has two channels of SATA RAID support. It uses the LSI Logic* SATA RAID stack, which is similar to Intel's RAID stack. This provides support for RAID level 0 or 1.

The LSI* 53C1030 integrated SCSI firmware RAID controller provides for one array. In one mode RAID 0 (Integrated Striping) or RAID 1/1e (Integrated Mirroring/Enhanced) the user is provided with one array. The array will not span across channels; all array drives need to be on one channel.

2.9.1.4 Low Pin Count (LPC) Interface

The ICH5R implements an LPC Interface as described in the Low Pin Count Interface Specification, Revision 1.1. The Low Pin Count (LPC) bridge function of the ICH5 resides in PCI Device 31:Function 0. In addition to the LPC bridge interface function, D31:F0 contains other functional units, including DMA, interrupt controllers, timers, power management, system management, GPIO, and RTC.

On the Server Board SE7520BD2, the LPC bus is connected from the ICH5R to both the SIO3 (National Semiconductor* PC87427) and the Intel® Management Module connector.

2.9.1.5 Compatibility Modules (DMA Controller, Timer/Counters, Interrupt Controller)

The DMA controller incorporates the logic of two 82C37 DMA controllers with seven independently programmable channels. Channels 0–3 are hardwired to 8-bit, count-by-byte transfers. Channels 5–7 are hardwired to 16-bit, count-by-word transfers. Any two of the seven DMA channels can be programmed to support fast Type-F transfers.

The ICH5R supports two types of DMA: LPC and PC/PCI. DMA via LPC is similar to ISA DMA. LPC DMA and PC/PCI DMA use the ICH5R's DMA controller. The PC/PCI protocol allows PCI-based peripherals to initiate DMA cycles by encoding requests and grants via two PC/PC REQ#/GNT# pairs. LPC DMA is handled through the use of the LDRQ# lines from peripherals and special encoding on LAD[3:0] from the host. Single, Demand, Verify, and Increment modes are supported on the LPC interface. Channels 0–3 are 8-bit channels. Channels 5–7 are 16-bit channels. Channel 4 is reserved as a generic bus master request.

The timer/counter block contains three counters that are equivalent in function to those found in one 82C54 programmable interval timer. These three counters are combined to provide the system timer function, and speaker tone. The 14.31818MHz oscillator input provides the clock source for these three counters.

The ICH5R provides an ISA-compatible Programmable Interrupt Controller (PIC) that incorporates the functionality of two 82C59 interrupt controllers. The two interrupt controllers are cascaded so that 14 external and two internal interrupts are possible. In addition, the ICH5R supports a serial interrupt scheme. All of the registers in these modules can be read and restored. This is required to save and restore system state after power has been removed and restored to the platform.

2.9.1.6 Advanced Programmable Interrupt Controller (APIC)

In addition to the standard ISA-compatible PIC described in the previous section, the ICH5R incorporates the Advanced Programmable Interrupt Controller (APIC).

2.9.1.7 Universal Serial Bus (USB) Controller

The ICH5R contains an Enhanced Host Controller Interface Specification for Universal Serial Bus, Revision 1.0-compliant host controller that supports USB high-speed signaling. High-speed USB 2.0 allows data transfers up to 480 Mb/s, which is 40 times faster than full-speed USB.

The ICH5R also contains four Universal Host Controller Interface (UHCI) controllers that support USB full-speed and low-speed signaling. On the Server Board SE7520BD2, the ICH5R supports five USB 2.0 ports. All five ports are high-speed, full-speed, and low-speed capable. ICH5R's port-routing logic determines whether a USB port is controlled by one of the UHCI controllers or by the EHCI controller.

The Server Board SE7520BD2 product codes SE7520BD2 and SE750BD2SCSI have five USB ports: three in the back and two in the front. Product codes SE7520BD2V, SE7520BD2SCSI2, SE7520BD2SATA2, SE7520VD2D2 have four USB ports: two in the back and two in the front.

2.9.1.8 RTC

The ICH5R contains a Motorola* MC146818A-compatible real-time clock with 256 bytes of battery-backed RAM. The real-time clock performs two key functions: keeping track of the time of day and storing system data, even when the system is powered down. The RTC operates on a 32.768 KHz crystal and a separate, 3V lithium battery.

The RTC supports two lockable memory ranges. By setting bits in the configuration space, two 8-byte ranges can be locked to read and write accesses. This prevents unauthorized reading of passwords or other system security information. The RTC supports a date alarm that allows for scheduling a wake event up to 30 days in advance.

2.9.1.9 GPIO (General Purpose I/O)

Various general-purpose inputs and outputs are provided for custom system design. The number of inputs and outputs varies depending on the ICH5R configuration.

All unused GPI pins must be pulled high or low, so that they are at a predefined level and do not cause undue side effects.

Additional notes:

- GPIO 0:15 sticky bits on input, level triggered, 61 usec min time for latch
- GPIs only: 0:15, 40-47 (note 42-47 unimplemented)
- GPOs only: 16-23, 48-55 (note 49-55 unimplemented)
- GPI or GPO: 24-39 (note 35-39 unimplemented, GPIO[33] is changed to SATA LED and this GPIO is NOT available)
- GPIO resume power well: 8-15, 24-25, 27-28
- GPIO core power well: 0-7, 16-23, 32-34, 40-41, 48

Table 8. GPIO on the Intel® Server Board SE7520BD2

ICH5R Signal	Type	Pin	PWR Well	Tolerant	Intel® Server Board SE7520BD2 Usage
INTRUDER DETECT	Input	Y12	Core	3.3V	TP
GPIO/REQA	Input	A5	Core	5V	Board SKU 0
GPI1/REQB/REQ5#	Input	E7	Core	5V	Board SKU 1
GPI6/AGPBUSY#	Input	R5	Core	5V	BIOS Recovery Boot
GPI7	Input	U3	Core	5V	MCH PME
GPI8	Input	Y2	Resume	3.3V	WAKE#/PCI PME#
GPI9/OC[4]#	Input	B14	Resume	3.3V	Reserved for USB OC4 (three in back, two in front)
GPI10/OC[5]#	Input	A14	Resume	3.3V	PERR# for PCI 32bit/33Mhz slot
GPI11/SMBALERT#	Input	AC3	Resume	3.3V	Board ID 0
GPI12	Input	W4	Resume	3.3V	SIO SMI
GPI13	Input	W5	Resume	3.3V	BMC IRQ SMI
GPI14/OC[6]#	Input	D13	Resume	3.3V	SIO > ICH5R PME
GPI15/OC[7]#	Input	C13	Resume	3.3V	Password clear
GPO16/GNTA#	Output	E8	Core	3.3V	TP
GPO17/GNTB#/GNT[5]#	Output	B4	Core	3.3V	TP
GPO18/STP_PCI#	Output	U21	Core	3.3V	TP
GPO19/SLP_S1#	Output	T20	Core	3.3V	PWRGD Toggle (for PLL Select) TP
GPO20/STP_CPU#	Output	U22	Core	3.3V	Video Disable
GPO21/C3_STAT#	Output	R1	Core	3.3V	SCSI Disable
GPO22/CPUPERF#	Output	U20	Core	3.3V	TP
GPO23/SSMUXSEL#	Output	F22	Core	3.3V	Legend connector POST complete Indicator
GPIO24/CLKRUN#	I/O	AC1	Resume	3.3V	Board ID 1
GPIO25	I/O	W3	Resume	3.3V	Board ID 2
GPIO27	I/O	V3	Resume	3.3V	TP
GPIO28	I/O	W2	Resume	3.3V	SM Module Present
GPIO32	I/O	T1	Core	3.3V	Board SKU 2
GPIO34	I/O	F21	Core	3.3V	IDE Primary Cable Sense
GPI40/REQ4#	Input	C6	Core	3.3V	CMOS Clear
GPI41/LDRQ1#	Input	R2	Core	3.3V	Emergency Bank Select
GPO48/GNT4#	Output	A4	Core	3.3V	FRB Timer Halt

2.9.1.10 Enhanced Power Management

The ICH5R's power management functions include enhanced clock control, local and global monitoring support for 14 individual devices, and various low-power (suspend) states (e.g., Suspend-to-DRAM and Suspend-to-Disk). A hardware-based thermal management circuit permits software-independent entrance to low-power states. The ICH5R contains full support for the Advanced Configuration and Power Interface (ACPI) Specification, Revision 2.0b.

2.9.1.11 System Management Bus (SMBus 2.0)

The ICH5R contains a SMBus Host interface that allows the processor to communicate with SMBus slaves. This interface is compatible with most I²C devices. Special I²C commands are implemented. The ICH5R's SMBus host controller provides a mechanism for the processor to initiate communications with SMBus peripherals (slaves). Also, the ICH5R supports slave functionality, including the Host Notify protocol. Hence, the host controller supports eight command protocols of the SMBus interface (see System Management Bus (SMBus) Specification, Version 2.0): Quick Command, Send Byte, Receive Byte, Write Byte/Word, Read Byte/Word, Process Call, Block Read/Write, and Host Notify.

2.9.2 PXH

The PXH provides the data interface between the MCH and two PCI-X bus segments over a high-speed PCI Express x8 link. Each of the two PCI segments in the PXH is individually controlled to operate in either PCI or PCI-X mode.

The PXH is configured to supports the following interfaces:

- PCI-X 1.0 bus

Two hot-plug capable PCI-X slots and LSI* 1030C U320 SCSI controller on 100MHz 3.3V Bus

Both buses are also PCI-X 100MHz and PCI 66MHz 3.3V capable, depending upon the card inserted.

PCI specification, revision 2.3 compliant

PCI-X 1.0a specification compliant

PCI-X 2.0 specification compliant

3.3V

Note: The PCI-X* 1.0-compliant bus is not 5V tolerant

- PCI-X 2.0 bus

One hot-plug capable slot supporting PCI-X 133MT/s 3.3V/1.5V bus

PCI-X 2.0 uses 4 groups of source synchronous signals, each with a strobe pair. Each group is routed together on the same layer with no layer changes, and length is matched to the groups' strobes. A minimum length delta is required between strobes of the source synchronous groups corresponding with mapping of signals onto the PCI-X connector. Additional details about source synchronous groups and their constraints can be found in the PCI-X 2.0 specification.

- PCI Express X8 link (2GB/s each direction, 4GB/s total)
Used for the connection between the PXH and MCH

PCI-X Slot 6 has been modified to allow a third-party add-in riser card. This slot is capable of being populated with three types of devices:

- Standard PCI 133MHz compatible add-in card
- 1U/1 Slot PCI-X 2.0 Riser card
- 2U/2 Slot PCI-X 1.0 (PCI-X 100) Riser card

If either of the riser cards is used, the riser card pin-out must match the slot's modified PCI-X 2.0 pin-out.

Note: In the table below, the signals in **bold** represent modifications from the standard PCI-X 2.0 pin-out; however, the PCI-X 2.0 compliant cards can still be used.

Table 9. Slot 6 PCI-X Pin-out

Pin	Slot 6 PCI-X 2.0 Third- party Riser	
	Side B	Side A
1	-12V	TRST#
2	TCK	+12V
3	Ground	Riser slot 1 clock
4	TDO	Riser slot 2 clock
5	+5V	+5V
6	+5V	INTA#
7	INTB#	INTC#
8	INTD#	+5V
9	PRSNT1#	ECC[5]
10	ECC[4]	+VI/O (3.3V/1.5V)
11	PRSNT2#	ECC[3]
12	CONNECTOR KEYWAY	
13		
14	ECC[2]	3.3Vaux
15	Ground	RST#
16	CLK	+VI/O (3.3V/1.5V)
17	Ground	GNT#
18	REQ#	Ground
19	+VI/O (3.3V/1.5V)	PME#
20	AD[31]	AD[30]
21	AD[29]	+3.3V
22	Ground	AD[28]
23	AD[27]	AD[26]
24	AD[25]	Ground
25	+3.3V	AD[24]
26	C/BE[3]#	IDSEL

Pin	Slot 6 PCI-X 2.0 Third- party Riser	
	Side B	Side A
27	AD[23]	+3.3V
28	Ground	AD[22]
29	AD[21]	AD[20]
30	AD[19]	Ground
31	+3.3V	AD[18]
32	AD[17]	AD[16]
33	C/BE[2]#	+3.3V
34	Ground	FRAME#
35	IRDY#	Ground
36	+3.3V	TRDY#
37	DEVSEL#	Ground
38	PCIXCAP	STOP#
39	LOCK#	+3.3V
40	PERR#	SMBCLK
41	+3.3V	SMBDAT
42	SERR#	Ground
43	+3.3V	PAR/ECC[0]
44	C/BE[1]#	AD[15]
45	AD[14]	+3.3V
46	Ground	AD[13]
47	AD[12]	AD[11]
48	AD[10]	Ground
49	M66EN	AD[09]
50	Mode 2	Ground
51	Ground	Ground
52	AD[08]	C/BE[0]#
53	AD[07]	+3.3V
54	+3.3V	AD[06]
55	AD[05]	AD[04]
56	AD[03]	Ground
57	Ground	AD[02]
58	AD[01]	AD[00]
59	+VI/O (3.3V/1.5V)	+VI/O (3.3V/1.5V)
60	ACK64#/ECC[1]	REQ64#/ECC[6]
61	+5V	
62		
KEYWAY	KEYWAY	
63	Reserved	Ground
64	Ground	C/BE[7]#
65	C/BE[6]#	CBE[5]#/AD[48]
66	CBE[4]#/AD[49]	+VI/O (3.3V/1.5V)
67	Ground	PAR64/ECC[7]
68	AD[63]	AD[62]

Pin	Slot 6 PCI-X 2.0 Third- party Riser	
	Side B	Side A
69	AD[61]	Ground
70	+VI/O (3.3V/1.5V)	AD[60]
71	AD[59]	AD[58]
72	AD[57]	Ground
73	Ground	AD[56]
74	AD[55]	AD[54]
75	AD[53]	+VI/O (3.3V/1.5V)
76	Ground	AD[52]
77	AD[51]	AD[50]
78	AD[49]/CBE[4]#	Ground
79	+VI/O (3.3V/1.5V)	AD[48]/CBE[5]#
80	AD[47]	AD[46]
81	AD[45]	Ground
82	Ground	AD[44]
83	AD[43]	AD[42]
84	AD[41]	+VI/O (3.3V/1.5V)
85	Ground	AD[40]
86	AD[39]	AD[38]
87	AD[37]	Ground
88	+VI/O (3.3V/1.5V)	AD[36]
89	AD[35]	AD[34]
90	AD[33]	Ground
91	Ground	AD[32]
92	Riser Presence 1	Riser Presence 0
93	Slot2 REQ	Ground
94	Ground	Slot2 GNT

2.9.3 Ultra320 SCSI Controller

The Server Board SE7520BD2 provides an embedded dual-channel SCSI bus through the use of an LSI* AIC-1030C SCSI controller. The AIC-1030C controller contains two independent SCSI controllers that share a single 64-bit/100MHz PCI-X mode 1 bus master interface as a multifunction device, packaged in a 456-pin BGA. Internally, each controller is identical, capable of operations using either 16-bit SE or LVD SCS providing 40MBps (Ultra-wide SE), 80MBps (Ultra 2), 160MBps (Ultra 160/m) or 320MBps (Ultra 320/m). Each controller has its own set of PCI configuration registers and SCSI I/O registers. The Server Board SE7520BD2 supports disabling of the onboard SCSI controller through the BIOS setup menu.

The Server Board SE7520BD2 provides active terminators, termination voltage, a polyswitch fuse, and a protection diode for both SCSI channels. By design, the onboard terminators are enabled and no ability is provided to turn off the terminators. The user should plug-in the SCSI devices in such a way that the SCSI controller is always at one end of the SCSI bus. This provides either RAID 0 (integrated striping) or RAID 1/1e (integrated mirroring/enhanced) support. The array will not span across multiple channels. All array drives need to be on one channel only.

2.9.4 Modular RAID on MotherBoard (MROMB)

The Server Board SE7520BD2 baseboard provides the hooks to support Modular RAID on MotherBoard (MROMB).

The PCI-X IRQs for slot 2 are PAIRQ<7.4>. During normal operation (no MROMB installed), PAIRQ 6 and 7 are shared between the SCSI device and PCI-X slot 2. When MROMB is installed, these interrupts are disconnected from the PXH and used between the SCSI controller and the PCI-X slot with the MROMB card. The following diagram outlines the connections on the server board.

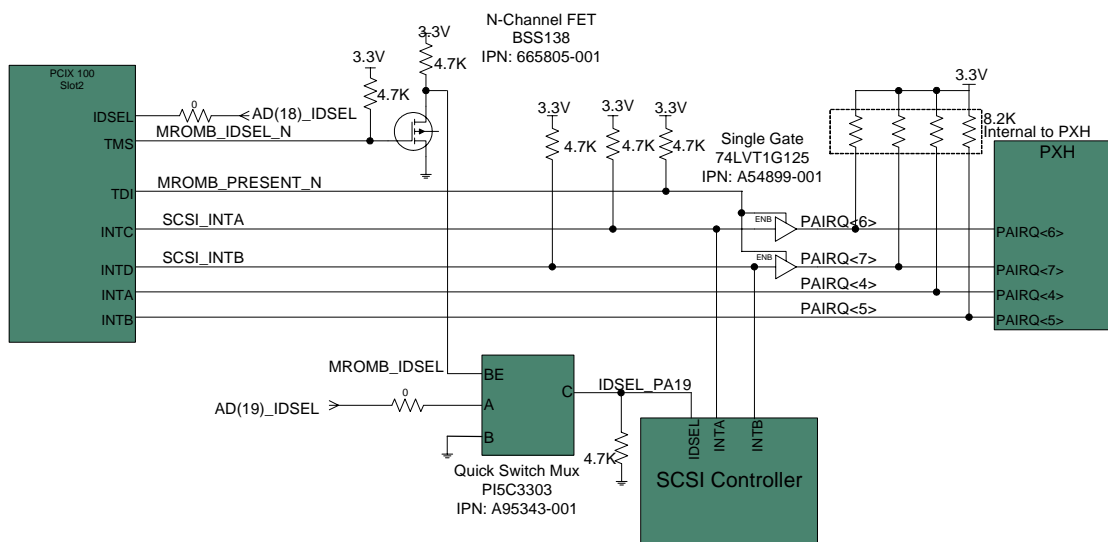


Figure 13. MROMB Implementation

Table 10. Signal Description/Functionality

PCI Card Signal	Server Board Signal	Description
TMS	MROMB_IDSEL_N	When Asserted, disconnects PAA17_N from the SCSI controller
TDI	MROMB_PRESENT_N	When Asserted, disconnects IRQ's (SCSI_INTA and SCSI_INTB) from the PXH
INTC	SCSI_INTA (PAIRQ<6>)	Shared interrupt between the PCI-X slot and the SCSI controller.
INTD	SCSI_INTB (PAIRQ<7>)	Shared interrupt between the PCI-X slot and the SCSI controller.

Table 11. Quick Switch MUX Functionality

MROMB_IDSEL	IDSEL_PA19
0	AD(19)_IDSEL
1	GND

2.10 IO Sub-System

2.10.1 Server I/O

The Server I/O is provided by the National Semiconductor* PC87427 controller. This controller is located on the ICH5R LPC bus. For LPC and SMBus access, the PC87427 features a fast X-Bus, over which boot flash and I/O devices can be accessed. The PC87427 supports X-Bus address line forcing (to 0 or 1) to access two BIOS code and data sets.

The SMBus controls serial port float, RTC access, and serial port interconnection (snoop and take-over modes). The PC87427 system health support includes a serial interface to LMPC0 health sensors, fan monitoring and control, and a chassis intrusion detector. The PC87427 incorporates a floppy disk controller (FDC), two serial ports (UARTs), a keyboard and mouse controller (KBC), general-purpose I/O (GPIO), GPIO extension for additional off-chip GPIO ports, and an interrupt serializer for parallel IRQs.

The SIO3 has the following features:

- 3.3V operation, standby powered
- Legacy modules: FDC, two Serial ports (UARTs) and a keyboard and mouse controller (KBC)
- LPC interface
- 8/16-bit fast X-Bus extension for boot flash, memory and I/O
- Two sets of BIOS code and data support, for main and back-up BIOS
- System health support, including LMPC sensor interface, fan monitor/control, and chassis intrusion detection, for all configurations (i.e., with or without a BMC or mBMC)
- Serial Interface for manageability (Serial Interface M). Two-to-one internally multiplexing of Serial Ports 1 and 2.
 - One external serial port
 - One internal serial port. This port can become the Emergency Management Port (EMP) if the system management card supports EMP
- 52 GPIO ports with a variety of wake-up events plus GPIO extension for additional off-chip GPIO ports
- Watchdog for autonomous system recovery for BIOS Boot process and for operating system use
- Pulse-Width-Modulated Fan Speed Control and Fan Tachometer Monitoring

2.10.2 Intel® 3-Volt Advanced+ Boot Block Flash Memory

The server board incorporates an Intel® 3-Volt Advanced+ Boot Block 28F320C3BD70 Flash memory component. The flash memory device interfaces to the server I/O via the 16-bit XBUS and contains the following:

- 32 megabit organized as 2048 K-words of 16 bits each
- Zero-latency, flexible block locking
- 128-bit Protection Register
- Ultra low-power operation at 2.7V
- Minimum 100,000 block erase cycles
- 48-pin VF-BGA package

2.10.3 Video Controller

The ATI RAGE XL video controller resides on the PCI 32-bit/33MHz bus of the ICH5R. It features the following:

- 5V 32-bit/33MHz PCI operation PCI Rev 2.3 compliant
- PCI version 2.1 bus mastering with scatter/gather support
- 32-bit wide memory mapped registers
- 64Mb SDRAM (512K * 32 * 4banks) at 143MHz

Instead of the 29.4MHz crystal specified in the ATI RAGE XL specification, a 14MHz clock from the CK409B clock generator is used to clock the ATI RAGE XL controller.

2.10.4 NIC Controllers

2.10.4.1 Marvell* “Yukon” 88E8050 – PCI Express LAN Controller

The Marvell* “Yukon” 88E8050 Gigabit Ethernet controller is a single, compact component with integrated Gigabit Ethernet Media Access Control (MAC) and physical layer (PHY) functions. This device uses PCI Express architecture (Revision 1.0a). The Marvell “Yukon” 88E8050 controller provides a standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE-TX, and 10BASE-T applications (802.3, 802.3u, and 802.3ab). In addition to managing MAC and PHY Ethernet layer functions, the controller manages PCI Express packet traffic across its transaction link and physical/logical layers via a x1 PCI Express link. The Marvell “Yukon” 88E8050 controller is packaged in a 64-pin, 9x9mm QFN package.

2.10.4.2 Intel® 82541PI Gigabit Ethernet Controller

The Intel® 82541PI Gigabit Ethernet controller is a single, compact component with an integrated Gigabit Ethernet Media Access Control (MAC) and physical layer (PHY) functions. The controller allows for Gigabit Ethernet implementation in a very small area. It integrates fourth-generation gigabit MAC design with fully integrated, physical layer circuitry to provide a standard IEEE 802.3 Ethernet interface for 1000BASE-T, 100BASE-TX, and 10BASE-T applications (802.3, 802.3u, and 802.3ab). The controller is capable of transmitting and receiving data at rates of 1000 Mbps, 100 Mbps, or 10 Mbps. The device interfaces with the ICH5R from the 32-bit PCI 2.3 compliant bus running at 33MHz.

2.11 Clock Generation and Distribution

2.11.1 CK409 Clock Generator

The CK409 clock generator provides four differential output pairs for all of the bus agents: one 100MHz differential output pair SRC (serial reference clock) for all PCI Express devices through DB800 companion differential buffer, and three 66MHz speed clocks that drive I/O buses, 66MHz clocks, 48MHz clocks, 33MHz clocks and 14MHz clocks.

The clock generator is configured to support the following clocks:

- Three host clock pairs for P1, P2, MCH
- 66MHz clocks for the ICH5R and MCH
- 33MHz clocks for ICH5R, SIO3, ATI* RAGE XL video controller, Intel® Management Module (IMM) connector, 82541PI LAN controller, PCI 32-bit/33MHz slot
- 48MHz clocks for the ICH5R and SIO3
- 14MHz clocks for the ICH5R and ATI RAGE XL video controller
- One 100MHz reference clock to the DB800 (for generating 100MHz Serial Reference Clocks).

2.11.2 DB800 Differential Buffer

The DB800 differential buffer provides 100MHz reference clocks for the PCI Express devices/slots and Serial ATA components. The DB800 accepts a single differential clock input from the CK409 clock synthesizer and produces eight buffered differential outputs.

On the Server Board SE7520BD2, the SRC is connected to the ICH5R, MCH, PXH, two PCI Express slots and the Marvell* Yukon 88E8050 LAN.

3. BIOS Architecture

The BIOS is implemented as firmware that resides in the Flash ROM. It provides hardware-specific initialization algorithms and standard PC-compatible basic input/output (I/O) services, and standard Intel® server board features. The Flash ROM also contains firmware for certain embedded devices. These images are supplied by the device manufacturers and are not specified in this document.

3.1 BIOS Functionality

The BIOS for the Intel® Server Board SE7520BD2 is comprised of the following components:

- The IA-32 core BIOS – This component contains most of the standard services and components found in an IA-32 system, e.g., PCI Resource manager, ACPI support, POST and RUNTIME functionality.
- The extensible firmware interface (EFI) - This is an abstraction layer between the operating system and system hardware.
- Server BIOS extensions – Provide support for the mini Baseboard Management Controller (mBMC) and Intelligent Platform Management Interface (IPMI).
- Processor Microcode Updates – The BIOS also includes the latest processor Microcode updates.

3.1.1 Support for BIOS Features

Table 12. BIOS Feature Support

Feature	Description / Comments
Support at least 128KB of available option space (C0000h ~ E0000h)	If possible, Intel will support available option ROM space from C0000h to E8000h.
Support Wired for Management specification as required to obtain WHQL compliance <i>Added to document, Microsoft Windows Logo Program System and Device Requirements 2.0</i>	
PXE 2.1 - PXE 2.1 (or higher) for onboard network controllers	PXE2.1 support PXE optional ROM with no setup screen For Intel® 82541PI and Marvell* Yukon 88E8050 Gbit NIC
Support Boot Integrity Services (BIS). Security handshake on PXE	
UUID - UUID Support (open standard in PXE environment)	UUID is written during manufacture
Wake up	RTC (real time clock): S1/S4 PME: S1/S4 Ring: S1/S4 PS/2* KB/MS: S1 USB: S1 Power button: S1/S4/S5

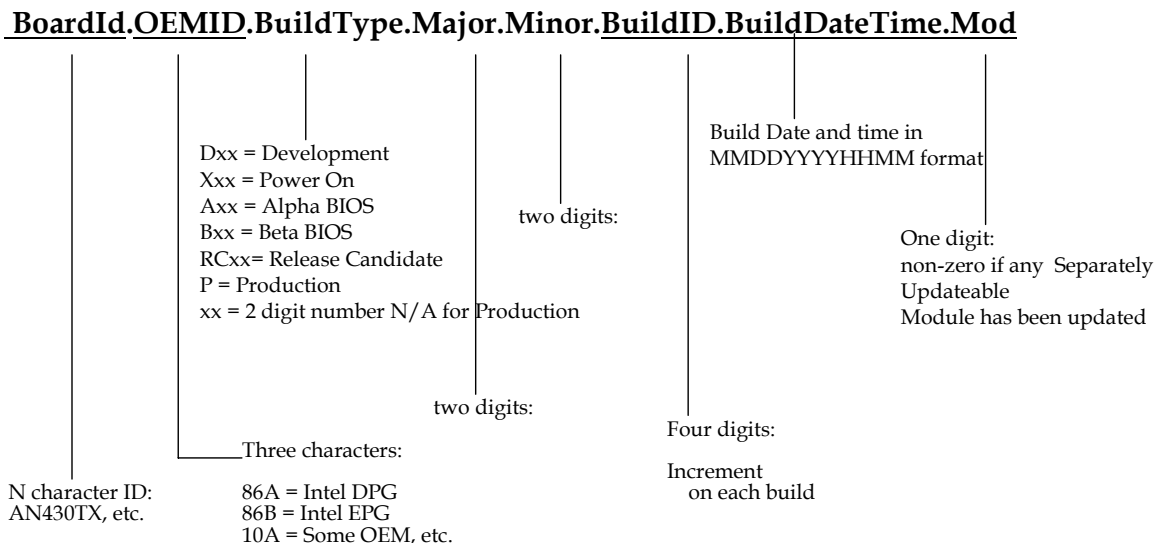
Feature	Description / Comments
USB Boot	USB boot support for USB 1.1/2.0 legacy compliant hard disk drive, CD-ROM drive, floppy drives, and disk-on-key
Support for BIOS recovery	LS120/LS240 USB bootable devices such as Disk-on-key (USB 1.1/2.0) or USB CD-ROM(1.1/2.0) ATAPI CD-ROM ATAPI DVD No support for legacy/USB floppy due to BIOS image size (2MB)
Legacy USB device support	Legacy USB KB/MS Implemented by SMI
Post Code/Port 80 Capture: Support POST Progress FIFO feature. Captures POST Codes and Port 80 codes for debugging with either a PCI plug-in POST card or onboard LEDs	Supported via onboard LEDs Log the POST check points to BMC
NMI dump switch support Logging of NMI dump event	Front panel NMI button Operating system logs the dump data if the NMI button is pressed.
Power-On AC Link: When the power returns after failure, if it was on it powers back on, if it was off it stays off.	Resume to latest and off state
Power Switch Disable: Power switch can be disabled	Power button can be disabled by BIOS setup.
CPU/Memory Failure: Continuous operation with disabled CPU/Memory (Supported at boot only)	BIOS will remember each boot and BIOS setup to reset.
BIOS Boot Block: BIOS has a segregated boot block enabling recovery of a corrupted BIOS. Uses BIOS Recovery Jumper	Force BIOS recovery by jumper or BIOS corruption detected. Protect boot block by using the block lock feature built into the Intel flash device (28F320C3) with "bottom boot".
BIOS Update: Enable Flash BIOS update and allow updates from network drives in DOS and via PXE	Support for CD-ROM, USB storage and network except for floppy
Chassis intrusion detection	Intel® Server Management (ISM) will detect chassis intrusion state, and notify administrator via network
Hardware support for monitoring voltages, temperature, fans	Supported by BMC
BIOS Setup will provide options to disable onboard I/O Peripheral components (LAN components, Serial ATA, SCSI, etc.). When disabled, these components are removed from the PCI address space, making them invisible to any loaded operating system	It is possible to disable embedded video (ATI RAGE* XL), SCSI (LSI* 53C1030), ICH5R serial ATA, and NIC (Intel® 82541PI and Marvell* Yukon 88E8050) controllers.
BIOS Setup provides options to disable/enable optional ROMs of onboard devices and PCI slots.	
Ability to store error events in non-volatile space	System stores events via BMC.
Rolling BIOS	Stores two versions of the BIOS on the board. It is possible to fail over if one bios is corrupted
Support for Spilt Option ROM based on PCI-SIG <i>PCI Firmware Specification</i> Revision 3.0	
On-line BIOS update capability	Ability to update BIOS or firmware while the operating system is up. Update takes effect at next reboot.

Feature	Description / Comments
SUP Utility	<p>SUP Utility allows updates of BMC/HSC firmware, FRU/SDR and BIOS 1)</p> <p>1) Ability to update all SW/FW in a single batch process, with one reboot at the end of the process.</p> <p>2) Ability to do # 1 after booting to a PXE server where the BMC+HSC+FRU/SDR+BIOS update files are stored.</p> <p>3) Ability to do # 1 after booting locally to a floppy diskette and then mapping to a shared network drive where the BMC+HSC+FRU/SDR+BIOS update files are stored.</p> <p>4) Current ability to do # 1 from hard drive, and CD-ROM drive needs to be maintained.</p>
Active thermal management to minimize noise at the system level. Should adhere to the acoustic section of the Blue Angel specification	Supported via BMC
Factory Automation support	This includes the ability to upgrade/update FW, BIOS, CMOS settings, OEM splash screen image, FRU/SDR and HSC code remotely (over a LAN) using automated tools in a volume production environment.
NMI detection	<p>Ability to detect parity/system errors on all PCI buses</p> <p>Ability to detect single/multiple bit error</p>
Support for sleep button	
Support for clear password by jumper	
Support for clear CMOS by jumper	
Support for IPMI 2.0/1.5	Mini BMC (1.5 compliant) or server module card (Sahalee 2.0 compliant))
Support for Intel diagnostic LEDs	
Support for serial console redirection	COMA/COMB
Support for serial on LAN (SOL)	Supported by Sahalee BMC
Support for FRU LEDs	
Support for FRB-1/2/3	
Support for EFI -32	EFI Rev. 1.1
Support for memory	<p>DDR266/333 or DDR2-400</p> <p>Memory re-map</p> <p>Memory Intel single device data correction (SDDC). Only for memory dual-channel mode</p> <p>Max memory size:</p> <p>24GB for DDR266</p> <p>16GB for DDR333</p> <p>16GB for DDR2-400</p> <p>Memory mirror: Dual-channel only</p> <p>Memory spare: Dual- and single-channel</p> <p>Mixing of DDR333 and DDR266: DDR333 is treated as DDR266</p>

Feature	Description / Comments
Support for CPU	Hyper-threading: enable/disable in BIOS Setup CPU Micro code update during POST CPU Micro code update during runtime POST and runtime (Int 15h, AX= 0D042h) Allow variable size microcode update (The maximum size of a microcode is 16KB)
Support for BBS	BBS Rev. 1.02
Support for PCI	PCI-X PCI-X* DDR PCI Express*
Support for MPS (APIC mode)	MPS 1.4 (MPS table)
Support for PIC mode	PCI IRQ routing table
Support for ACPI	ACPI 2.0 S0/S1/S4/S5 ACPI SPCR (serial port console redirection) table
Support for SMBIOS	SMBIOS 2.3.1 Below 1MB in memory
Support for KB and MS swap	AMI* firmware
No support for parallel port	Not supported by NS* PC87427
BIOS warning messages in English instead of beep codes, assuming video is available	
Multi-language	English/French/Spanish/Italian/ German
Support for security	PS/2 KB and MS lock Floppy write protection Video blanking Front panel lock Password protection
Support for boot	Quiet boot during POST Quick boot during POST Console-free boot Boot menu
Windows BIOS update utility	
Server Management	
Power control in any state (operating system up, down, hung)	Required ISM
Sensor monitoring and fault alerting while operating system present	Requires ISM
Fault alerting via local or via LAN while operating system present	Requires ISM
Remote BIOS / Firmware upgrade	BIOS support not available.
IPMI / DMI / CIM compliant	IPMI 1.5/2.0 and CIM. Full IPMI 2.0 for server module (Sahalee) Subset of IPMI 1.5 for onboard NS PC87431 mBMC
Integration with ISM software	
operating system support	Microsoft* Windows* 2003, 2000, Linux, Novell*
Security features to protect unwanted tampering of the server	ISM provides chassis intrusion and HW and SW change reporting.

3.1.2 BIOS Identification String

The BIOS Identification string is used to uniquely identify the revision of the BIOS being used on the system. The string is formatted as follows:



The system BIOS has the following unique BIOS ID: SE7520BD2.

The following is a sample production data string that is displayed during POST:

SE7520BD20.86B.X02.01.00.0002.081320031156

3.1.3 Hardware Requiring BIOS Support

The Server Board SE7520BD2 contains the following onboard Application Specific Integrated Circuits (ASICs) that require BIOS support:

- Intel® E7520 MCH with Memory with PCI-E and Mirror/Spare support.
- Intel® ICH5R to integrate USB controller 2.0, Serial ATA100, IDE controller, SMBUS controller, LPC Bridge, and RTC.
- Intel® PXH PCI bridge to support PCI-X /PCI-X DDR
- 4MB flash ROM to provide BIOS code storage.
- National Semiconductor* PC87427 Super I/O to integrate Serial Ports/PS/2 KB/MS/Floppy and hardware monitor functionality.
- ATI* RAGE XL with 8MB SDRAM support
- LSI* 53C1030 SCSI controller providing dual-channel Ultra320
- Intel® 82541PI NIC providing single-channel 10/100/1000
- Marvell* Yukon 88E8050 NIC providing single-channel 10/100/1000

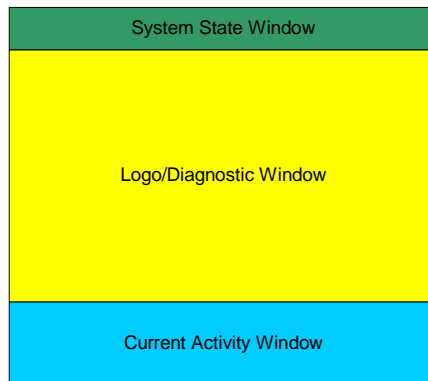
3.1.4 BIOS POST

The BIOS supports one system splash screen. When the system is booting, the BIOS displays the splash screen instead of BIOS messages. The user can view BIOS messages by pressing the <Esc> key during POST. Once the BIOS POST message screen is selected, the splash screen is no longer accessible during the current boot sequence. The splash screen can be customized by using the 'Change Logo' utility. See the Change Logo for AMIBIOS User's Guide, Version 2.22, for details.

3.1.5 User Interface

Two types of consoles are used for displaying the user interface: graphical or text-based. Graphical consoles are displayed in 640x480 mode. Text-based consoles are displayed in 80x25 mode.

Console output is partitioned into three areas: System State Window, Logo/Diagnostic Window, and Current Activity Window. The System State Window displays information about the current state of the system (i.e., is it active, hung, or requires user intervention). The Logo/Diagnostic Window displays the OEM splash screen logo or a diagnostic boot screen. The Current Activity Window displays information about the currently executing portion of POST as well as user prompts or status messages.



When the CMOS is corrupt, the BIOS displays the following message:

```
Press F1 for Setup and F2 to Continue
```

The BIOS pauses at this message for 5 seconds. If no response is received, the BIOS continues the boot process using default setup settings.

The BIOS displays the following information during POST:

- Copyright message
- BIOS ID
- Current processor configuration
- Installed physical memory size
- Current activity and user intervention

3.2 BIOS Setup Utility

The BIOS Setup Utility is provided to perform system configuration changes as well as to display current settings and environment information.

The BIOS Setup stores configuration settings in system non-volatile storage. Changes effected by BIOS Setup will not take effect until the system is rebooted. The BIOS Setup Utility can be accessed from POST by pressing the <F2> key.

3.2.1 Entering BIOS Setup

The BIOS Setup Utility is accessed by pressing the <F2> key during POST.

3.2.2 Keyboard Commands

The Keyboard Command Bar supports the following keyboard commands.

Table 13. BIOS Setup Utility Keyboard Commands

Key	Option	Description
Enter	Execute Command	The <Enter> key is used to activate sub-menus when the selected feature is a sub-menu, or to display a pick list if a selected option has a value field, or to select a sub-field for multi-valued features like time and date. If a pick list is displayed, the <Enter> key will undo the pick list, and allow another selection in the parent menu.
ESC	Exit	The <Esc> key provides a mechanism for backing out of any field. This key will undo the pressing of the <Enter> key. When the <Esc> key is pressed while editing any field or selecting features of a menu, the parent menu is re-entered. When the <Esc> key is pressed in any sub-menu, the parent menu is re-entered. When the <Esc> key is pressed in any major menu, the exit confirmation window is displayed and the user is asked whether changes can be discarded. If "No" is selected and the <Enter> key is pressed, or if the <Esc> key is pressed, the user is returned to where they were before <Esc> was pressed without affecting any existing settings. If "Yes" is selected and the <Enter> key is pressed, setup is exited and the BIOS continues with POST.
	Select Item	The up arrow is used to select the previous value in a pick list, or the previous options in a menu item's option list. The selected item must then be activated by pressing the <Enter> key.
	Select Item	The down arrow is used to select the next value in a menu item's option list, or a value field's pick list. The selected item must then be activated by pressing the <Enter> key.
	Select Menu	The left and right arrow keys are used to move between the major menu pages. The keys have no affect if a sub-menu or pick list is displayed.
Tab	Select Field	The Tab key is used to move between fields. For example, tab can be used to move from hours to minutes in the time item in the main menu.
-	Change Value	The minus key on the keypad is used to change the value of the current item to the previous value. This key scrolls through the values in the associated pick list without displaying the full list.
+	Change Value	The plus key on the keypad is used to change the value of the current menu item to the next value. This key scrolls through the values in the associated pick list without displaying the full list. On 106-key Japanese keyboards, the plus key has a different scan code but will have the same effect

Key	Option	Description						
F9	Setup Defaults	<p>Pressing <F9> causes the following to appear:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2" style="text-align: center;">Setup Confirmation</td> </tr> <tr> <td colspan="2" style="text-align: center;">Load default configuration now?</td> </tr> <tr> <td style="text-align: center;">[Yes]</td> <td style="text-align: center;">[No]</td> </tr> </table> <p>If “Yes” is selected and the <Enter> key is pressed, all Setup fields are set to their default values. If “No” is selected and the <Enter> key is pressed, or if the <Esc> key is pressed, the user is returned to where they were before <F9> was pressed without affecting any existing field values</p>	Setup Confirmation		Load default configuration now?		[Yes]	[No]
Setup Confirmation								
Load default configuration now?								
[Yes]	[No]							
F10	Save and Exit	<p>Pressing <F10> causes the following message to appear:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2" style="text-align: center;">Setup Confirmation</td> </tr> <tr> <td colspan="2" style="text-align: center;">Save Configuration changes and exit now?</td> </tr> <tr> <td style="text-align: center;">[Yes]</td> <td style="text-align: center;">[No]</td> </tr> </table> <p>If “Yes” is selected and the <Enter> key is pressed, all changes are saved and Setup is exited. If “No” is selected and the <Enter> key is pressed, or the <Esc> key is pressed, the user is returned to where he or she was before <F10> was pressed without affecting any existing values.</p>	Setup Confirmation		Save Configuration changes and exit now?		[Yes]	[No]
Setup Confirmation								
Save Configuration changes and exit now?								
[Yes]	[No]							

3.2.3 Menu Selection

The first screen displayed upon entering the BIOS Setup Utility is the Main Menu Selection screen. This screen displays the various major menu selections available.

3.2.4 Main Menu

The first screen displayed when entering the BIOS Setup Utility is the Main Menu selection screen. This screen displays the major menu selections available: The following tables describe the available options on the top level and lower level menus. Default values are shown in **bold** text.

Table 14. BIOS Setup, Main Menu Options

Feature	Options	Help Text	Description
System Overview			
AMI BIOS			
Version	N/A	N/A	BIOS ID string (excluding the build time and date)
Build Date	N/A	N/A	BIOS build date
Processor			
Type	N/A	N/A	Processor brand ID string
Speed	N/A	N/A	Calculated processor speed
Count	N/A	N/A	Detected number of physical processors

Feature	Options	Help Text	Description
System Memory			
Size	N/A	N/A	Amount of physical memory detected
Server Board MCH Stepping			
Stepping	N/A	N/A	Display stepping revision of the Memory Controller
System Time	HH:MM:SS	Use [ENTER], [TAB] or [SHIFT-TAB] to select a field. Use [+] or [-] to configure system Time.	Configures the system time on a 24 hour clock. Default is 00:00:00
System Date	DAY MM/DD/YYYY	Use [ENTER], [TAB] or [SHIFT-TAB] to select a field. Use [+] or [-] to configure system Date.	Configures the system date. Default is [Tue 01/01/2002]. Day of the week is automatically calculated.
Language	English French German Italian Spanish	Select the current default language used by the BIOS.	Select the current default language used by BIOS.

3.2.5 Advanced Menu

Table 15. BIOS Setup, Advanced Menu Options

Feature	Options	Help Text	Description
Advanced Settings			
WARNING: Setting the wrong values in below sections may cause system to malfunction.			
Processor Configuration	N/A	Configure processors.	Selects submenu.
IDE Configuration	N/A	Configure the IDE device(s).	Selects submenu.
Floppy Configuration	N/A	Configure the Floppy drive(s).	Selects submenu.
Super I/O Configuration	N/A	Configure the Super I/O Chipset.	Selects submenu.
USB Configuration	N/A	Configure the USB support.	Selects submenu.
PCI Configuration	N/A	Configure PCI devices.	Selects submenu.
Memory Configuration	N/A	Configure memory devices.	Selects submenu.
Preproduction Debug	N/A	This option provides engineering access to internal settings. It does not exist on production releases.	Selects submenu.

3.2.5.1 Processor Configuration Sub-menu

Table 16. BIOS Setup, Processor Configuration Sub-menu Options

Feature	Options	Help Text	Description
Configure Advanced Processor Settings			
Manufacturer	Intel	N/A	Displays processor manufacturer string
Brand String	N/A	N/A	Displays processor brand ID string
Frequency	N/A	N/A	Displays the calculated processor speed
FSB Speed	N/A	N/A	Displays the processor front-side bus speed.
CPU 1			
CPUID	N/A	N/A	Displays the CPUID of the processor.
Cache L1	N/A	N/A	Displays cache L1 size.
Cache L2	N/A	N/A	Displays cache L2 size.
Cache L3	N/A	N/A	Displays cache L3 size. Visible only if the processor contains an L3 cache.
CPU 2			
CPUID	N/A	N/A	Displays the CPUID of the processor.
Cache L1	N/A	N/A	Displays cache L1 size.
Cache L2	N/A	N/A	Displays cache L2 size.
Cache L3	N/A	N/A	Displays cache L3 size. Visible only if the processor contains an L3 cache.
Processor Retest	Disabled Enabled	If enabled, all processors will be activated and retested on the next boot. This option will be automatically reset to disabled on the next boot.	Rearms the processor sensors. Only displayed if the Intel® Management Module is present.
Max CPUID Value Limit	Disabled Enabled	This should be enabled in order to boot legacy operating systems that cannot support processors with extended CPUID functions.	This option is to support legacy operating systems; for example, Windows NT 4.0.
Hyper-Threading Technology	Disabled Enabled	Enable Hyper-Threading Technology only if operating system supports it.	Controls Hyper-Threading state. Primarily used to support older Operating Systems that do not support Hyper-Threading Technology.
HT Technology in MPS	Disabled Enabled	Enabling adds secondary processor threads to the MPS Table for pre-ACPI operating systems. Only enable this feature if the pre-ACPI operating system supports Hyper-ThreadingTechnology.	This option is provided to support FreeBSD*.

Feature	Options	Help Text	Description
Intel SpeedStep® Technology	Auto Disabled	Select disabled for maximum CPU speed. Select Auto to allow the operating system to reduce power consumption.	This setup option will be hidden if processors do not support this feature.
Execute Disable Bit	Enabled Disabled	Intel's Execute Disable Bit functionality can prevent certain virus attacks.	This setup option will be hidden if processors do not support this feature.
Hardware Prefetcher	Enabled Disabled	This option enables / disables the processor hardware Prefetch Feature. Changing the default may affect performance depending on the application being used.	For DP/MP servers, the default should be set based on performance results observed during platform validation and testing.
Adjacent Cache Line Prefetch	Enabled Disabled	This option enables / disables the processor Adjacent Cache Line Prefetch Feature. Changing the default may affect performance depending on the application being used.	For DP/MP servers, the default should be set based on performance results observed during platform validation and testing.

3.2.5.2 IDE Configuration Sub-menu

Table 17. BIOS Setup IDE Configuration Menu Options

Feature	Options	Help Text	Description
IDE Configuration			
Onboard PATA Channels	Disabled Primary	Disabled: disables the integrated PATA Controller. Primary: enables only the primary PATA Controller.	Controls state of integrated PATA controller.
Onboard SATA Channels	Disabled Enabled	Disabled: disables the integrated SATA Controller. Enabled: enables the integrated SATA Controller.	Controls state of integrated SATA controller.
Configure SATA as RAID	Disabled Enabled	When enabled the SATA channels are reserved to be used as RAID.	
SATA Ports Definition	A1-Master/A2-Slave A1-Slave/A2-Master	Defines priority between SATA channels.	
Mixed PATA / SATA	N/A	Lets you remove a PATA and replace it by SATA in a given channel. Only 1 channel can be SATA.	Selects submenu for configuring mixed PATA and SATA.
Primary IDE Master	N/A	While entering setup, BIOS auto detects the presence of IDE devices. This displays the status of auto detection of IDE devices.	Selects submenu with additional device details.

Feature	Options	Help Text	Description
Primary IDE Slave	N/A	While entering setup, BIOS auto detects the presence of IDE devices. This displays the status of auto detection of IDE devices.	Selects submenu with additional device details.
Secondary IDE Master	N/A	While entering setup, BIOS auto detects the presence of IDE devices. This displays the status of auto detection of IDE devices.	Selects submenu with additional device details.
Secondary IDE Slave	N/A	While entering setup, BIOS auto detects the presence of IDE devices. This displays the status of auto detection of IDE devices.	Selects submenu with additional device details.
Hard Disk Write Protect	Disabled Enabled	Disable/Enable device write protection. This will be effective only if device is accessed through BIOS.	Primarily used to prevent unauthorized writes to hard drives.
IDE Detect Time Out (Sec)	0 5 10 15 20 25 30 35	Select the time out value for detecting ATA/ATAPI device(s).	Primarily used with older IDE devices with longer spin up times.
ATA(Pi) 80Pin Cable Detection	Host & Device Host Device	Select the mechanism for detecting 80Pin ATA(Pi) Cable.	The 80-pin cable is required for UDMA-66 and above. BIOS detects the cable by querying the host and/or device.

Table 18. Mixed PATA-SATA Configuration with only Primary PATA

Feature	Options	Help Text	Description
First ATA Channel	PATA M-S SATA M-S	Configures the first ATA channel for use by PATA or ATAPI devices in master and slave modes, or by a SATA device in present Master/Slave combination.	Defines the SATA device for this channel.
Second ATA Channel	SATA M-S None	Show the second ATA channel configuration The channel will be shown as <i>None</i> if the SATA_M-S ports have already been assigned to first channel.	Display only. If the first channel selects PATA, it reverts to SATA M-S.

Table 19. BIOS Setup, IDE Device Configuration Sub-menu Selections

Feature	Options	Help Text	Description
Primary/Secondary/Third/Fourth IDE Master/Slave			
Device	N/A	N/A	Display detected device info
Vendor	N/A	N/A.	Display IDE device vendor.
Size	N/A	N/A	Display IDE DISK size.
LBA Mode	N/A	N/A	Display LBA Mode
Block Mode	N/A	N/A	Display Block Mode
PIO Mode	N/A	N/A	Display PIO Mode
Async DMA	N/A	N/A	Display Async DMA mode
Ultra DMA	N/A	N/A	Display Ultra DMA mode.
S.M.A.R.T.	N/A	N/A	Display S.M.A.R.T. support.
Type	Not Installed Auto CDROM ARMD	Select the type of device connected to the system.	The Auto setting is correct in most cases.
LBA/Large Mode	Disabled Auto	Disabled: Disables LBA Mode. Auto: Enabled LBA Mode if the device supports it and the device is not already formatted with LBA Mode disabled.	The Auto setting is correct in most cases.
Block (Multi-Sector Transfer) Mode	Disabled Auto	Disabled: The Data transfer from and to the device occurs one sector at a time. Auto: The data transfer from and to the device occurs multiple sectors at a time if the device supports it.	The Auto setting is correct in most cases.
PIO Mode	Auto 0 1 2 3 4	Select PIO Mode.	The Auto setting is correct in most cases.
DMA Mode	Auto SWDMA0 SWDMA1 SWDMA2 MWDMA0 MWDMA1 MWDMA2 UWDMA0 UWDMA1 UWDMA2 UWDMA3 UWDMA4 UWDMA5	Select DMA Mode. Auto: Auto detected SWDMA: SinglewordDMA MWDMA: MultiwordDMA UWDMA: UltraDMA	The Auto setting is correct in most cases.

Feature	Options	Help Text	Description
S.M.A.R.T.	Auto Disabled Enabled	Self-Monitoring, Analysis and Reporting Technology.	The Auto setting is correct in most cases.
32-bit Data Transfer	Disabled Enabled	Enable/Disable 32-bit Data Transfer	

3.2.5.3 Floppy Configuration Sub-menu

Table 20. BIOS Setup, Floppy Configuration Sub-menu Selections

Feature	Options	Help Text	Description
Floppy Configuration			
Floppy A	Disabled 720KB 3 1/2" 1.44MB 3 1/2" 2.88MB 3 1/2"	Select the type of floppy drive connected to the system.	Note: Intel no longer validates 720Kb and 2.88Mb drives.
Onboard Floppy Controller	Disabled Enabled	Enable or disable the floppy controller.	

3.2.5.4 Super I/O Configuration Sub-menu

Table 21. BIOS Setup, Super I/O Configuration Sub-menu

Feature	Options	Help Text	Description
Configure Nattional Semiconductor* 42x Super I/O Chipset			
Serial Port A Address	Disabled 3F8/IRQ4 2F8/IRQ3 3E8/IRQ4 2E8/IRQ3	Allows BIOS to Select Serial Port A Base Addresses.	Option that is used by the other serial port is hidden to prevent conflicting settings.
Serial Port B Address	Disabled 3F8/IRQ4 2F8/IRQ3 3E8/IRQ4 2E8/IRQ3	Allows BIOS to Select Serial Port B Base Addresses.	Option that is used by other serial port is hidden to prevent conflicting settings.

3.2.5.5 USB Configuration Sub-menu

Table 22. BIOS Setup, USB Configuration Sub-menu Selections

Feature	Options	Help Text	Description
USB Configuration			
USB Devices Enabled	N/A	N/A	List of USB devices detected by BIOS.
USB Function	Disabled Enabled	Enables USB HOST controllers.	When set to disabled, other USB options are grayed out.
Legacy USB Support	Disabled Keyboard only Auto Keyboard and Mouse	Enables support for legacy USB. AUTO option disables legacy support if no USB devices are connected. If disabled, USB Legacy Support will not be disabled until booting an operating system.	
Port 60/64 Emulation	Disabled Enabled	Enables I/O port 60/64h emulation support. This should be enabled for the complete USB keyboard legacy support for non-USB aware operating systems.	
USB 2.0 Controller	Disabled Enabled	N/A	
USB 2.0 Controller mode	FullSpeed HiSpeed	Configures the USB 2.0 controller in HiSpeed (480Mbps) or FullSpeed (12Mbps).	
USB Mass Storage Device Configuration	N/A	Configure the USB Mass Storage Class Devices.	Selects submenu with USB Device enable.

3.2.5.5.1 USB Mass Storage Device Configuration Sub-menu**Table 23. BIOS Setup, USB Mass Storage Device Configuration Sub-menu Selections**

Feature	Options	Help Text	Description
USB Mass Storage Device Configuration			
USB Mass Storage Reset Delay	10 Seconds 20 Seconds 30 Seconds 40 Seconds	Number of seconds POST waits for the USB mass storage device after start unit command.	
Device #1	N/A	N/A	Only displayed if a device is detected, includes a DeviceID string returned by the USB device.
Emulation Type	Auto Floppy Forced FDD Hard Disk CDROM	If Auto, USB devices less than 530MB will be emulated as Floppy and remaining as hard drive. Forced FDD option can be used to force a HDD formatted drive to boot as FDD (Ex. ZIP drive).	
Device #n	N/A	N/A	Only displayed if a device is detected, includes a DeviceID string returned by the USB device.
Emulation Type	Auto Floppy Forced FDD Hard Disk CDROM	If Auto, USB devices less than 530MB will be emulated as floppy and remaining as hard drive. Forced FDD option can be used to force a HDD formatted drive to boot as FDD (Ex. ZIP drive).	

3.2.5.6 PCI Configuration Sub-menu

This sub-menu provides control over PCI devices and their option ROMs. If the BIOS is reporting POST error 146, use this menu to disable option ROM's that are not required to boot the system.

Table 24. BIOS Setup, PCI Configuration Sub-menu Selections

Feature	Options	Help Text	Description
PCI Configuration			
Onboard Video	Disabled Enabled	Enable/Disable on board VGA Controller	
Dual Monitor Video	Disabled Enabled	Select which graphics controller to use as the primary boot device. Enabled selects the on board device.	Grayed out if Onboard Video is set to "Disabled."
Onboard NIC 1 (Bottom)	Disabled Enabled	Enable/Disable OnBoard NIC 1.	
Onboard NIC 1 ROM	Disabled Enabled	Enable/Disable OnBoard NIC 1 ROM.	Grayed out if device is disabled.
Onboard NIC 2 (Top)	Disabled Enabled	Enable/Disable OnBoard NIC 2.	
Onboard NIC 2 ROM	Disabled Enabled	Enable/Disable OnBoard NIC 2 ROM.	Grayed out if device is disabled.
Onboard SCSI	Disabled Enabled	Enable/Disable OnBoard SCSI.	
Onboard SCSI ROM	Disabled Enabled	Enable/Disable OnBoard SCSI ROM.	Grayed out if device is disabled.
Onboard SCSI Mode	IM/IME IS	IM/IME: Integrated Mirroring/Integrated Mirroring Enhanced IS: Integrated Striping Before changing modes, back up array data and delete existing arrays, if any. Loss of all data may occur.	After operating system installation with a selected SCSI RAID mode, only change this mode selection if prepared to rebuild RAID array. Changing the mode could damage current operating system installation on RAID volume. Grayed out if device is disabled.

Feature	Options	Help Text	Description
PCI Priority Arbitration	Disabled Enabled	Disabled: Use round-robin priority scheme for devices on PCI bus. Enabled: Use high/low priority scheme for devices on PCI bus.	Round-robin verses alternate high/low priority scheme: In round-robin (default), the device with the lowest req/gnt pair gets first chance at the bus. In this case, the server board devices have an advantage (req/gnt 0) followed by the bottom slots (req/gnt 1), middle slot (req/gnt 2), and lastly, the top slot (req/gnt 3). In the alternate high/low scheme, each device gets a equal opportunity to be the first device after the PXH timeslot (PXH has high priority and others are low priority).
MMIO above 4GB	Disabled Enabled	Enable/Disable memory mapped I/O of 64-bit PCI devices to 4GB or greater address space.	
Slot 1 Option ROM	Disabled Enabled	PCI-X 64/100	
Slot 2 Option ROM	Disabled Enabled	PCI-X 64/100	
Slot 3 Option ROM	Disabled Enabled	PCI 32/33	
Slot 4 Option ROM	Disabled Enabled	PCI Express x4	
Slot 5 Option ROM	Disabled Enabled	PCI Express x8	
Slot 6 Option ROM	Disabled Enabled	PCI-X 64/133 2U riser	

3.2.5.7 Memory Configuration Sub-menu

This sub-menu provides information about the DIMMs detected by BIOS. The DIMM number is printed on the server board next to each device.

Table 25. BIOS Setup, Memory Configuration Sub-menu Selections

Feature	Options	Help Text	Description
System Memory Settings			
DIMM 1A	Installed Not Installed Disabled Mirror Spare		Informational display.
DIMM 1B	Installed Not Installed Disabled Mirror Spare		Informational display.
DIMM 2A	Installed Not Installed Disabled Mirror Spare		Informational display.
DIMM 2B	Installed Not Installed Disabled Mirror Spare		Informational display.
DIMM 3A	Installed Not Installed Disabled Mirror Spare		Informational display.
DIMM 3B	Installed Not Installed Disabled Mirror Spare		Informational display.
Extended Memory Test	1MB 1KB Every Location Disabled	Settings for extended memory test	

Feature	Options	Help Text	Description
Memory Retest	Disabled Enabled	Enabled: The BIOS will activate and retest all DIMMs on the next system boot. This option will automatically reset to "Disabled" on the next system boot.	
Memory Remap Feature	Disabled Enabled	Enable: Allow remapping of overlapped PCI memory above the total physical memory. Disable: Do not allow remapping of memory.	
Memory Mirroring / Sparing	Disabled Spare Mirror	Disabled provides the most memory space. Sparing reserves memory to replace failures. Mirroring keeps a second copy of memory contents.	Sparing or Mirroring is grayed out if the installed DIMM configuration does not support it.

3.2.6 Boot Menu

Table 26. BIOS Setup, Boot Menu Selections

Feature	Options	Help Text	Description
Boot Settings			
Boot Settings Configuration	N/A	Configure settings during system boot.	Selects submenu.
Boot Device Priority	N/A	Specifies the boot device priority sequence.	Selects submenu.
Hard Disk Drives	N/A	Specifies the boot device priority sequence from available hard drives.	Selects submenu.
Removable Drives	N/A	Specifies the boot device priority sequence from available removable drives.	Selects submenu.
CD/DVD Drives	N/A	Specifies the boot device priority sequence from available CD/DVD drives.	Selects submenu.

3.2.6.1 Boot Settings Configuration Sub-menu Selections

Table 27. BIOS Setup, Boot Settings Configuration Sub-menu Selections

Feature	Options	Help Text	Description
Quick Boot	Disabled Enabled	Allows BIOS to skip certain tests while booting. This will decrease the time needed to boot the system.	
Quiet Boot	Disabled Enabled	Disabled: Displays normal POST messages. Enabled: Displays OEM Logo instead of POST messages.	
Bootup Num-Lock	Off On	Select power-on state for numlock.	
PS/2 Mouse Support	Disabled Enabled Auto	Select support for PS/2 mouse.	
POST Error Pause	Disabled Enabled	If enabled, the system will wait for user intervention on critical POST errors. If disabled, the system will boot with no intervention, if possible.	
Hit <F2> Message Display	Disabled Enabled	Displays "Press <F2> to run Setup" in POST.	
Scan User Flash Area	Disabled Enabled	Allows BIOS to scan the Flash ROM for user binaries.	

3.2.6.2 Boot Device Priority Sub-menu Selections

Table 28. BIOS Setup, Boot Device Priority Sub-menu Selections

Feature	Options	Help Text	Description
Boot Device Priority			
1st Boot Device	Varies	Specifies the boot sequence from the available devices. A device enclosed in parenthesis has been disabled in the corresponding type menu.	Number of entries will vary based on system configuration.
nth Boot Device	Varies	Specifies the boot sequence from the available devices. A device enclosed in parenthesis has been disabled in the corresponding type menu.	

3.2.6.2.1 Hard Disk Drive Sub-menu Selections**Table 29. BIOS Setup, Hard Disk Drive Sub-Menu Selections**

Feature	Options	Help Text	Description
Hard Disk Drives			
1st Drive	Varies	Specifies the boot sequence from the available devices.	Varies based on system configuration.
nth Drive	Varies	Specifies the boot sequence from the available devices.	Varies based on system configuration.

3.2.6.2.2 Removable Drive Sub-menu Selections**Table 30. BIOS Setup, Removable Drives Sub-menu Selections**

Feature	Options	Help Text	Description
Removable Drives			
1st Drive	Varies	Specifies the boot sequence from the available devices.	Varies based on system configuration.
nth Drive	Varies	Specifies the boot sequence from the available devices.	Varies based on system configuration.

3.2.6.2.3 ATAPI CD-ROM Drives Sub-menu Selections**Table 31. BIOS Setup, CD/DVD Drives Sub-menu Selections**

Feature	Options	Help Text	Description
CD-ROM / DVD-ROM Drives			
1st Drive	Varies	Specifies the boot sequence from the available devices.	Varies based on system configuration.
nth Drive	Varies	Specifies the boot sequence from the available devices.	Varies based on system configuration.

3.2.7 Security Menu

Table 32. BIOS Setup, Security Menu Options

Feature	Options	Help Text	Description
Security Settings			
Administrator Password is	N/A	Install / Not installed	Informational display.
User Password is	N/A	Install / Not installed	Informational display.
Set Admin Password	N/A	Set or clear Admin password	Pressing <Enter> twice clears the password. If Administrator password is cleared the User password is also cleared.
Set User Password	N/A	Set or clear User password	Pressing <Enter> twice clears the password. This node is grayed out if Administrator password is not set.
User Access Level	No Access View Only Limited Full Access	No Access: Prevents User access to the Setup Utility. View Only: Allows access to the Setup Utility but the fields can not be changed. Limited: Allows only limited fields to be changed such as Date and Time. Full: Allows any field to be changed.	This node is grayed out if Administrator password is not installed.
Clear User Password	N/A	Immediately clears the user password.	Admin uses this option to clear User password (Admin password is used to enter setup is required). This node is grayed out if Administrator password is not installed.
Fixed disk boot sector protection	Disabled Enabled	Enable/Disable Boot Sector Virus Protection.	
Password On Boot	Disabled Enabled	If enabled, requires password entry before boot.	This node is grayed out if a user password is not installed.
Secure Mode Timer	1 minute 2 minutes 5 minutes 10 minutes 20 minutes 60 minutes 120 minutes	Period of key or PS/2 mouse inactivity specified for Secure Mode to activate. A password is required for Secure Mode to function. Has no effect unless at least one password is enabled.	This node is grayed out if a user password is not installed.

Feature	Options	Help Text	Description
Secure Mode Hot Key (Ctrl-Alt-)	[L] [Z]	Key assigned to invoke the secure mode feature. Cannot be enabled unless at least one password is enabled. Can be disabled by entering a new key followed by a backspace or by entering delete.	This node is grayed out if a user password is not installed.
Secure Mode Boot	Disabled Enabled	When enabled, allows the host system to complete the boot process without a password. The keyboard will remain locked until a password is entered. A password is required to boot from a diskette.	This node is grayed out if a user password is not installed.
Diskette Write Protect	Disabled Enabled	Disable diskette write protection when Secure mode is activated. A password is required to unlock the system.	This node is grayed out if a user password is not installed. This node is hidden if the Intel® Management Module is not present.
Video Blanking	Disabled Enabled	Blank video when Secure mode is activated. A password is required to unlock the system. This option controls the embedded video controller only.	This node is grayed out if a user password is not installed. This node is hidden if the Intel Management Module is not present.
Power & Reset Switch Inhibit	Disabled Enabled	Disable the Front Panel Power and Reset Switch when Secure mode is activated. A password is required to unlock the system.	This node is grayed out if a user password is not installed. This node is only available with mBMC.
Power Switch Inhibit	Disabled Enabled	Disable the Front Panel Power Switch when Secure mode is activated. A password is required to unlock the system.	This node is grayed out if a user password is not installed. This node is hidden if the Intel Management Module is not present.
Reset Switch Inhibit	Disabled Enabled	Disable the Front Panel Reset Switch when Secure mode is activated. A password is required to unlock the system.	This node is grayed out if a user password is not installed. This node is hidden if the Intel Management Module is not present.
NMI Control	Disabled Enabled	Enable / disable NMI control for the front panel NMI button.	Default settings: For mBMC: Disabled For IMM: Enabled

3.2.8 Server Menu

Table 33. BIOS Setup, Server Menu Selections

Feature	Options	Help Text	Description
System management	N/A	N/A	Selects submenu.
Serial Console Features	N/A	N/A	Selects submenu.
Event Log configuration	N/A	Configures event logging.	Selects submenu.
Assert NMI on SERR	Disabled Enabled	If enabled, NMI is generated on SERR and logged.	
Assert NMI on PERR	Disabled Enabled	If enabled, NMI is generated. SERR option needs to be enabled to activate this option.	Grayed out if "NMI on SERR" is disabled.
Resume on AC Power Loss	Stays Off Power On Last State	Determines the mode of operation if a power loss occurs. Stays off, the system will remain off once power is restored. Power On, boots the system after power is restored.	"Last State" is only displayed if the Intel® Management Module is present. When displayed, "Last State" is the default. When set to "Stays Off," "Power Switch Inhibit" is disabled.
FRB-2 Policy	Disable BSP Do not disable BSP Retry on Next Boot Disable FRB2 Timer	This controls action if the boot processor will be disabled or not.	"Disable BSP" and "Do not disable BSP" are only displayed if the Intel Management Module is present.
Late POST Timeout	Disabled 5 minutes 10 minutes 15 minutes 20 minutes	This controls the time limit for add-in card detection. The system is reset on timeout.	
Hard Disk OS Boot Timeout	Disabled 5 minutes 10 minutes 15 minutes 20 minutes	This controls the time limit allowed for booting an operating system from a hard disk drive. The action taken on timeout is determined by the OS Watchdog Timer policy setting.	
PXE OS Boot Timeout	Disabled 5 minutes 10 minutes 15 minutes 20 minutes	This controls the time limit allowed for booting an operating system using PXE boot. The action taken on timeout is determined by OS Watchdog Timer policy setting.	
OS Watchdog Timer Policy	Stay On Reset Power Off	Controls the policy upon timeout. Stay on action will take no overt action. Reset will force the system to reset. Power off will force the system to power off.	
Platform Event Filtering	Disabled Enabled	Disable triggers for system sensor events.	

3.2.8.1 System Management Sub-menu Selections

Table 34. BIOS Setup, System Management Sub-menu Selections

Feature	Options	Help Text	Description
System Management			
Server Board Part Number	N/A	N/A	Field content varies
Server Board Serial Number	N/A	N/A	Field content varies
NIC 1 MAC Address	N/A	N/A	Field content varies
NIC 2 MAC Address	N/A	N/A	Field content varies
System Part Number	N/A	N/A	Field content varies
System Serial Number	N/A	N/A	Field content varies
Chassis Part Number	N/A	N/A	Field content varies
Chassis Serial Number	N/A	N/A	Field content varies
BIOS Version	N/A	N/A	BIOS ID string (excluding the build time and date).
BMC Device ID	N/A	N/A	Field content varies
BMC Firmware Revision	N/A	N/A	Field content varies
BMC Device Revision	N/A	N/A	Field content varies
PIA Revision	N/A	N/A	Field content varies. This node is only present when the Intel Management Module is installed.
FRUSDR Package Revision	N/A	N/A	Field content varies
Primary HSBP Revision	N/A	N/A	Firmware revision of the Hot-swap controller. Displays n/a if the controller is not present. This node is only present when the Intel Management Module is installed.
Secondary HSBP Revision	N/A	N/A	Firmware revision of the Hot-swap controller. Displays n/a if the controller is not present. This node is only present when the Intel Management Module is installed.

3.2.8.2 Serial Console Features Sub-menu Selections

Table 35. BIOS Setup, Serial Console Features Sub-menu Selections

Feature	Options	Help Text	Description
Serial Console Features			
BIOS Redirection Port	Disabled Serial A Serial B	If enabled, BIOS uses the specified serial port to redirect the console to a remote ANSI terminal. Enabling this option disables Quiet Boot. For Serial Over LAN, select Serial B.	When the Intel® Management Module is present, the help text directs the user to select Serial B for Serial Over LAN.
Baud Rate	9600 19.2K 38.4K 57.6K 115.2K	N/A	
Flow Control	No Flow Control CTS/RTS XON/XOFF CTS/RTS + CD	If enabled, it will use the flow control selected. CTS/RTS = Hardware XON/XOFF = Software CTS/RTS + CD = Hardware + Carrier Detect for modem use.	
Terminal Type	PC-ANSI VT100+ VT-UTF8	VT100+ selection only works for English as the selected language. VT-UTF8 uses Unicode. PC-ANSI is the standard PC-type terminal.	
ACPI Redirection	Disabled Enabled	Enable / Disable the ACPI OS Headless Console Redirection.	
Serial Port Connector	Serial A Serial B	Selects which serial port will be routed to the serial port connector on the back of the chassis. Serial A selects UARTA and Serial B selects UARTB.	

3.2.8.3 Event Log Configuration Sub-menu Selections

Table 36. BIOS Setup, Event Log Configuration Sub-menu Selections

Feature	Options	Help Text	Description
Event Log Configuration			
Clear All Event Logs	Disabled Enabled	Setting this to enabled will clear the System Event Log during the next boot.	
BIOS Event Logging	Disabled Enabled	Select enabled to allow logging of BIOS events.	Enables BIOS to log events to the SEL. This option controls BIOS events only.
Critical Event Logging	Disabled Enabled	If enabled, BIOS will detect and log events for system critical errors. Critical errors are fatal to system operation. These errors include PERR, SERR, ECC.	Enable SMM handlers to detect and log events to SEL.
ECC Event Logging	Disabled Enabled	Enables or disables ECC Event Logging.	Grayed out if "Critical Event Logging" option is disabled.
PCI Error Logging	Disabled Enabled	Enables or disables PCI Error Logging.	Grayed out if "Critical Event Logging" option is disabled.
FSB Error Logging	Disabled Enabled	Enables or disables Front-Side Bus Error Logging.	Grayed out if "Critical Event Logging" option is disabled.
Hublink Error Logging	Disabled Enabled	Enables or disables Hublink Error Logging.	Grayed out if "Critical Event Logging" option is disabled.

3.2.9 Exit Menu

Table 37. BIOS Setup, Exit Menu Selections

Feature	Options	Help Text
Exit Options		
Save Changes and Exit	N/A	Exit system setup after saving the changes. The <F10> key can be used for this operation.
Discard Changes and Exit	N/A	Exit system setup without saving any changes. The <Esc> key can be used for this operation.
Discard Changes	N/A	Discards changes to any of the setup questions. The <F7> key can be used for this operation.
Load Setup Defaults	N/A	Load Setup Default values for all the setup questions. The <F9> key can be used for this operation.
Load Custom Defaults	N/A	Load custom defaults.
Save Custom Defaults	N/A	Save custom defaults

3.3 Other BIOS Configuration Utilities

3.3.1 Flash Update Utility

To perform a floppy update from a bootable storage device that has a capacity greater than 5MB:

1. Copy `afudos.exe`, `f.bat`, `fbf.bat`, and `SBD2AC04.ROM` to a bootable storage device, such as an USB key device.
2. Boot the system and press <F2> to run BIOS Setup.
3. Write down the current custom changes to any default settings in the BIOS Setup program. You will need these settings to reconfigure your system at the end of the update procedure because CMOS values will be cleared automatically during the BIOS update.
4. Press <Esc> to exit BIOS Setup.
5. Connect the bootable storage device, such as an USB device, containing the new BIOS to the USB port on the system, and boot to pure DOS mode. (non-himem environment).
6. Run `f.bat` or `fbf.bat`, depending upon whether the boot block needs to be updated:
`f.bat`: Updates system ROM only; the boot block does not change.
`fbf.bat`: Updates both system ROM and the boot block.

Note: If running `fbf.bat` or `f.bat`, the J1B1 jumper (BIOS partition selection) should be set to pins 1-2 to select the correct BIOS partition.

When the Flash Update is complete, a completion message will display.

7. Power cycle the system.
8. If the Flash Update process fails, follow the instructions for BIOS Recovery. (**Note:** BIOS version AC02 or earlier does not support BIOS Recovery.)
9. Press <F2> to enter BIOS Setup, and re-enter the custom values you wrote down at the beginning of the update process. Press <F10> to save the values and exit BIOS Setup.

Note: CMOS should always be cleared after a BIOS update. You may encounter a CMOS Checksum error or other problem after reboot. Try shutting down the system and booting it again. CMOS checksum errors require that you enter Setup, check your settings, save your settings, and exit Setup.

3.4 Localization Details

The BIOS supports English, Spanish, French, German, and Italian. Intel provides translations for console strings in the supported languages. The language can be selected using the BIOS user interface.

3.5 Flash Architecture and Flash Update Utility

The flash ROM contains system initialization routines, the BIOS Setup Utility, and runtime support routines. The exact layout is subject to change, as determined by Intel. A 64KB user block is available for user ROM code or custom logos. The flash ROM also contains initialization code in compressed form for onboard peripherals, such as SCSI, NIC and video controllers. It also contains support for the rolling single-boot BIOS update feature.

The complete ROM is visible, starting at physical address 4GB minus the size of the flash ROM device. The Flash Memory Update utility loads the BIOS image minus the recovery block to the secondary flash partition, and notifies the BIOS that this image should be used on the next system re-boot. Because of shadowing, none of the flash blocks are visible at the aliased addresses below 1MB.

A 16KB parameter block in the flash ROM is dedicated to storing configuration data that controls the system configuration (ESCD). Application software must use standard APIs to access these areas; application software cannot access the data directly.

3.5.1 Rolling BIOS and On-line Updates

Online update refers to the ability to update the BIOS while the server is online and in operation, as opposed to taking the server out of operation while performing a BIOS update. Rolling BIOS refers to the capability of having two copies of BIOS: the current BIOS in use, and a second BIOS to which an updated BIOS version can be written. When ready, the system can roll forward to the new BIOS. In case of a failure with the new BIOS version, the system can roll back to the previous version.

The BIOS relies on specialized hardware and additional flash space to accomplish online update/rolling of the BIOS. The flash is divided into two partitions, primary (active partition from which the BIOS boots) and secondary. The AMI FLASH update suite and Intel online updates preserve the existing BIOS image on the primary partition.

BIOS updates are diverted to the secondary partition. After the update is complete, a notification flag is set. During the next boot, the system first attempts to boot from the primary BIOS partition. On determining that a BIOS update occurred, the system then attempts to boot from the new BIOS. If a failure happens while booting to the new BIOS, the specialized hardware on the system switches to the primary BIOS partition, affecting a “roll back”.

3.5.2 Flash Update Utility

Server platforms support a DOS-based firmware update utility. This utility loads a fresh copy of the BIOS into the flash ROM. The BIOS update may affect the following items:

- The system BIOS, including the recovery code, setup utility and strings
- Onboard video BIOS, SCSI BIOS, and other option ROMs for the devices embedded on the server board
- OEM binary area
- Microcode updates

3.5.3 Flash BIOS

The BIOS flash utility is compatible with DOS, Windows* 2000 / 2003 / XP, and Linux operating system environments. An `afuXXX` AMI Firmware Update utility (such as `afudos`, `AFUWIN`, `afulnx`, or `AFUEFI`) is required for a BIOS update. Use the appropriate file for your environment:

- DOS: AFUDOS.EXE
- Windows 2000, 2003, XP: AFUWIN.EXE
- Linux: AFULNX
- EFI: AFUEFI

The `AFUxxx` utilities must be used with the following format:

```
afuXXX /i<ROM filename> [/n] [/p[b][n][c]] [/r<registry_path>]
[/s] [/k] [/q] [/h]
```

Where:

- `/n` = do not check ROM ID
- `/pb` = program boot block
- `/pn` = program NVRAM
- `/pc` = destroy system CMOS
- `/r` = registry path to store result of operation (only for Windows 2000, 2003, XP)
- `/k` = program non-critical block only
- `/s` = leave signature in BIOS
- `/q` = silent execution
- `/h` = print help

3.5.3.1 Updating the BIOS from DOS

1. Make sure that the flash bootable disk contains both the ROM image and the `afudos` update utility.
2. Boot to DOS.
3. Run the `afudos` utility as follows:

```
AFUDOS /i<ROM filename> [/n][/p[b][n][c]]
```

3.5.3.2 Updating the BIOS from Microsoft* Windows* NT 4.0 / 2000 / XP

1. Make sure that the flash disk contains the ROM image, `AMIFLDRV.SYS` and `AFUWIN.EXE`.
2. Boot to Microsoft Windows NT 4.0/2000/XP.
3. Run the `AFUWIN` utility as follows:

```
AFUWIN /i<ROM filename> [/n][/p[b][n][c]]
```


3.5.3.3 Updating the BIOS from Linux

1. Make sure that the flash disk contains the ROM image and the AFULNX utility.
2. Boot to Linux and set up a floppy device.
3. Run the AFULNX utility as follows:

```
./afulnx /i<ROM filename> [/n][p[b][n][c]]
```

3.5.3.4 Updating the BIOS from the EFI Shell

1. Make sure that the flash disk contains the ROM image and the AFUEFI utility.
2. Boot to the EFI Shell with the flash disk.
3. Do a `map -r` to retrieve the file system on the disk.
4. Change to the flash disk, e.g., if the flash disk is `fs0:`, type `fs0:` at the prompt.
5. Run the `afuefi` utility as follows:

```
afuefi [/n] [/p[b][n][c]] <ROM filename>
```

3.5.4 User Binary Area

The server board includes an area in flash for implementation-specific OEM add-ons. This OEM binary area can be updated as part of the system BIOS update or it can be updated independent of the system BIOS.

The command-line usage for the utility is as follows:

```
UBinD </R> or </I> or </D> </?> [/M<ModID>] /F<RomFileName>  
/B<NewUserBinaryFileName> [/N<NewRomFileName>] [/O<NCB>]
```

Where:

- `</R>` = replace user binary module
- `</I>` = insert user binary module
- `</D>` = delete user binary module from the ROM file.
- `</?>` = display help.
- `/M<ModID>` = hexadecimal user binary module ID; Default ModID = 0xF0.
- `/O<NCB>` = 0-based index of the non-critical block number calculated from the start of the ROM file. Default NCB = 1, used only with insert option. See ROMInfo for reference.
- `</N<NewRomFileName>` = if this option is not included, the ROM is saved with the same name.

3.6 Recovery Mode

Three conditions can cause the system to enter recovery mode:

- Pressing a hot key: (<Ctrl>+<Home>)
- Setting the recovery jumper (J4H1, labeled RCVR BOOT) to pins 1-2
- Damaging the ROM image, which will cause the system to enter recovery and update the system ROM including the boot block

3.6.1 Single Disk BIOS Recovery

The BIOS has a ROM image size of 2MB. A standard 1.44MB floppy diskette cannot hold the entire ROM file due to the large file size. To compensate for this, a multi-disk recovery method is available for BIOS recover (see Section 3.6.2).

The BIOS contains a primary and secondary partition, and can support rolling BIOS updates. The recovery process performs an update on the secondary partition in the same fashion that the normal flash update process updates the secondary partition. After recovery is complete and the power is cycled to the system, the BIOS partitions switch and the code executing POST will be the code that was just flashed from the recovery media.

The BIOS is made up of a boot block recovery section, a main BIOS section, an OEM logo/user binary section, and an NVRAM section. The NVRAM section will either be preserved or destroyed based on a hot-key press during invocation of the recovery:

- <Ctrl>+<Home>: Recovery with CMOS destroyed and NVRAM preserved
- <Ctrl>+<PageDown>: Recovery with both CMOS and NVRAM preserved
- <Ctrl>+<PageUp>: Recovery with both CMOS and NVRAM destroyed

All other sections of the secondary BIOS will be updated during the recovery process. If an OEM wishes to preserve the OEM section across an update, it is recommended that the OEM modify the provided `AMIBOOT.ROM` file with the user binary or OEM logo tools before performing the recovery.

A BIOS recovery can be accomplished from one of the following devices: a standard 1.44 or 2.88MB floppy drive, an USB Disk-On-Key, an ATAPI CD-ROM/DVD, an ATAPI ZIP* drive, or a LS-120* / LS-240* removable drive.

The recovery media must include the BIOS image file, `AMIBOOT.ROM`. The recovery mode procedure is as follows:

1. Insert or plug-in the recovery media that contains the `AMIBOOT.ROM` file.
2. Power on the system. When progress code E9 is displayed on port 80h, the system will detect the recovery media (if there is no image file present, the system will cycle through progress code F1 to EF).

When F3 is displayed on port 80h, the system will read the BIOS image file. When recovery mode is complete, the system will halt and it can be powered off.

3.6.2 Multi-disk BIOS Recovery

The multi-disk recovery method is available to support ROM images greater than 1MB when performing a BIOS recovery from multiple floppy disks. Do the following to perform a multi-disk BIOS recovery:

Notes:

- The recovery medium must include the BIOS image file, `AMIBOOT.ROM`.
 - The maximum number of files supported by the Multi-disk Recovery method is 1,000 files (`AMIBOOT.000` through `AMIBOOT.999`).
1. Execute the `SPLIT.EXE` utility to split the ROM image. Use the following command at the command prompt:

```
split <File Name To Be Split> <New File Name> <File Size in KB>
```

Example: `C:\split AMIBOOT.ROM AMIBOOT 1024`

This command will create files of size 1MB each (1024KB) with the names `AMIBOOT.000`, `AMIBOOT.001`... and so on. The number of files (or floppy disks) will depend upon the size of the `AMIBOOT.ROM` file.

2. Load the first disk with the `AMIBOOT.000` file into the system.
3. After reading the file, the system will increment the file extension and begin searching for the second file, `AMIBOOT.001`, on the same floppy disk. If the system cannot find the file on the floppy disk, it will beep once for one second and then search again. At this point, load the second floppy disk.
4. The system will continue reading and searching for files in this fashion. Once a file has been read, the system will increment the file extension and then begin searching for the next file. If searching for the `AMIBOOT.002` file, the system will beep twice (each beep 1 second long with a 0.5 sec gap between beeps). If searching for the `AMIBOOT.003` file, the system will beep three times with a 0.5 sec gap between beeps.
5. This process continues until the total file size read in is equal to the size of the ROM image.

3.6.3 Update OEM Logo

An Intel-supplied utility package is used to change the OEM logo in ROM. The OEM logo can be updated by flashing the ROM. The Rombuild.exe is different for DOS and Microsoft Windows environments. Use the appropriate file for your environment:

```
OEMLogo <RomFileName> <NewOEMImageFileName> [/F or /FN or /N] or  
OEMLogo <RomFileName> [/D]
```

Where:

- [/F] = force replacement of OEM logo even if logo formats do not match.
- [/N] = insert 16-color BMP without converting it to AMI format.
- [/FN] = force replacement of OEM logo, without converting 16 color BMP to AMI Format.
- [/D] = delete logo module from the ROM file.

Supported formats (depending on the ROM) include:

- 16 color BMP, size up to 640x480, even width
- 256 color BMP, 640x480
- JPEG, 640x480, 800x600, or 1024x768
- 256 color PCX, 640x480

3.6.3.1 Update OEM Logo from DOS

1. Boot to DOS.
2. Copy the following four files to your hard drive: OEMLOGOD.exe, Rombuild.exe, RomFile, and NewOEMlogImage.
3. Run `OEMLogoD <RomFileName> <NewOEMImageFileName> [/F or /FN or /N]`

3.6.3.2 Update OEM Logo from Windows 98 / 2000 / XP

1. Boot to your Windows operating system.
2. Copy the following four files to your hard disk: OEMLOGO.exe, Rombuild.exe, RomFile, and NewOEMlogImage.
3. At the command prompt, run
`OEMLogo <RomFileName> <NewOEMImageFileName> [/F or /FN or /N]`
or
`OEMLogo <RomFileName> [/D]`

3.7 OEM Binary

System customers can supply 16KB of code and data for use during POST and at run-time. Individual platforms may support a larger user binary. User binary code is executed at several defined hook points during POST.

The user binary code is stored in the system flash. If no run-time code is added, the BIOS temporarily allocates a code buffer according to [PMM]. If run-time code is present, the BIOS shadows the entire block as though it were an option ROM. The BIOS leaves this region writeable to allow the user binary to update any data structures it defines. System software can locate a run-time user binary by searching for it like an option ROM, checking each 2KB boundary from C0000h to DFFFFh. The system vendor can place a signature within the user binary to distinguish it from other option ROMs.

Intel will provide the tools and reference code to help OEMs build a user binary. The user binary must adhere to the following requirements:

- In order to be recognized by the BIOS and protected from runtime memory managers, the user binary must have an option ROM header (55AA, size).
- The system BIOS performs a scan of the user binary area at predefined points during POST. Mask bits must be set within the user binary to inform the BIOS if an entry point exists for a given time during POST.
- The system state must be preserved by the user binary.
- User binary code must be relocatable. It will be located within the first megabyte. The user binary code should not make any assumptions about the value of the code segment.
- User binary code will always be executed from RAM and never from flash.
- The code in user binary should not hook critical interrupts, should not re-program the chipset and should not take any action that affects the correct functioning of the system BIOS.

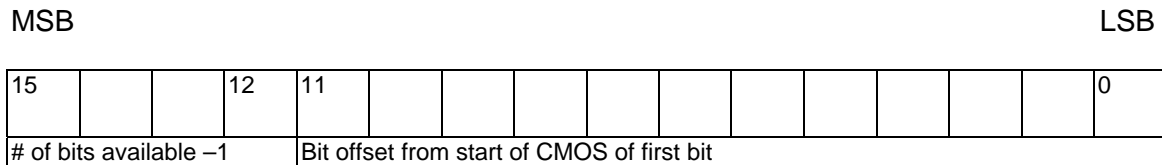
The BIOS copies the user binary into system memory before the first scan point. If the user binary reports that it does not contain runtime code, it is located in conventional memory (0 - 640KB).

Reporting that the user binary is POSTed has only the advantage that it does not use up limited option ROM space, and more option ROMs space can be used for other devices. If user binary code is required at run-time, it is copied to the option ROM space. At each scan-point during POST, the system BIOS determines if the scan-point has a corresponding user binary entry point to transfer control to.

To determine this, the bitmap at byte 4 of the header is tested against the current mask bit that has been determined / defined by the scan point. If the bitmap has the appropriate bit set, the mask is placed in AL and execution is passed to the address computed by $(ADR(\text{Byte } 5) + 5 * \text{scan sequence } \#)$.

During execution, the user binary may access 11 bytes of Extended BIOS Data Area RAM (EBDA). The segment of the EBDA can be found at address 40:0e. Offset 18 to offset 21h is available for the user binary. The BIOS also reserves eight CMOS bits for the user binary. These bits are in an unchecksummed region of CMOS with default values of zero, and will always be located in the first bank of CMOS. These bits are contiguous, but are not in a fixed location. Upon entry into the user binary, DX contains a ‘token’ that points to the reserved bits.

This token has the following format:



The most significant 4 bits are equal to the number of CMOS bits available, minus 1. This field is equal to 7, since 8 CMOS bits are available. The 12 least significant bits define the position of the CMOS bit in RTC. This is a bit address, not a byte address. The CMOS byte location is 1/8th of the 12-bit number, and the remainder is the starting bit position within that byte. For example, if the 12-bit number is 0109h, the user binary can use bit 1 of CMOS byte 0108h/8 or 021h.

The following code fragment shows the header and format for a user binary:

```

    db    55h, 0AAh, 20h    ; 20h = 8KB USER Area. 40h=16KB.

    MyCode    PROC    FAR    ; MUST be a FAR procedure
                db    CBh    ; Far return instruction
    db    04h    ; Bit map to define call points, a 1 in any bit
; specifies that the BIOS is called at that scan
; point in POST

                db    CBh    ; First transfer address used to point
; to user binary extension structure

                dw    ?    ; Word Pointer to extension structure
                dw    0    ; Reserved

; This is a list of 7 transfer addresses, one for each bit in the bitmap.
; 5 Bytes must be used for each.
    JMP    ErrRet
    JMP    ErrRet
    JMP    Start ; JMP to maintain proper offset for each entry.
                ; Unused entry JMP's should be filled with 5 byte
                ; filler or JMP to a RETF

    JMP    ErrRet
    JMP    ErrRet
    JMP    ErrRet
    JMP    ErrRet

```

Start:

3.8 PCI Numeration

PCI Slot 6 (PCI-X 133) is near the center of the board, Slot 5 and 6 are PCI Express, slot 4 is PVIC 32/33, and slots 1 and 2 are both PCI-X64/100 based. Slots 1 and 2 are nearest to the edge of the board.

3.9 ACPI Runtime Checkpoints

ACPI checkpoints are displayed when an ACPI capable operating system either enters or leaves a sleep state. The following table describes the type of checkpoints that may occur during ACPI sleep or wake events.

Table 38. ACPI Runtime Checkpoints

Checkpoint	Description
AC	First ASL check point. Indicates the system is running in ACPI mode.
AA	System is running in APIC mode.
01, 02, 03, 04, 05	Entering sleep state S1, S2, S3, S4, or S5.
10, 20, 30, 40, 50	Waking from sleep state S1, S2, S3, S4, or S5.

4. Platform Management Architecture

4.1 Management Architecture Overview

4.1.1 Tiered Server Management Model

To provide the flexibility of different management features, the server board supports a three tiered server management model. The features offered with the second tier build upon the features of the first, and the features of the third tier build upon the features of the second.

Tier 1 – Essentials (Default)

Essentials server management functions are provided by default and are built into the server board. This tier is minimally IPMI 1.5 compliant, although some functionality may be implemented in a manner different from the Standard and Advanced management models. The essential functions are provided by a combination of BIOS and a National Semiconductor* PC87431x Mini Baseboard Management Controller (mBMC).

Tier 2 – Standard (Optional)

The Standard management model utilizes the feature set of a fully IPMI 2.0 compliant Sahalee Baseboard Management Controller (BMC). On the Server Board SE7520BD2 the Sahalee BMC is located on an optionally installed Intel® Management Module that plugs into a dedicated server management connector on the server board. When an IMM is installed, the mBMC is automatically converted from an autonomous controller to an I²C based I/O device, allowing the Sahalee BMC to completely manage the system.

Tier 3 – Advanced (Optional)

Like the Standard management model, the Advanced management model is implemented using an optionally installed IMM which has a Sahalee BMC integrated onto it. In addition to the features provided with the Standard management module, the Advanced module supports a number of network based Out Of Band (OOB) management capabilities, including the availability of a dedicated management NIC for faster network access and to support a full TCP/IP software stack.

The following tables provide an overview of the features supported with each of the three management tiers.

Table 39. Tiered Platform Management Feature Overview

Element	Essentials	Standard	Advanced
IPMI Messaging, Commands, and Abstractions	Yes	Yes	Yes
Baseboard Management Controller (BMC)	Yes	Yes	Yes
Sensors	Limited	Yes	Yes
Sensor Data Records (SDRs) and SDR Repository	Limited	Yes	Yes
FRU Information	Limited	Yes	Yes
Autonomous Event Logging	Yes	Yes	Yes
System Event Log (SEL)	92 Entries	3276 Entries	3276 Entries
BMC Watchdog Timer, covering BIOS and Run-Time software	Limited	Yes	Yes
IPMI Channels, and Sessions	Limited	Yes	Yes
EMP (Emergency Management Port) - IPMI Messaging over Serial/Modem. This feature is also referred to as DPC (Direct Platform Control) over serial/modem.	No	Yes	Yes
Serial/Modem Paging	No	Yes	Yes
Serial/Modem Alerting over PPP using the Platform Event Trap (PET) format	No	Yes	Yes
DPC (Direct Platform Control) - IPMI Messaging over LAN (available via both onboard network controllers)	Yes	Yes	Yes
LAN Alerting using PET	Yes	Yes	Yes
Platform Event Filtering (PEF)	Yes	Yes	Yes
ICMB (Intelligent Chassis Management Bus) - IPMI Messaging between chassis	No	Yes	Yes
PCI SMBus support	No	Yes	Yes
Fault Resilient Booting	Limited	Yes	Yes
Magic Packet and Wake On LAN (WOL) / Power On LAN support	Yes	Yes	Yes
BIOS logging of POST progress and POST errors	Errors Only	Yes	Yes
Integration with BIOS console redirection via IPMI v2.0 Serial Port Sharing	No	Yes	Yes
Wake On Ring (WOR) support	No	Yes	Yes
Access via web browser	No	No	Yes
SNMP access	No	No	Yes
Telnet access	No	No	Yes
Alerting via Email	No	No	Yes
Keyboard/Video/Mouse (KVM) redirection via LAN	No	No	Yes
High speed access to dedicated NIC	No	No	Yes

Table 40. Power and Reset Control

Source	Power Cycle		Power Up		Power Down		Hard Reset	
	Ess	Std / Adv	Ess	Std / Adv	Ess	Std / Adv	Ess	Std / Adv
	DPC (Serial)	No	Yes	No	Yes	No	Yes	No
DPC (LAN)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AC Power Restore	No	No	Yes	Yes	Yes	Yes	N/A	N/A
IPMB	No	Yes	No	Yes	No	Yes	No	Yes
ICMB	No	Yes	No	Yes	No	Yes	No	Yes
PCI SMBus	No	Yes	No	Yes	No	Yes	No	Yes
System Interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Watchdog Timer Expiration	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes
PEF Event	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes
Front Panel Button	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Wake on LAN ¹	N/A	N/A	Yes	Yes	N/A	N/A	N/A	N/A
Modem Ring Indicate ¹	N/A	N/A	Yes	Yes	N/A	N/A	N/A	N/A
'Time of Day' request from system RTC ¹	N/A	N/A	Yes	Yes	N/A	N/A	N/A	N/A
ACPI / OS Power Down	N/A	N/A	N/A	N/A	Yes	Yes	N/A	N/A
FRB-3 Timeout	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes

Note:

1. Via the chipset asserting (for power down) or deasserting (for power up) SLEEP_S5

Table 41. Secure Mode Button Actions

	ACPI State	Power Switch	Sleep Switch	Reset Switch	NMI Switch	ID Switch
Standard and Advanced	S0 On	Protected – No Action	Protected – No Action	Protected – No Action	Unprotected	Unprotected
	S1 Sleep	Unprotected- Wakes Server	Unprotected	Protected – No Action	Unprotected	Unprotected
	S4/S5 Off	Unprotected – Powers On	Unprotected	Unprotected	Unprotected	Unprotected
Essentials	S0 On	Protected – No Action	Unprotected	Protected – No Action	Unprotected	Unprotected
	S1 Sleep	Protected – No Action	Unprotected	Protected – No Action	Unprotected	Unprotected
	S4/S5 Off	Protected – No Action	Unprotected	Protected – No Action	Unprotected	Unprotected

Table 42. Memory RAS Feature Support by Server Management Tier

Memory RAS Feature	Essentials	Standard	Advanced
Inventory	No	Yes	Yes
Correctable Error Reporting	No	Yes	Yes
Uncorrectable Error Reporting	Yes	Yes	Yes
DIMM Sparing	Partial ¹	Yes	Yes
DIMM Mirroring	Partial ¹	Yes	Yes

Note:

1. No SEL logging.

The following diagram shows a logical block diagram of the platform management architecture implemented on the Server Board SE7520BD2.

Note: The interconnections and blocks shown are to illustrate the functional relationships between the system management elements, and do not map directly to the exact circuit implementation of the architecture.

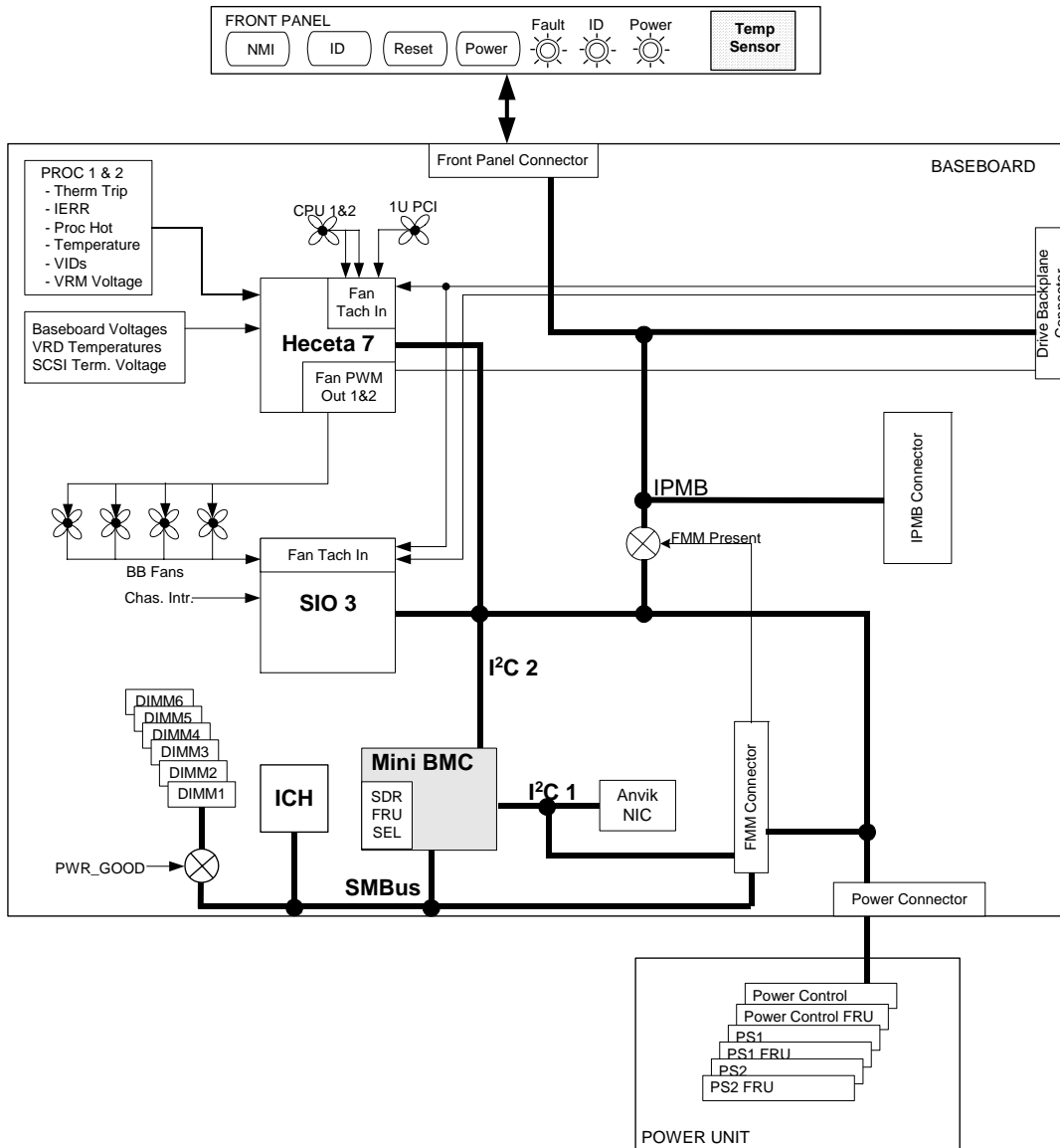


Figure 14. Block Diagram of Platform Management Architecture

4.1.2 5V Standby

The power supply must provide a 5V Standby power source for the platform to provide any management functionality. 5V Standby is a low power 5V supply that is active whenever the system is plugged into AC power. 5V Standby is used by the following onboard management devices:

- Management Controller (BMC and/or mBMC) and associated RAM, Flash, and EEPROM which are used to monitor the various system power control sources including the front panel Power Button, the server board RTC alarm signal, and power on request messages from the auxiliary IPMB connector and PCI SMBus.
- Onboard NICs that support IPMI-over-LAN and LAN Alerting, Wake-On LAN, and Magic Packet* operation.
- Emergency management port
- IPMB
- PCI SMBus in addition to certain logic and private buses used for power control
- ICMB Transceiver card (if present)
- IPMB isolation circuit
- System Status LED on the front panel
- System Identify LED

4.1.3 IPMI Messaging, Commands, and Abstractions

The IPMI specification defines a standardized, abstracted, message-based interface between software and the platform management subsystem, and a common set of messages (commands) for performing operations such as accessing temperature, voltage, and fan sensors, setting thresholds, logging events, controlling a watchdog timer, etc.

IPMI also includes a set of records called Sensor Data Records (SDRs) that make the platform management subsystem self-descriptive to system management software. The SDRs include software information, such as how many sensors are present, what type they are and what events they generate. The SDRs also include information, such as minimum and maximum ranges, sensor type, accuracy and tolerance, etc., that guides software in interpreting and presenting sensor data.

Together, IPMI Messaging and the SDRs provide a self-descriptive, abstracted platform interface that allows management software to automatically configure itself to the number and types of platform management features on the system. In turn, this enables one piece of management software to be used on multiple systems. Since the same IPMI messages are used over the serial/modem and LAN interfaces, a software stack designed for in-band (local) management access can readily be re-used as an out-of-band remote management stack by changing the underlying communications layer for IPMI messaging.

4.1.4 IPMI Sensor Model

An IPMI-compatible Sensor Model is used to unify the way that temperature, voltage, and other platform management status and control is represented and accessed. The implementation of this model is done according to command and data formats defined in the *Intelligent Platform Management Interface Specification*.

The majority of monitored platform elements are accessed as logical sensors under this model. This access is accomplished using an abstracted, message-based interface (IPMI messages). Instead of having system software access the platform monitoring and control hardware registers directly, it sends commands, such as the *Get Sensor Reading* command, for sensor access. The message-based interface isolates software from the particular hardware implementation.

System Management Software discovers the platform's sensor capabilities by reading the Sensor Data Records from a Sensor Data Record Repository managed by the management controller. Sensor Data Records provide a list of the sensors, their characteristics, location, type, and associated Sensor Number, for sensors in a particular system. The Sensor Data Records also hold default threshold values (if the sensor has threshold based events), factors for converting a sensor reading into the appropriate units (mV, rpm, degrees Celsius, etc.), and information on the types of events that a sensor can generate.

Sensor Data Records also provide information on where Field Replaceable Unit (FRU) information is located, and information to link sensors with the entity and/or FRU they're associated with.

Information in the SDRs is also used for configuring and restoring sensor thresholds and event generation whenever the system powers up or is reset. This is accomplished via a process called the 'initialization agent'. The BMC reads the SDRs and based on bit settings, writes the threshold data. Then it enables event generation for the various sensors it monitors and in management controllers on the IPMB for systems based on the Standard or Advanced management models.

System Management Software uses the data contained in the Sensor Data Record information to locate sensors in order to poll them, interpret, and present their data readings, adjust thresholds, interpret SEL entries, and alter event generation settings.

In Standard and Advanced management models, SDRs also provide a mechanism for extending the baseboard management with additional chassis or OEM 'value-added' monitoring and events. The baseboard monitoring can be extended by implementing an IPMI-compatible management controller, connecting it to the IPMB, and adding new SDRs describing that controller and its sensors to the SDR Repository. System Management Software can then read the SDRs and use them to automatically incorporate the additional sensors.

4.1.5 Private Management Buses

A Private Management Bus is a single-master I²C bus that is controlled by the management controller. Access to any of the devices on the Private Management Bus is accomplished indirectly via commands to the management controller via the IPMB or system interfaces. Private Management buses are a common mechanism used for accessing temperature sensors, system processor information, and other baseboard monitoring devices that are located in various locations in the system.

The devices on the Private Management Bus are isolated from traffic on the IPMB. Because devices (such as temperature sensors) are polled by the management controller, this removes the polling traffic from the 'public' IPMB bus. This also increases the reliability of access to the information, since issues with IPMB bus arbitration and message retries are avoided.

Furthermore, placing managed I²C devices on the private management bus frees up the I²C addresses that those devices would have used up on the IPMB.

4.1.6 Management Controllers

At the heart of platform management is a management controller. To support the tiered management model, the Server Board SE7520BD2 supports two different management controllers. Integrated onto the server board is the National Semiconductor* Mini-BMC (mBMC) to provide the functionality of the Essentials management tier. The Standard and Advanced modules electrically replace the Mini-BMC with the more full featured 'Sahalee' microcontroller. Sahalee is a custom ARM7-TDMI based microcontroller designed for baseboard management applications on Intel® server boards.

The management controller is a microcontroller that provides the intelligence at the heart of the Intelligent Platform Management architecture. The primary purpose of the management controller is to autonomously monitor system sensors for system platform management events, such as over-temperature, out-of-range voltages, etc., and log their occurrence in the non-volatile System Event Log (SEL). The management controller also provides the interface to the sensors and SEL so System Management Software can poll and retrieve the present status of the platform. The contents of the log can be retrieved post mortem to provide failure analysis information to field service personnel. It is accessible by System Management Software, such as Intel® Server Management (ISM), running under the operating system.

The management controller includes the ability to generate a selectable action, such as a system power-off or reset, when a match occurs to one of a configurable set of events. This capability is called *Platform Event Filtering*, or PEF.

The management controller includes recovery control functions that allow local or remote software to request actions such as power on/off, power cycle, and system hard resets, plus an IPMI Watchdog Timer that can be used by BIOS and run-time management software as a way to detect software hangs.

The management controller provides out-of-band remote management interfaces providing access to the platform health, event log, and recovery control features via LAN (all tiers). Standard and Advanced systems also allow access via serial/modem, IPMB, PCI SMBus, and ICMB interfaces. These interfaces remain active on standby power, providing a mechanism where the SEL, SDR, and recovery control features can be accessed even when the system is powered down.

Because the management controller operates independently from the main processor(s), the management controller monitoring and logging functions, and the out-of-band interfaces can remain operative even under failure conditions that cause the main processors, operating system, or local system software to stop.

The management controller also provides the interface to the non-volatile Sensor Data Record (SDR) Repository. IPMI Sensor Data Records provide a set of information that system management software can use to automatically configure itself for the number and type of IPMI sensors (e.g. temperature sensors, voltage sensors, etc.) in the system. This information allows management software to automatically adapt itself to the particular system, enabling the development of management software that can work on multiple platforms without requiring the software to be modified.

The following is a list of the major functions that are managed by either or both the mBMC and BMC.

- Sensors and Sensor Polling
- FRU Information Access. FRU (Field Replaceable Unit) information is non-volatile storage for serial number, part number, asset tag and other inventory information for the server board and chassis. The FRU implementation on SE7520BD2 includes write support for OEM-specific records.
- Autonomous Event Logging. The management controller autonomously polls server board sensors and generates IPMI Platform Events, also called Event Messages, when an event condition is detected. The events are automatically logged to the System Event Log (SEL).
- System Event Log (SEL). Non-volatile storage for platform health events. Events can be autonomously logged by the BMC, or by sending Event Messages via the system interface or IPMB to the BMC. This enables BIOS, software, and add-in cards to also log events.
- Sensor Data Record (SDR) Repository. Non-volatile storage holding records describing the number and type of management sensors on the server board and in the chassis. Includes write support for OEM-specific records and sensors.
- SDR/SEL Timestamp Clock. A clock internally maintained by the management controller that is used for time-stamping events and recording when SDR and SEL contents have changed.
- Intelligent Platform Management Bus (IPMB). The IPMB is a two-wire, multi-master serial bus that provides a point for extending the baseboard management to include chassis management features, and for enabling add-in cards to access the baseboard management subsystem. (Standard and Advanced systems only.)

- Watchdog Timer with selectable timeout actions (power off, power cycle, reset, or NMI) and automatic logging of timeout event
- Direct Platform Control (DPC) LAN Remote Management Connection
- LAN Alerting via PET (Platform Event Trap) format SNMP trap
- Serial/Modem Remote Management Connection (Standard and Advanced systems only)
- Serial/Modem Event Paging/Alerting (Standard and Advanced systems only)
- Platform Event Filtering (PEF)
- Keyboard Controller Style (KCS) IPMI-System Interface (Standard and Advanced systems only)
- SMBus IPMI-System Interface (Essentials systems only)
- Intelligent Chassis Management Bus (ICMB) support (Standard and Advanced systems only)
- Remote Boot Control
- Local and Remote Power On/Off/Reset Control
- Local and Remote Diagnostic Interrupt (NMI) Control
- Fault-Resilient Booting
- Front Panel LED Control
- Platform Management Interrupt Routing (Standard and Advanced systems only)
- Power Distribution Board (PDB) monitoring (Standard and Advanced systems only)
- Updateable BMC Firmware
- System Management Power Control (including providing Sleep/Wake and power button interfaces)
- Platform Event Filtering (PEF)
- Baseboard Fan Speed Control and Failure Monitoring
- Speaker 'Beep' Capability (used to indicate conditions such as FRB failure) (Standard and Advanced systems only)
- Baseboard FRU Information interface
- Diagnostic Interrupt (Front Panel NMI) Handling
- SMI/NMI status monitor (Standard and Advanced systems only)
- System interface to the IPMB (via System Interface Ports) (Standard and Advanced systems only)
- System interface to the PCI SMBus (via System Interface Ports) (Standard and Advanced systems only)

- Secure Mode Control - front panel lock/unlock initiation.
- IPMI v2.0 Management Controller Initialization Agent function (Standard and Advanced)
- Emergency Management Port (EMP) Serial/Modem platform management interface (Standard and Advanced systems only)
- Dedicated Network Interface Controller (NIC) and full TCP/IP software stack (Advanced only)

Table 43. mBMC Built-in Sensors

Sensor Name	Sensor #	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	EventData
Physical Security Violation	01	Physical Security 05h	Sensor Specific 6Fh	LAN Leash Lost	As	LAN Leash Lost	Trig Offset
Platform Security Violation	02	Platform Security Violation Attempt 06h	Sensor Specific 6Fh	Out-of-band access password violation	As	–	Trig Offset
Power Unit Status	03	Power Unit 09h	Sensor Specific 6Fh	Power On/Off Power cycle AC Lost	As	–	Trig Offset
Button	04h	Button 14h	Sensor Specific 6Fh	Power Button Reset Button	As	–	Trig Offset
Watchdog	05h	Watchdog2 23h	Sensor Specific 6Fh	Timer Expired Hard Reset Power Down Power cycle Timer Interrupt	As	–	Trig Offset
System Boot	06h	System boot Initiated 1Dh	Sensor Specific 6Fh	Initiated by power up Initiated by hard reset Initiated by warm reset	As	–	Trig Offset
System PEF Event	07h	System Event 12h	Sensor Specific 6Fh	PEF Action	As	–	Trig Offset
Platform Alert	08h	Platform Alert 24h	Sensor Specific 6Fh	Platform Event Trap generated	As	–	Trig Offset

Table 44. Onboard Platform Instrumentation using the mBMC

Sensor Name	Sensor #	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	PEF Action	SDR Record Type
Physical Security Violation	0Ah	Physical Security 05h	Sensor Specific 6Fh	General Chassis Intrusion	As	General Chassis Intrusion	Trig Offset	X	02
CPU1 12v	0Bh	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
CPU2 12v	0Ch	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +1.5V	0Dh	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +3.3V	0Eh	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +5V	0Fh	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +12V	10h	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB -12V	11h	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Aux +3.3V	12h	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
STBY +5V	13h	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
STBY +3.3V	14h	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01
FSB Vtt	15h	Voltage 02h	Threshold 01h	[u,l][c,nc]	As & De	Analog	R, T	Fault LED Action	01

Sensor Name	Sensor #	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	PEF Action	SDR Record Type
MEM_Core Volt	16h	Voltage 02h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
SCSI Core(1.8v)	17h	Voltage 02h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc1 VCCP	19h	Voltage 02h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc2 VCCP	1Ah	Voltage 02h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 1	1Bh	Fan 04h	Threshold 01h	[u][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 2	1Ch	Fan 04h	Threshold 01h	[u][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 3	1Dh	Fan 04h	Threshold 01h	[u][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 4	1Eh	Fan 04h	Threshold 01h	[u][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 5	1Fh	Fan 04h	Threshold 01h	[u][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 6	20h	Fan 04h	Threshold 01h	[u][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc1 IERR	21h	Processor 07h	Sensor Specific 6Fh	IERR	As	–	Trig Offset	–	02
Proc2 IERR	22h	Processor 07h	Sensor Specific 6Fh	IERR	As	–	Trig Offset	–	02
Proc1 Thermal Trip	23h	Processor 07h	Sensor Specific 6Fh	Thermal Trip	As	–	Trig Offset	Fault LED Action	02
Proc2 Thermal Trip	24h	Processor 07h	Sensor Specific 6Fh	Thermal Trip	As	–	Trig Offset	Fault LED Action	02

Sensor Name	Sensor #	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	PEF Action	SDR Record Type
Proc1 Thermal Control	25h	Temp 01h	Threshold 01h	[u][c,nc]	As & De	Analog	Trig Offset	Fault LED Action	01
Proc2 Thermal Control	26h	Temp 01h	Threshold 01h	[u][c,nc]	As & De	Analog	Trig Offset	Fault LED Action	01
Diagnostic Interrupt Button	27h	Critical Interrupt 13h	Sensor Specific 6Fh	FP NMI Button	As	–	Trig Offset	NMI Pulse	02
Chassis Identify Button	28h	Button 14h	Generic 03h	State Assert	As	–	Trig Offset	ID LED Action	02
Proc1 Fan	29h	Fan 04h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc2 Fan	2Ah	Fan 04h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc1 Core Temp	2Bh	Temp 01h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc2 Core Temp	2Ch	Temp 01h	Threshold 01h	[u,][c,nc]	As & De	Analog	R, T	Fault LED Action	01
CPU Configuration Error	2Dh	Processor 07h	Generic 03h	State Asserted	As & De	Discrete	R, T	Fault LED Action	02
OEM Type 53h	–	OEM Type 53h	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 45. Platform Instrumentation Sensors using the Intel® Management Module

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
Power Unit Status	01h	Power Unit 09h	Sensor Specific 6Fh	Power Off Power Cycle A/C Lost Soft Power Control Fault Power Unit Failure Predictive Failure	As	–	Trig Offset	A	X
Power Unit Redundancy	02h	Power Unit 09h	Generic 0Bh	Redundancy Regained Redundancy lost Redundancy Degraded Non-red:Suff res from redund Non-red:Suff res from insuff res Non-red:Insuff res Redundancy Degraded from full redundancy Redundancy Degraded from non-redundant	As	–	Trig Offset	A	X
Watchdog	03h	Watchdog2 23h	Sensor Specific 6Fh	Timer Expired Hard Reset Power Down Power Cycle Timer Interrupt	As & De	–	Trig Offset	A	X
Platform Security Violation	04h	Platform Security Violation Attempt 06h	Sensor Specific 6Fh	Secure mode violation attempt Out-of-band access password violation	As	–	Trig Offset	A	X
Physical Security Violation	05h	Physical Security 05h	Sensor Specific 6Fh	General Chassis Intrusion LAN Leash Lost	As & De	General Chassis Intrusion LAN Leash Lost	Trig Offset	A	X

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
POST Error	06h	POST Error 0Fh	Sensor Specific 6Fh	POST error	As	–	POST Code	A	–
Critical Interrupt Sensor	07h	Critical Interrupt 13h	Sensor Specific 6Fh	Front Panel NMI Bus Error	As & De	–	Trig Offset	A	–
Memory	08h	Memory 0Ch	Sensor Specific 6Fh	Uncorrectable ECC	As	–	Trig Offset	A	–
Event Logging Disabled	09h	Event Logging Disabled 10h	Sensor Specific 6Fh	Correctable Memory Error Logging Disabled Log Area Reset/Cleared	As	–	Trig Offset	A	X
Session Audit	0Ah	Session Audit 2Ah	Sensor Specific 6Fh	00: Session Activation 01: Session Deactivation	As	–	As defined by IPMI	A	X
BB +1.2V Vtt	10h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
BB +1.2V NIC Core	11h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
BB +1.5V	12h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
BB +1.8V SCSI Core	13h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
BB +2.5V	14h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
BB +3.3V	15h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
BB +3.3V Standby	16h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	X

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
BB +3.3V AUX	17h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	X
BB +5V	18h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	-
BB +5V Standby	19h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	X
BB +12V	1Ah	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	-
BB -12V	1Bh	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	-
BB Vbat	1Ch	Voltage 02h	Digital Discrete 05h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	X
BB Temp	30h	Temp 01h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	X
Front Panel Temp	32h	Temp 01h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	X
Drive Backplane Temp	35h	Temp 01h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	-
Tach Fan 1	40h	Fan 04h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	M	-
Tach Fan 2	41h	Fan 04h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	M	-
Tach Fan 3	42h	Fan 04h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	M	-
Tach Fan 4	43h	Fan 04h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	M	-
Tach Fan 5	44h	Fan 04h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	M	-

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
Tach Fan 6	45h	Fan 04h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	M	–
Fan 1 Presence	4Bh	Slot/Connector 21h	Sensor Specific 6Fh	Device Installed	As & De	–	Trig Offset	A	–
Fan 2 Presence	4Ch	Slot/Connector 21h	Sensor Specific 6Fh	Device Installed	As & De	–	Trig Offset	A	–
Fan 3 Presence	4Dh	Slot/Connector 21h	Sensor Specific 6Fh	Device Installed	As & De	–	Trig Offset	A	–
Fan 4 Presence	4Eh	Slot/Connector 21h	Sensor Specific 6Fh	Device Installed	As & De	–	Trig Offset	A	–
Fan Redundancy	4Fh	Fan 04h	Generic 0Bh	Redundancy Regained Redundancy lost Redundancy Degraded Non-red:Suff res from redund Non-red:Suff res from insuff res Non-red:Insuff res Redundancy Degraded from full redundancy Redundancy Degraded from non-redundant	As	–	Trig Offset	A	–
LVDS SCSI channel 1 terminator fault	60h	Terminator 1Ch	Digital Discrete 06h	Performance Met or Lags	As	–	Trig Offset	A	–
LVDS SCSI channel 2 terminator fault	61h	Terminator 1Ch	Digital Discrete 06h	Performance Met or Lags	As	–	Trig Offset	A	–

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
Power Supply Status 1	70h	Power Supply 08h	Sensor Specific 6Fh	Presence Failure Predictive Fail A/C Lost	As & De	–	Trig Offset	A	X
Power Supply Status 2 (Redundant SKU only)	71h	Power Supply 08h	Sensor Specific 6Fh	Presence Failure Predictive Fail A/C Lost	As & De	–	Trig Offset	A	X
Power Nozzle Power Supply 1	78h	Current 03h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Power Nozzle Power Supply 2	79h	Current 03h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Power Gauge V1 rail (+12v) Power Supply 1	7Ah	Current 03h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Power Gauge V1 rail (+12v) Power Supply 2	7Bh	Current 03h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Power Gauge (aggregate power) Power Supply 1	7Ch	Other Units 0Bh	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Power Gauge (aggregate power) Power Supply 2	7Dh	Other Units 0Bh	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Processor Missing	80h	Module / Board 15h	Digital Discrete 03h	State Asserted State Deasserted	As	–	Trig Offset	A	–

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
System ACPI Power State	82h	System ACPI Power State 22h	Sensor Specific 6Fh	S0 / G0 S1 S4 S5 / G2 G3 Mechanical Off	As	–	Trig Offset	A	X
System Event	83h	System Event 12h	Sensor Specific 6Fh	OEM System Boot Event (Hard Reset) PEF Action	As	–	Trig Offset	A	–
Button	84h	Button 14h	Sensor Specific 6Fh	Power Button Sleep Button Reset Button	As	–	Trig Offset	A	X
SMI Timeout	85h	SMI Timeout F3h	Digital Discrete 03h	State Asserted State Deasserted	As	–	Trig Offset	A	–
Sensor Failure	86h	Sensor Failure F6h	OEM Sensor Specific 73h	I2C device not found I2C device error detected I2C Bus Timeout	As	–	Trig Offset	A	X
NMI Signal State	87h	OEM C0h	Digital Discrete 03h	State Asserted State Deasserted	–	–	–	–	–
SMI Signal State	88h	OEM C0h	Digital Discrete 03h	State Asserted State Deasserted	–	–	–	–	–
DIMM Sparing Redundancy	89h	Availability Status 0Bh	Discrete 0Bh	Fully Redundant Non-red:Suff res from redund Non-red:Suff res from insuff res Non-red:Insuff res	As	–	Trig Offset	A	–

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
DIMM Sparing Enabled	8Ah	Entity Presence 25h	Sensor Specific 6Fh	Entity Present	As	–	Trig Offset	A	–
Memory Mirroring Redundancy	8Bh	Availability Status 0Bh	Discrete 0Bh	Fully Redundant Non-red:Suff res from redund Non-red:Suff res from insuff res Non-red:Insuff res	As	–	Trig Offset	A	–
Memory Mirroring Enabled	8Ch	Entity Presence 25h	Sensor Specific 6Fh	Entity Present	As	–	Trig Offset	A	–
Processor 1 Status	90h	Processor 07h	Sensor Specific 6Fh	IERR Thermal Trip FRB1, FRB2, FRB3 Config Error Presence Disabled	As & De	–	Trig Offset	M	X
Processor 2 Status	91h	Processor 07h	Sensor Specific 6Fh	IERR Thermal Trip FRB1, FRB2, FRB3 Config Error Presence Disabled	As & De	–	Trig Offset	M	X
Processor 1 Core Temp	98h	Temp 01h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Processor 2 Core Temp	99h	Temp 01h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–
Processor 1 12v VRM	B8h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	–

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
Processor 2 12v VRM	B9h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	-
Processor 1 Fan	A8h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	M	-
Processor 2 Fan	A9h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	M	-
Processor 1 Thermal Control	C0h	Temp 01h	Digital Discrete 07h	Transitioned to Non-Critical from OK	As & De	-	Trig Offset	M	-
Processor 2 Thermal Control	C1h	Temp 01h	Digital Discrete 07h	Transitioned to Non-Critical from OK	As & De	-	Trig Offset	M	-
Processor 1 VRD Over Temp	C8h	Temp 01h	Digital Discrete 07h	Transitioned to Non-Critical from OK	As & De	-	Trig Offset	M	-
Processor 2 VRD Over Temp	C9h	Temp 01h	Digital Discrete 07h	Transitioned to Non-Critical from OK	As & De	-	Trig Offset	M	-
Processor 1 Vcc	D0h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	-
Processor 2 Vcc	D1h	Voltage 02h	Threshold 01h	[u,l][nr,c,nc]	As & De	Analog	R, T	A	-
CPU Configuration Error	D8h	Processor 07h	Generic 03h	State Asserted	As & De	Discrete	R, T	A	-
DIMM 1	E0h	Slot Connector 21h	Sensor Specific 6Fh	Fault Status Asserted Device Installed Disabled	As	-	Trig Offset	A	-

Sensor Name	Sensor Number	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	Event Data	Rearm	Standby
DIMM 2	E1h	Slot Connector 21h	Sensor Specific 6Fh	Fault Status Asserted Device Installed Disabled	As	–	Trig Offset	A	–
DIMM 3	E2h	Slot Connector 21h	Sensor Specific 6Fh	Fault Status Asserted Device Installed Disabled	As	–	Trig Offset	A	–
DIMM 4	E3h	Slot Connector 21h	Sensor Specific 6Fh	Fault Status Asserted Device Installed Disabled	As	–	Trig Offset	A	–
DIMM 5	E4h	Slot Connector 21h	Sensor Specific 6Fh	Fault Status Asserted Device Installed Disabled	As	–	Trig Offset	A	–
DIMM 6	E5h	Slot Connector 21h	Sensor Specific 6Fh	Fault Status Asserted Device Installed Disabled	As	–	Trig Offset	A	–

4.2 Essentials Management Features and Functionality

4.2.1 Overview of mBMC

The mini Baseboard Management Controller (mBMC) is an Application Specific Integrated Circuit (ASIC) with many peripheral devices embedded into it. The mBMC contains the logic needed for controlling the system, monitoring the sensors, and communicating with other systems and devices via various external interfaces.

The following figure is a block diagram of the mBMC as it is used in a server management system. The external interface blocks to the mBMC are the discrete hardware peripheral device interface modules.

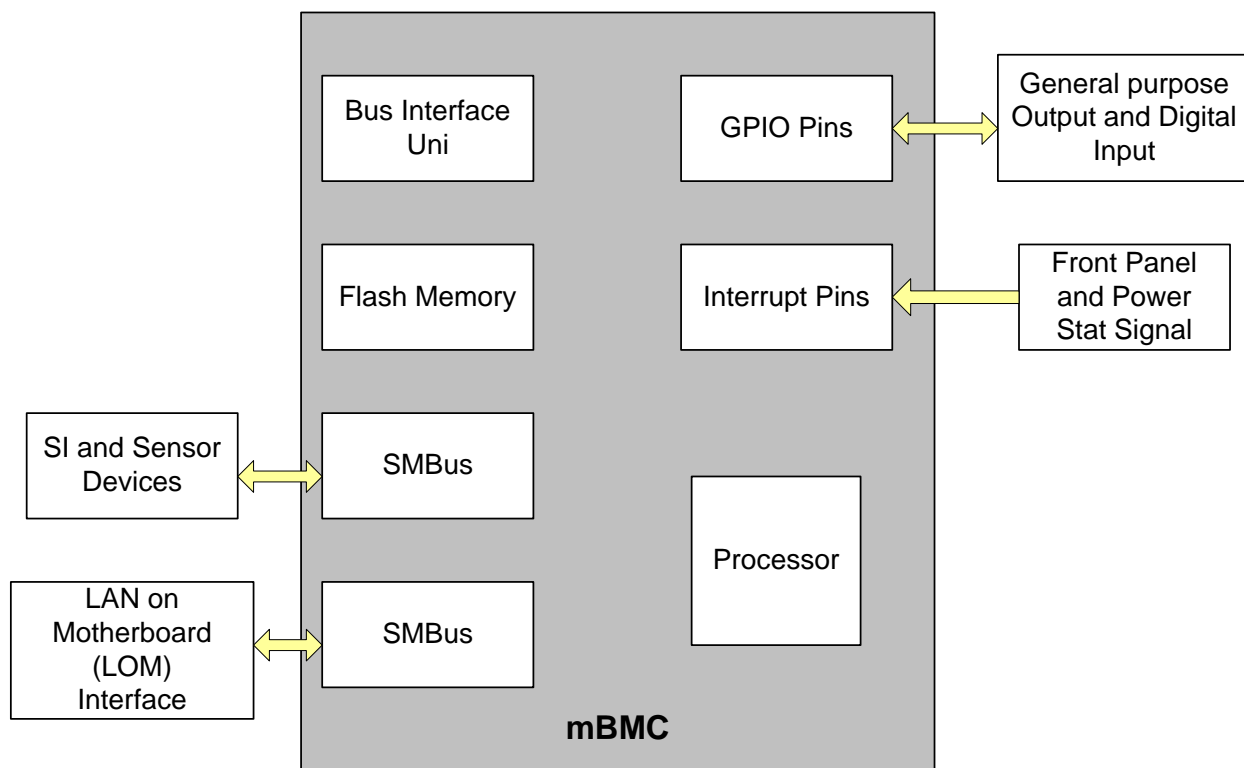


Figure 15. mBMC in a Server Management System

4.2.2 mBMC Self-test

The mBMC performs various tests as part of its initialization. If a failure is determined, the mBMC stores the error internally. A failure may be caused by a corrupt mBMC FRU, SDR, or SEL. The *IPMI 1.5 Get Self Test Results* command can be used to return the first error detected.

Executing the *Get Self Test Results* command causes the mBMC self-test to be run. It is strongly recommended to reset the mBMC via an AC cycle.

4.2.3 SMBus Interfaces

The mBMC incorporates one slave and two master-only SMBus interfaces. The mBMC interfaces with the host through the slave SMBus interface. It interfaces with the LAN On Motherboard (LOM) and peripherals through the two independent master bus interfaces.

4.2.4 External Interface to mBMC

Figure 16 shows the data/control flow to and within the functional modules of the mBMC. External interfaces from the host system, LOM, and peripherals interact with the mBMC through the corresponding interface modules as shown.

The mBMC communicates with the internal modules using its private SMBus. External devices and sensors interact with the mBMC using the peripheral SMBus through SIO. LOM communicates through the LOM SMBus. GPIO pins are available and are used for various input and output functions. Dedicated LED lines are used for LED/color control.

Also built into the mBMC are the control functions for both the power supply and front panel.

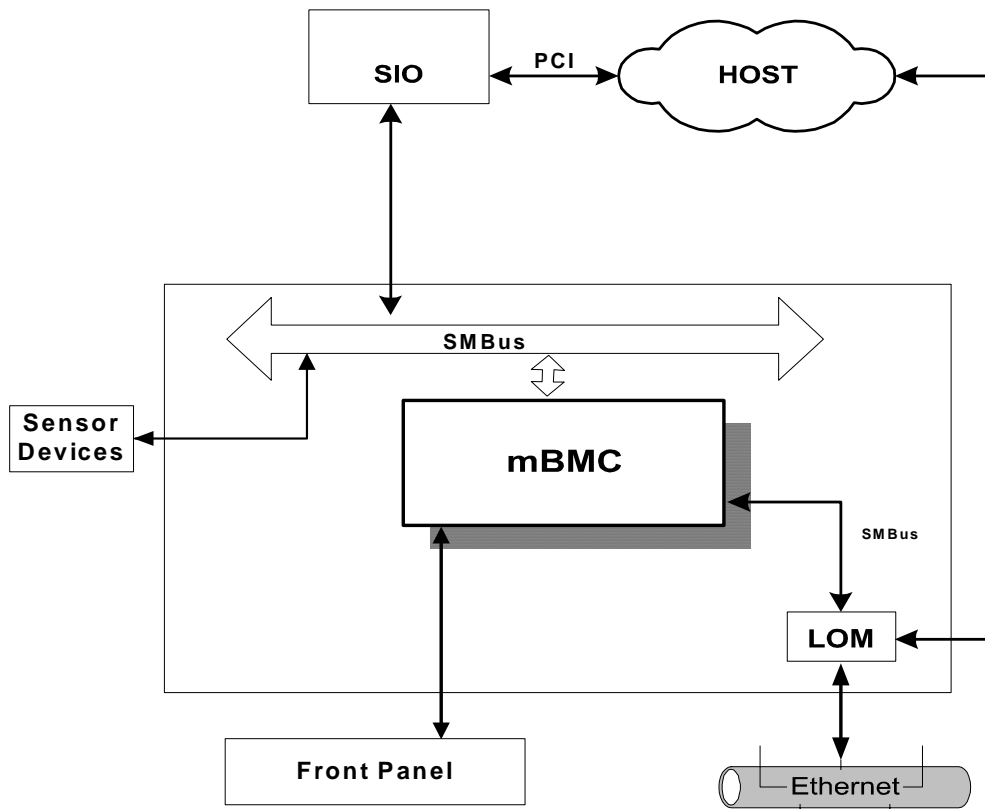


Figure 16. External Interfaces to the mBMC

4.2.4.1 Private Management I²C Buses

The mBMC implements a single private management bus. The mBMC is the sole master on this bus. External agents must use the mBMC *Master Write/Read I²C* command if they require direct communication with a device on this bus. In addition, the mBMC provides a *Reserve Device* command that gives an external agent exclusive access to a specific device for a selectable time.

4.2.5 Messaging Interfaces

This section describes the supported mBMC communication interfaces:

- Host SMS interface via SMBus interface
- LAN interface using the LAN On Motherboard SMBus

4.2.5.1 Channel Management

The mBMC supports two channels:

- System interface
- 802.3 LAN

Table 46. Supported Channel Assignments

Channel ID	Media Type	Interface	Supports Sessions
1	802.3 LAN	IPMB 1.0	Multi sessions
2	System Interface	IPMI-SMBus	Session-less

4.2.5.2 User Model

The mBMC supports one anonymous user (null user name) with a settable password. The IPMI command to set the password is supported.

4.2.5.3 Request/Response Protocol

All of the protocols used in the host interface and the LOM interface are Request/Response protocols. A Request Message is issued to an intelligent device, to which the device responds with a separate Response Message.

4.2.5.4 Host to mBMC Communication Interface

The host communicates with the mBMC via the System Management Bus (SMBus). The interface consists of three signals:

- SMBus clock signal (SCLH)
- SMBus data signal (SDAH)
- Optional SMBus alert signal (SMBAH). The signal notifies the host that the PC87431x has data to provide.

The mBMC is a slave device on the bus. The host interface is designed to support polled operations. Host applications can optionally handle an SMBus alert interrupt if the mBMC is unable to respond immediately to a host request. In this case, “Not Ready” is indicated in one of two ways:

- The host interface bandwidth is limited by the bus clock and mBMC latency. To meet the device latency, the mBMC slows down the bus periodically by extending the SMBus clock low interval (SCLH).
- If the mBMC is in the middle of a LAN or peripheral device communication, or if a response to the host request is not yet ready, the mBMC does not acknowledge the device address (“NAK”). This forces the host software to stop and restart the session.

For more information on read-write through SMBus see the *System Management Bus (SMBus) Specification 2.0*

4.2.5.5 LAN Interface

The server board supports one DPC LAN interface via a UDP port 26Fh. The mBMC supports a maximum of one simultaneous session across all authenticated channels. The server board implements gratuitous ARP support according to the IPMI 1.5 Specification.

The IPMI Specification v1.5 defines how IPMI messages, encapsulated in RMCP packet format, can be sent to and from the mBMC. This capability allows a remote console application to access the mBMC and perform the following operations:

- Chassis Control, e.g., get chassis status, reset chassis, power-up chassis, power-down chassis
- Get system sensor readings
- Get and Set system boot options
- Get Field Replaceable Unit (FRU) information
- Get System Event Log (SEL) entries
- Get Sensor Data Records (SDR)
- Set Platform Event Filtering (PEF)
- Set LAN configurations

In addition, the mBMC supports LAN alerting in the form of SNMP traps that conform to the IPMI Platform Event Trap (PET) format.

Table 47. LAN Channel Capacity

LAN Channel Capability	Options
Number of Sessions	1
Number of Users	1
User	Name NULL (anonymous)
User Password	Configurable
Privilege Levels	User, Operator, Administrator
Authentication Types	MD5
Number of LAN Alert Destinations	1
Address Resolution Protocol (ARP)	Gratuitous ARP

4.2.6 Direct Platform Control (IPMI over LAN)

Direct Platform Control provides a mechanism for delivering IPMI Messages directly to the management controllers via a LAN connection. The NICs and the management controllers remain active on standby power, enabling the IPMI Messaging when the system is powered up, powered down, and in a system sleep state. This allows a remote console application to be able to access the management controller capabilities, including:

- Power on/off and reset control with the ability to set BIOS boot flags
- FRU, SDR, and SEL access
- BMC configuration access
- Remote NMI Generation
- Ability to transfer IPMI messages between the LAN interface and other interfaces, such as the System Interface, IPMB, and PCI SMBus. This capability enables messages to be delivered to system management software, and provides the ability to access sensors and FRU information on other management controllers.

IPMI Messages are encapsulated in a packet format called RMCP (Remote Management Control Protocol). The Distributed Management Task Force (DMTF) has defined RMCP for supporting pre-operating system and operating system-absent management. RMCP is a simple request-response protocol that can be delivered using UDP datagrams. IPMI-over-LAN uses version 1 of the RMCP protocol and packet format.

UDP port 26Fh is a 'well-known port' address that is specified to carry RMCP (Remote Management Control Protocol) formatted UDP datagrams. The onboard Intel® network interface controllers contain circuitry that enables detecting and capturing RMCP packets that are received on Port 26Fh and making them available to the management controller via a 'side-band' interface that is separate from the PCI interface to the NIC. Similarly, the management controller can use the side-band interface to send packets from Port 26Fh, as shown in the following figure.

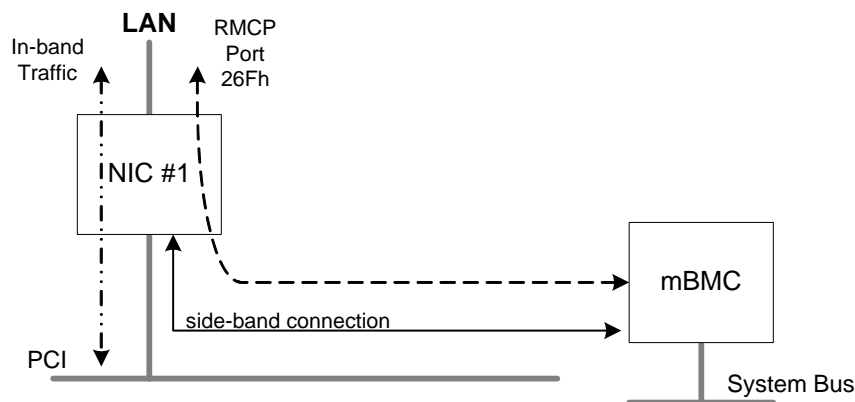


Figure 17. IPMI-over-LAN

RMCP includes a field that indicates the class of messages that can be embedded in an RMCP message packet. For RMCP version 1.0, the defined classes are IPMI, ASF, and OEM. IPMI-over-LAN uses the IPMI class to transfer IPMI Messages encapsulated in RMCP packets. Intelligent Platform Management Interface v1.5 Specification specifies the packet formats and commands used to perform IPMI Messaging on LAN via RMCP.

The management controller transmits to other port addresses as needed. For example, LAN Alerts, which are sent as SNMP Traps, can be transmitted to the SNMP Trap ‘well known’ port address, 162 (0A2h).

4.2.6.1 LAN Channel Specifications

The following table presents the minimum support that will be provided.

Note: The system management software and utilities may not use all the available management controller options and capabilities. For detailed technical information on the operation of the LAN channel operation and LAN Alerting, see the *Intelligent Platform Management Interface Specification, Version 1.5*.

Table48. LAN Channel Specifications

Configuration Capability	Options	Description/Notes
Channel Access Modes	Always-active, disabled	This option determines when the BMC can be accessed via IPMI Messaging over LAN.
Number of Sessions	One (Essentials)	The number of simultaneous sessions that can be supported is shared across the LAN and serial/modem channels.
Number of Users	One (Essentials)	User information is a resource that is shared across the LAN and serial/modem channels.
Configurable User Names	No (Essentials)	User information is a resource that is shared across the LAN and serial/modem channels.
Configurable User Passwords	Yes	
Privilege Levels	User, Operator, Administrator	

Configuration Capability	Options	Description/Notes
IPMI Message Authentication Type Support	MD5	
Number of LAN Alert destinations	One (Essentials)	
PET Acknowledge support	Yes	
Gratuitous ARP Support	Yes	

4.2.6.2 LAN Drivers and Setup

The IPMI-over-LAN feature must be used with the appropriate Intel NIC driver, and the NIC correctly configured in order for DPC LAN operation to occur transparently to the operating system and network applications. If an incorrect driver or NIC configuration is used, it is possible to get driver timeouts when the IPMI-over-LAN feature is enabled.

4.2.6.3 BIOS Boot Flags

A remote console application can use the IPMI *Set System Boot Options* command to configure a set of BIOS boot flags and boot initiator parameters that are held by the management controller. These parameters include information that identifies the party that initiated the boot, plus flags and other information that can be used to direct the way booting proceeds after a system reset or power-up. For example, the system can be configured to boot normally, boot using PXE, boot to a diagnostic partition, etc.

4.2.6.4 Boot Flags and LAN Console Redirection

The system BIOS includes a LAN Console Redirection capability. This capability can only be directed to one IP Address at a time. Thus, the boot flags and boot initiator information are also used to tell the BIOS where to send LAN Console Redirection.

4.2.7 Wake On LAN / Power On LAN and Magic Packet* Support

The server board supports Wake On LAN / Power On LAN capability using the onboard network interface chips or an add-in network interface card. An add-in network card can deliver the wake signal to the server board via the PME signal on the PCI bus. The actual support for Magic Packet and/or packet filtering for Wake On LAN / Power On LAN is provided by the NIC. The server board handles the corresponding wake signal.

4.2.7.1 Wake On LAN with S4/S5

A configuration option is provided that allows the onboard NICs to be enabled to wake the system in an S4/S5 state, even if the operating system disabled Wake-On-LAN when it powered down the system. This provides an option for users who want to use standard, but non-secure, WOL capability for operations such as after-hours maintenance. The DPC LAN capability provides a secure system power-up, plus the ability to provide BIOS boot options, by sending authenticated IPMI messages directly to the BMC via the onboard NICs.

4.2.8 Watchdog Timer

The mBMC implements an IPMI 1.5-compatible watchdog timer. SMI and NMI pre-timeout actions are supported, as are hard reset, power down, and power cycle timeout actions. See the IPMI specification for details.

4.2.9 System Event Log (SEL)

The mBMC implements the logical System Event Log device as specified in the *Intelligent Platform Management Interface Specification, Version 1.5*. The SEL is accessible via all communication transports. In this way, the SEL information can be accessed while the system is down by means of out-of-band interfaces. The maximum SEL size that is supported by mBMC is 92 entries.

Supported commands are:

- Get SEL Info
- Reserve SEL
- Get SEL Entry
- Add SEL Entry
- Clear SEL
- Get SEL Time
- Set SEL Time

4.2.9.1 Timestamp Clock

The mBMC maintains a four-byte internal timestamp clock used by the SEL and SDR subsystems. This clock is incremented once per second. It is read using the *Get SEL Time* command and set using the *Set SEL Time* command. The *Get SDR Time* command can also be used to read the timestamp clock. These commands are specified in the *Intelligent Platform Management Interface Specification, Version 1.5*.

After a mBMC reset or power up, the mBMC sets the initial value of the timestamp clock to 0x00000000. It is incremented once per second after that. A SEL event containing a timestamp from 0x00000000 to 0x140000000 has a timestamp value that is relative to mBMC initialization.

During POST, the BIOS tells the mBMC the current time via the *Set SEL Time* command. The mBMC maintains this time, incrementing it once per second until the mBMC is reset or until the time is changed via another *Set SEL Time* command.

If the RTC changes during system operation, system management software must synchronize the mBMC time with the system time. If this is not done, the server should be reset so that the BIOS will pass the new time to the mBMC.

4.2.10 Sensor Data Record (SDR) Repository

The mBMC includes built-in Sensor Data Records that provide platform management capabilities (sensor types, locations, event generation and access information). The SDR Repository is accessible via all communication transports. This way, out-of-band interfaces can access the SDR Repository information if the system is down.

The mBMC supports 2176 bytes of storage for SDR records. The SDR defines the type of sensor, thresholds, hysteresis values and event configuration. The mBMC supports up to six threshold values for threshold-based full sensor records, and up to 15 events for non threshold-based full and compact sensor records. It supports both low-going and high-going sensor devices.

4.2.10.1 Initialization Agent

The mBMC implements the internal sensor initialization agent functionality specified in the *Intelligent Platform Management Interface Specification, Version 1.5*. When the mBMC initializes, or when the system boots, the initialization agent scans the SDR repository and configures the sensors referenced by the SDRs. This includes setting sensor thresholds, enabling/disabling sensor event message scanning, and enabling/disabling sensor event messages.

4.2.11 Event Message Reception

The mBMC supports externally (e.g., BIOS) generated events via the Platform Event Message command. Events received via this command will be logged to the SEL and processed by PEF.

4.2.12 Event Filtering and Alerting

The mBMC implements the following IPMI 1.5 alerting features:

- PEF
- Alert over LAN

4.2.12.1 Platform Event Filtering (PEF)

The mBMC monitors platform health and logs failure events into the SEL. The Platform Event Filtering feature provides a configurable mechanism to allow events to trigger alert actions. PEF provides a flexible, general mechanism that enables the mBMC to perform selectable actions triggered by a configurable set of platform events. The mBMC supports the following IPMI PEF actions:

- Power-down
- Soft shut-down
- Power cycle
- Reset
- Diagnostic Interrupt
- Alert

The mBMC maintains an Event Filter table with 30 entries that is used to select the actions to perform. Also maintained is a fixed/read-only Alert Policy Table entry. No alert strings are supported.

Note: All Fault/Status LED and ID LED behaviors are driven off of PEF. PEF should not be disabled and the “as shipped” entry configuration should not be modified or these behaviors will be changed.

Each time the PEF module receives either an externally or internally generated event message, it compares the event data against the entries in the event filter table. The mBMC scans all entries in the table and determines a set of actions to be performed. If a combination of actions is identified, such as power down, power cycle, and/or reset actions, the action are performed according to PEF Action Priorities. Action priorities are outlined in the following table.

Note: An action that has changed from delayed to non-delayed, or an action whose delay time has been reduced has a higher priority. Each generated event is logged to the SEL.

Table 49. PEF Action Priorities

Action	Priority	Delayed	Type	Note
Power-down	1	Yes	PEF Action	
Soft shut-down	2	Yes	OEM PEF Action	Not executed if a power-down action was also selected.
Power cycle	3	Yes	PEF Action	Not executed if a power-down action was also selected.
Reset	4	Yes	PEF Action	Not executed if a power-down action was also selected.
NMI	5	No	PEF Action	Not executed if a power-down action was also selected.
PET Alert	6	No	PEF Action	When selected, always occurs immediately after detection of a critical event.
IPMB message event	8	No	OEM PEF Action	When selected, always occurs immediately after detection of a critical event.

Table 50. mBMC Factory Default Event Filters

Event Filter #	Offset Mask	Events
1	Non-critical	Voltage Assert
2	Non-critical	Voltage Deassert
3	Critical	Voltage Assert
4	Critical	Voltage Deassert
5	Critical	PS Soft Fail Assert
6	Critical	PS Soft Fail Deassert
7	Critical	Proc 1-2 Thermal Trip Assert
8	Critical	Proc 1-2 Thermal Trip, Config Error and IERR Deassert
9	Degraded	Proc 1-2 FRB3 Assert
10	Degraded	Proc 1-2 FRB3 Deassert
11	Degraded	Proc 1-2 Hot Assert

Event Filter #	Offset Mask	Events
12	Degraded	Proc 1-2 Hot Deassert
13	Critical	FP NMI Assert
14	Critical	FP NMI Deassert
15	Non Critical	SCSI Terminator Fail Assert
16	Non Critical	SCSI Terminator Fail Deassert
17	N/A	ID Button Assert
18	N/A	ID Button Deassert
19	Critical	Fan Speed Assert
20	Critical	Fan Speed Deassert
21	Non Critical	Fan Speed Assert
22	Non Critical	Fan Speed Deassert
23	Critical	Temperature Assert
24	Critical	Temperature Deassert
25	Non Critical	Temperature Assert
26	Non Critical	Temperature Deassert
27	Critical	Proc 1-2 IERR Assert
28	Critical	CPU Configuration Error
29	N/A	Reserved for Intel® Server Management (ISM)
30	N/A	Reserved for ISM

4.2.12.2 Alert Over LAN

LAN alerts are sent as SNMP traps in ASF formatted Platform Event Traps to a specified alert destination. The Alert over LAN feature is used to send either Platform Event Trap alerts or directed events to a remote system management application, regardless of the state of the host's operating system. LAN alerts may be sent over the LAN channel. LAN alerts can be used by PEF to send out alerts to selected destination whenever an event matches an event filter table entry. For more information on LAN alerts, see the *IPMI Specification v1.5*.

4.2.12.3 System Identification in Alerts

The PET alert format used in PPP and LAN Alerting contains a system GUID field that can be used to uniquely identify the system that raised the alert. In addition, since the PET is carried in a UDP packet, the alerting system's IP address is also present.

4.2.12.4 Platform Alerting Setup

The management controller provides commands via the System Interface that support setting/retrieving the alerting configuration LAN settings in mBMC NV storage.

The user does not typically deal with filter contents directly. Instead, the Server Setup Utility provides a user interface that allows the user to select among a fixed set of pre-configured event filters.

The following list presents the type of alerting configuration options that are provided:

- Enabling/Disabling PEF
- Configuring Alert actions
- Selecting which pre-configured events trigger an alert
- Configuring the serial/modem and PPP communication and link parameters
- Configuring the alert destination information

4.2.12.5 Alerting On Power Down Events

The mBMC is capable of generating alerts while the system is powered down. A watchdog power-down event alert is sent after the power down so that the alert does not delay the power-down action.

4.2.12.6 Alerting On System Reset Events

The alerting process must complete before the system reset is completed. This is done to simplify timing interactions between the mBMC and BIOS initialization after a system reset.

4.2.12.7 Alert-in-Progress Termination

An alert in progress will be terminated by a system reset or power on, or by disabling alerting via commands to the management controller.

4.2.13 NMI Generation

The following can cause the mBMC to generate an NMI pulse:

- Receiving a *Chassis Control* command issued from one of the command interfaces. Use of this command will not cause an event to be logged in the SEL.
- Detecting that the front panel Diagnostic Interrupt button has been pressed.
- A PEF table entry matching an event where the filter entry has the NMI action indicated.
- A processor IERR or Thermal Trip (if the mBMC is so configured).
- Watchdog timer pre-timeout expiration with NMI pre-timeout action enabled.

The mBMC-generated NMI pulse duration is 200ms. This time is chosen to try to avoid the BIOS missing the NMI if the BIOS is in the SMI Handler and the SMI Handler is masking the NMI.

4.2.14 SMI Generation

The mBMC can generate an SMI due to watchdog timer pre-timeout expiration with SMI pre-timeout interrupt specified. The SMI generation is software configurable. The above conditions may or may not be enabled to cause an SMI.

4.3 Platform Management Interconnects

4.3.1 Power Supply Interface Signals

The mBMC supports two power supply control signals: *Power On* and *Power Good*. The *Power On* signal connects to the chassis power subsystem and is used to request power state changes (asserted = request *Power On*). The *Power Good* signal from the chassis power subsystem indicates current the power state (asserted = power is on).

Figure 18 shows the power supply control signals and their sources. To turn on the system, the mBMC asserts the *Power On* signal and waits for the *Power Good* signal to assert in response, indicating that DC power is on.

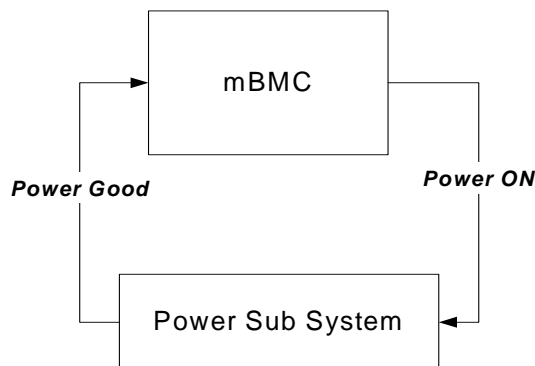


Figure 18. Power Supply Control Signals

The mBMC uses the *Power Good* signal to monitor whether the power supply is on and operational, and to confirm whether the actual system power state matches the intended system on/off power state that was commanded with the *Power On* signal.

De-assertion of the *Power Good* signal generates an interrupt that the mBMC uses to detect either power subsystem failure or loss of AC power. If AC power is suddenly lost, the mBMC:

1. Immediately asserts system reset
2. Powers down the system
3. Waits for configured system off time (depending on configuration)
4. Attempts to power the system on (depending on configuration)

4.3.1.1 Power-up Sequence

When turning on the system power in response to one of the event occurrences listed in Table 51, the mBMC executes the following procedure:

1. The mBMC asserts *Power On* and waits for the power subsystem to assert *Power Good*. The system is held in reset.
2. The mBMC initializes all sensors to their Power On initialization state by running the init agent.
3. The mBMC attempts to boot the system by running the FRB3 algorithm, if FRB3 is enabled.

4.3.1.2 Power-down Sequence

To power down the system, the mBMC effectively performs the sequence of power-up steps in reverse order. This operation can be initiated by one of the event occurrences listed in Table 51 and proceeds as follows:

1. The mBMC asserts system reset (de-asserts *Power Good*).
2. If enabled, the mBMC sends a *Set ACPI Power State* command, indicating an S0 state to all management controllers whose SDR management device records indicate that they should receive the notification.
3. The mBMC de-asserts the *Power On* signal.
4. The power subsystem turns off system power upon de-assertion of the *Power On* signal.

4.3.1.3 Power Control Sources

The sources listed in the following table can initiate power-up and/or power-down activity.

Table 51. Power Control Initiators

#	Source	External Signal Name or Internal Subsystem	Capabilities
1	Power Button	FP Power button	Turns power ON or OFF
2	mBMC Watchdog Timer	Internal mBMC timer	Turns power OFF, or power cycle
3	Platform Event Filtering	PEF	Turns power OFF, or power cycle
4	Command	Routed through command processor	Turns power ON or OFF, or power cycle
5	Power state retention	Implemented via mBMC internal logic	Turns power ON when AC power returns
6	Chipset	Sleep S5	Turns power ON or OFF

4.3.2 System Reset Control

4.3.2.1 Reset Signal Output

The mBMC asserts the *System Reset* signal on the server board to perform a system reset. The mBMC asserts the *System Reset* signal before powering the system up. After power is stable, as indicated by the power subsystem *Power Good* signal, the mBMC sets the processor enable state appropriately and de-asserts the *System Reset* signal, taking the system out of reset.

To reset the system without a power state change, the mBMC:

1. Asserts the *System Reset* signal.
2. Holds this state for as long as the reset button is pushed. When a command is used to generate a system reset, the state is held for the stipulated time.
3. De-asserts the *System Reset* signal.

4.3.2.2 Reset Control Sources

The following table shows the reset sources and the actions taken by the system.

Table 52. System Reset Sources and Actions

#	Reset Source	System Reset?	mBMC Reset
1	Standby power comes up	No (no DC power)	Yes
2	Main system power comes up	Yes	No
3	Reset button or in-target probe (ITP) reset	Yes	No
4	Warm boot (example: DOS Ctrl-Alt-Del)	Yes	No
5	Command to reset the system	Yes	No
6	Set Processor State command	Yes	No
7	Watchdog timer configured for reset	Yes	No
8	FRB3 failure	Yes	No
9	PEF action	Optional	No

4.3.3 Fan Speed Control

Server board hardware implements an external ambient-temperature-based fan speed control that is part of normal system operation with the mBMC and an internally ambient temperature with the Sahalee BMC. With one exception, the management controller does not participate in fan speed control. The feature allows the server board to drive different fan speeds based on various temperature measurements in order to lower the acoustic noise of the system.

The ambient-temperature thresholds at which the Fan Speed increases does not correspond to a non-critical (warning) condition for the fan because the fan's state is still 'OK' from the system's point-of-view.

The server board has two analog fan speed signals that are driven by pulse-width modulator (PWM) circuits by the server board hardware. These signals can be driven to several levels according to temperature measurements. Multiple bytes of a Sensor Initialization Table are used to hold parameters that set the temperature thresholds and corresponding PWM duty cycles. This SDR or table is loaded as part of the server board configuration.

The management controller firmware expects to find an LM30 temperature sensor on the front panel board. Thus, the ambient temperature-based fan speed control capability is not enabled by default for the Server Board SE7520BD2 as a baseboard-only product, but can be enabled via a management controller configuration change.

4.3.3.1 Fan Kick Start

Some fans may not begin rotating unless started at high speed. To ensure that the fans start, the server board hardware starts and run the fans at high speed for a brief interval following system power up.

4.3.4 Front Panel Control

The mBMC provides the main 'front panel control' functions. These include control of the system Power Button, Reset Button, Diagnostic Interrupt (Front Panel NMI) Button, System Identify Button, System ID LED, Status/Fault LED, and Chassis Intrusion Switch. Front panel control also includes the front panel lockout features.

4.3.4.1 Power Button

After de-bouncing the front panel *Power Button* signal, the mBMC asserts the PWBTOUT signal to the chipset PWRBTN input. The chipset responds by deasserting SLEEP S5 to the CPU configuration circuitry. If the configuration is OK, PS_PWRON is asserted to the power supply. The supply then asserts POWERGOOD back to the mBMC.

If the system is in Secure Mode or the *Power Button* is forced protected, then when the power switch is pressed, a Platform Security Violation Attempt event message is generated and no power control action is taken.

In the case of simultaneous button presses, the *Power Button* action takes priority over all other buttons. For example, if the sleep button is depressed for one second and then the *Power Button* is pressed and released, the system powers down. Due to the routing of the de-bounced *Power Button* signal to the chipset, the power signal action overrides the action of the other switch signals.

4.3.4.2 Reset Button

The reset button is a momentary contact button on the front panel. Its signal is routed through the front panel connector to the mBMC, which monitors and de-bounces it. The signal must be stable for at least 25ms before a state change is recognized.

An assertion of the front *Panel Reset* signal to the mBMC causes the mBMC to start the reset and reboot process. This action is immediate and without the cooperation of any software or operating system running on the system.

If Secure Mode is enabled or the button is forced protected, the reset button does not reset the system, but instead a Platform Security Violation Attempt event message is generated. The reset button is disabled in sleep mode.

4.3.4.3 Diagnostic Interrupt Button (Front Panel NMI)

As stated in the *IPMI 1.5 Specification*, a Diagnostic Interrupt is a non-maskable interrupt or signal for generating diagnostic traces and core dumps from the operating system. The mBMC generates the NMI, which can be used as an OEM-specific diagnostic front panel interface.

The Diagnostic Interrupt button is connected to the mBMC through the front panel connector. A Diagnostic Interrupt button press causes the mBMC to generate a 200mSec system NMI pulse.

This generates an event (NMI button sensor), the NMI is actually generated by a factory-defined PEF Filter.

4.3.4.4 Chassis ID Button and LED

The front panel interface supports a chassis identify button and a corresponding blue chassis identify LED. A second blue chassis identify LED is mounted on the back edge of the server board where it may be visible when viewed from the back of an integrated system.

The LED provides a way to identify one system in a group of identical systems in a high-density rack environment

The chassis identify LED can be turned on either locally via the button signal, or by local or remote software using the IPMI *Chassis Identify* command. The following list summarizes the chassis identify button and LED operation:

- The *Identify* signal state is preserved on standby power across system power-on/off and system hard resets. It is not preserved if A/C power is removed. The initial LED state is off when A/C power is applied.
- The IPMI *Chassis Identify* command can be used to control the LED. If the *Chassis Identify* command is used to turn the LED on, the command will automatically timeout and turn off the LED unless another *Chassis Identify* command to turn on the LED is received. The default timeout for the command is 15 seconds. The server board supports the optional command parameter to allow the timeout to be set anywhere from 1 to 255 seconds.
- The optional timeout parameter in the *Chassis Identify* command also allows software to tell the LED to turn off immediately.
- The chassis identify button works using a “push-on/push-off” operation. Each press of the button toggles the LED signal state between on and off. If the button is used to turn on the LED, it will stay on indefinitely, until either the button is pressed again or a *Chassis Identify* command causes the LED to turn off.

Table 53. Chassis ID LEDs

Color	Condition	When
Blue	Off	Ok
	Blink	Identify button pressed or Chassis Identify command executed

4.3.4.5 Status/Fault LED

The following table shows mapping of sensors/faults to the LED state.

Table 54. Fault/Status LED

Color	Condition	When
Green	Solid	System Ready
	Blink	System Ready, but degraded. CPU fault, DIMM killed
Amber	Solid	Critical Failure: critical fan, voltage, temperature state
	Blink	Non-Critical Failure: non-critical fan, voltage, temperature state
Off	Solid	Not Ready. POST error/NMI event/CPU or terminator missing

Critical Condition

Any critical or non-recoverable threshold crossing associated with the following events:

- Temperature, voltage, or fan critical threshold crossing
- Power subsystem failure. The BMC asserts this failure whenever it detects a power control fault (e.g., the BMC detects that the system power is remaining on even though the BMC has deasserted the signal to turn off power to the system).
- “Critical Event Logging” errors, including: System Memory Uncorrectable ECC error and Fatal/Uncorrectable Bus errors, such as PCI SERR and PERR

Non-Critical Condition

- Temperature, voltage, or fan non-critical threshold crossing
- Chassis intrusion

Degraded Condition

- One or more processors are disabled by Fault Resilient Boot (FRB) or BIOS
- BIOS has disabled or mapped out some of the system memory

4.3.4.6 Chassis Intrusion Switch

Some platforms support chassis intrusion detection. On these platforms, the mBMC monitors the state of the *Chassis Intrusion* signal and makes the status of the signal available via the *Get Chassis Status* command and *Physical Security* sensor state. If enabled, a chassis intrusion state change causes the mBMC to generate a *Physical Security* sensor event message with a *General Chassis Intrusion* offset.

4.3.4.7 Front Panel Lockout

The management controller monitors a *Secure Mode* signal from the keyboard controller on the server board. When the *Secure Mode* signal is asserted, the management controller locks out the ability to power down or reset the system using the power or reset push buttons, respectively. Secure Mode does not block the ability to initiate a sleep request using the sleep button.

The management controller generates a ‘Secure Mode Violation Attempt’ event message if an attempt is made to power-down or reset the system using the push buttons while Secure Mode is active.

The set of buttons protected when Secure Mode is active varies depending on the system ACPI power state and whether the Sahalee BMC or the mBMC is in control as shown in the following table. Differences are highlighted.

Note: The mBMC will prevent the system from powering up via button press when either secure mode or the front panel lockout I/O signal is asserted.

4.3.5 FRU Information

The platform management architecture supports providing Field Replaceable Unit (FRU) information for the server board and major replaceable modules for the chassis. 'Major Module' is defined as any circuit board in the system containing active electronic circuitry.

FRU information includes the board serial number, part number, name, asset tag, and other information. FRUs that contain a management controller use the controller to provide access to the FRU information. FRUs that do not have a management controller can make their FRU information available via a SEEPROM directly connected to the mBMC's sensor device private I²C bus. This allows the system integrator to provide a chassis FRU device without having to implement a management controller. This information can only be accessed via IPMI Master Write-Read commands.

The mBMC implements the interface for logical FRU inventory devices as specified in the *Intelligent Platform Management Interface Specification, Version 1.5*. This functionality provides commands used for accessing and managing the FRU inventory information associated with the baseboard (FRU ID 0). These commands can be delivered via all interfaces. All other FRUs must be accessed using IPMI Master Write-Read commands.

4.3.5.1 mBMC FRU Inventory Area Format

The mBMC FRU inventory area format follows the Platform Management FRU Information Storage Definition. See *Platform Management FRU Information Storage Definition, Version 1.0* for details.

The mBMC provides only low-level access to the FRU inventory area storage. It does not validate or interpret the data stored in the FRU memory.

The server board's FRU information is stored in the mBMC internal flash memory.

4.4 Sensors

4.4.1 Sensor Type Codes

The following tables list the sensor identification numbers and information regarding the sensor type, name, supported thresholds, assertion and deassertion information, and a brief description of the sensor purpose. See the *Intelligent Platform Management Interface Specification, Version 1.5*, for sensor and event/reading-type table information.

- **Sensor Type**
The Sensor Type references the values enumerated in the *Sensor Type Codes* table in the IPMI specification. It provides the context in which to interpret the sensor, e.g., the physical entity or characteristic that is represented by this sensor.
- **Event/Reading Type**
The Event/Reading Type references values from the *Event/Reading Type Code Ranges* and *Generic Event/Reading Type Codes* tables in the *IPMI specification*. Note that digital sensors are a specific type of discrete sensors, which have only two states.

- **Event Offset/Triggers**

Event Thresholds are supported event generating thresholds for threshold types of sensors.

- [u,l][nr,c,nc] upper nonrecoverable, upper critical, upper noncritical, lower nonrecoverable, lower critical, lower noncritical
- uc, lc upper critical, lower critical

Event Triggers are supported event generating offsets for discrete type sensors. The offsets can be found in the *Generic Event/Reading Type Codes* or *Sensor Type Codes* tables in the IPMI specification, depending on whether the sensor event/reading type is generic or a sensor specific response.

- **Assertion/Deassertion Enables**

Assertions and Deassertion indicators reveals the type of events the sensor can generate:

- As: Assertions
- De: Deassertion

- **Readable Value / Offsets**

- Readable Value indicates the type of value returned for threshold and other non-discrete type sensors.
- Readable Offsets indicates the offsets for discrete sensors that are readable via the *Get Sensor Reading* command. Unless otherwise indicated, all Event Triggers are readable, i.e., *Readable Offsets* consists of the reading type offsets that do not generate events.

- **Event Data**

This is the data that is included in an event message generated by the associated sensor. For threshold-based sensors, the following abbreviations are used:

- R: Reading value
- T: Threshold value

The following table lists the core sensors located within the mBMC. These sensors are fixed and hard-coded. They cannot be modified by a user.

Table 55. mBMC Built-in Sensors

Sensor Name	Sens Or #	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value / Offsets	EventData
Physical Security Violation	01	Physical Security 05h	Sensor Specific 6Fh	LAN Leash Lost	As	LAN Leash Lost	Trig Offset
Platform Security Violation	02	Platform Security Violation Attempt 06h	Sensor Specific 6Fh	Out-of-band access password violation	As	–	Trig Offset
Power Unit Status	03	Power Unit 09h	Sensor Specific 6Fh	Power On/Off Power Cycle AC Lost	As	–	Trig Offset
Button	04h	Button 14h	Sensor Specific 6Fh	Power Button Reset Button	As	–	Trig Offset
Watchdog	05h	Watchdog2 23h	Sensor Specific 6Fh	Timer Expired Hard Reset Power Down Power Cycle Timer Interrupt	As	–	Trig Offset

The following table shows the server board/platform sensors that are supported by the mBMC.

Table 56. Intel® Server Board SE7520BD2 Platform Sensors for Essentials Management

Sensor Name	Sensor #	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value/Offsets	Event Data	PEF Action	SDR Record Type
Physical Security Violation	07h	Physical Security 05h	Sensor Specific 6Fh	General Chassis Intrusion	As	General Chassis Intrusion	Trig Offset	X	02
CPU1 12v	08h	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
CPU2 12v	09h	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +1.5V	0Ah	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +1.8V	0Bh	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +3.3V	0Ch	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +5V	0Dh	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB +12V	0Eh	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
BB -12V	0Fh	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
FSB Vtt	10h	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
MCH Vtt	11h	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
SCSI Core(1.8v)	12h	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc1 VCCP	13h	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc2 VCCP	14h	Voltage 02h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 1	15h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 2	16h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 3	17h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 4	18h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 5	19h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 6	1Ah	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 7	1Bh	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Tach Fan 8	1Ch	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01

Sensor Name	Sensor #	Sensor Type	Event / Reading Type	Event Offset Triggers	Assert / Deassert	Readable Value/Offsets	Event Data	PEF Action	SDR Record Type
Tach Fan 9	1Dh	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
System Event	1Eh	System Event 12h	Sensor Specific 6Fh	PEF Action	As	–	Trig Offset	–	02
Proc1 IERR	1Fh	Processor 07h	Sensor Specific 6Fh	IERR	As	–	Trig Offset	–	02
Proc2 IERR	20h	Processor 07h	Sensor Specific 6Fh	IERR	As	–	Trig Offset	–	02
Proc1 Thermal trip	21h	Processor 07h	Sensor Specific 6Fh	Thermal Trip	As	–	Trig Offset	Fault LED Action	02
Proc2 Thermal trip	22h	Processor 07h	Sensor Specific 6Fh	Thermal Trip	As	–	Trig Offset	Fault LED Action	02
Proc1 Thermal Control	23h	Temp 01h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	Trig Offset	Fault LED Action	01
Proc2 Thermal Control	24h	Temp 01h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	Trig Offset	Fault LED Action	01
Diagnostic Interrupt Button	25h	Critical Interrupt 13h	Sensor Specific 6Fh	FP NMI Button	As	–	Trig Offset	NMI Pulse	02
Chassis Identify Button	26h	Button 14h	Generic 03h	Sate Deasserted State Assert	As & De	–	Trig Offset	ID LED Action	02
Proc1 Fan	27h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc2 Fan	28h	Fan 04h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc1 Core temp	29h	Temp 01h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
Proc2 Core temp	2Ah	Temp 01h	Threshold 01h	[u,l][nr, c,nc]	As & De	Analog	R, T	Fault LED Action	01
CPU Configuration Error	2Bh	Processor 07h	Generic 03h	State Asserted	As & De	Discrete	R, T	Fault LED Action	02

4.5 Management Buses and Connectors

The server board interfaces to the server/system management controller (SMC) via a system management connector. When a system management card is installed, the features associated with system management will be through the installed add-in SM card. When not installed, there is no system management interface, only a hardware monitor (Heceta 7 and SIO) for fans, voltage, temperature, reset, and voltage monitoring.

The platform has two modes of system management operation. The first mode is strictly hardware monitoring and fan control to monitor critical systems and control all fans. The second mode utilizes a system management card to support enhanced server management features, control reset/power good functionality and provide an interface for the user to access devices on different SMBuses. This is done through the system management connection described in the previous subsection.

4.5.1 SIO Keyboard and Mouse

The SIO keyboard/mouse signals can be driven from the KVM solution when there is a need for remote management. Logic on the module performs the appropriate voltage translation from the output of the 3.3V KVM solution to the required input voltage of the SIO.

4.5.2 PS2 Keyboard and Mouse

The PS2 keyboard/mouse signals are supplied to the KVM solution for encrypting and sending over the FML/SMBUS bus. This enables local keyboard/mouse activity to be observed by remote management. The KVM solution will pass this data on to the SIO.

Local keyboard/mouse activity takes priority over remote activity. The signals from the PS2 connector are typically pulled up to 5V and the KVM solution is not 5V tolerant. Voltage translation logic is available on the module to convert the bi-directional interface to a signaling level the KVM solution can tolerate.

In order for the KVM solution to work, the PS2 to SIO connection on the server board must be broken. Logic must be supplied on the server board to break the connection when the KM_INHIB_N signal is asserted.

4.5.3 Fast Management Link (FML)

The Fast Management Link interface is a single master and single slave bus, which can also operate in a SMBUS mode. The FML provides a high-speed interface to an Intel® networking component for KVM and web-based management traffic.

The FML bus is Intel proprietary. Its electrical characteristics and protocols will be defined in a separate document. The bus operates at 8Mhz. It is meant to be point-to-point routing, and it largely follows the SMBUS protocols but uses separate wires for Data In (FML_SDA) and Data Out (FML_MDA_I2CSDA). There is a separate line for the clock (FML_CLK_I2CSCL), which is always driven by the master.

The bus supports a dual-purpose interrupt/clock stretching line (FML_SINTEX), which is driven by the slave device. The two purposes are more fully described as follows:

- Alert the master device to read from slave. When the interrupt is asserted, it will be asserted until the next start.
- Clock extension. When set to zero, it indicates to the master to extend its current clock state (if the master clock is high it should remain high until the FML_SINTEX is high again). This way, the slave can hold the transaction when it is not ready yet.

The FML_SINTEX functions as an alert signal while the bus is idle (between stop to start) and as a clock extension request from the slave device during the transaction itself.

The behavior of the bus and the transactions on the bus are the same as in SMBus (Start, Stop, repeated start ...).

As can be seen from the naming convention, the bus can operate in a SMBUS compatible mode, where Data Out acts as the SMBUS bi-directional data line and the clock acts as the SMBUS CLK line.

The main difference between the SMBus and the FML bus is that the FML bus is point-to-point where there is only one master and one slave. These two devices cannot change their roles. Each wire in the interface is driven by a single source (Master or Slave), and is not an open-drain bus.

4.5.4 LPC/Keyboard Controller Style Ports

The Intel® Management Module interfaces to its host system via the low pin count (LPC) bus. The IMM incorporates three 8042 keyboard controller style (KCS) ports. These ports can be used for either IPMI 1.5 or Advanced Configuration and Power Interface (ACPI) embedded controller standard communication. One system implementation is to use the three ports for the IPMI system management software interface, system management mode interface, and the ACPI embedded controller interface.

The KCS interface 0 has the ability to interrupt the host by assertion of the SYSIRQ output.

The KCS ports provided by the IMM reside at specific I/O addresses on the host's LPC bus. These addresses are programmable by firmware running on the IMM to provide for system integration flexibility. Externally, these ports are accessible only by the LPC host.

From the LPC Host's perspective, each KCS slave port uses three registers and occupies two bytes of I/O space. Each slave port must be mapped to begin at a two-byte address boundary.

Note: These registers *must* be accessed eight bits at a time; Sahalee hardware permits only 8-bit write operations.

The host I/O address that the interfaces respond to is configurable by Sahalee firmware. After a Sahalee reset, LPCPD#, or LRST#, all LPC keyboard controller style interface registers are reset to their default values and an interface will not respond to an LPC cycle until its KCS base address register is programmed.

If more than one KCS interface is mapped to the same base address (not recommended), then the lowest numbered interface has priority and responds to the LPC cycle.

4.5.5 USB

The USB interface allows a future KVM implementation to act as a target to the host USB controller. The intention is that the KVM will act as a mass storage class device such as a floppy or CDROM so that redirection can occur over the network. The target interface is USB 1.1.

4.5.6 I²C Interfaces

The IMM incorporates two master/slave I²C interfaces (I²C interfaces 0 and 1) and four master-only I²C interfaces (I²C interfaces 2, 3, 4 and 5). All I²C interfaces can generate an I²C clock at a firmware-programmable rate, with the I²C clock rate derived from the IMM master clock. Programmable values support the standard rates up to a 1 megabit/sec rate, as well as intermediate and higher clock rates that may be used in particular implementations in which I²C slaves support higher clock rates.

The I²C master interface supports 10-bit addressing at the standard I²C 10-bit address locations. This support is accomplished by the interface's interpretation of the initial address byte. All I²C interfaces are SMBUS 2.0 compliant.

The master/slave interfaces each have two separate transmit registers. The I²C Master Transmit Data Register is used when the interface acts as a master accessing a slave device. The I²C Slave Transmit Data Register is used to write data to the bus when the interface has been addressed as a slave to be read from.

The master-only interfaces do not have an I²C Slave Transmit Data Register.

The slave interface sections of each of the master/slave interfaces can be configured by IMM firmware to respond at one, two, or three separate slave addresses.

The I²C clock and data inputs to the Sahalee are digitally filtered so that input glitches of less than four Sahalee clock cycles are rejected. Both high and low polarity glitches are rejected.

This specification defines a transaction as a data transfer bounded by a START and STOP, or bounded by a START and repeated START. A stream is defined as one or more transactions bounded by a START and STOP.

There are two types of bus transactions in master mode: Master Transmit and Master Receive. Master Transmit pertains to writing data to a slave device. Master Receive pertains to reading from a slave device. The I²C interface recognizes the transaction type by sampling bit 0 of XMIT_DATA when the I²C Master Transmit Data Register is written to with the START bit set. If bit 0 of XMIT_DATA is equal to 0, the transaction is a Master Transmit. If it is equal to 1, the transaction is a Master Receive.

When in Master Mode, the interface is responsible for generating the I²C clock. This is straightforward when performing a Master Transmit transaction. Each byte written to the I²C Master Transmit Data register results in nine clock cycles on the bus: eight for the data bits, and one for the ACK/NAK bit.

4.5.7 16550*-style UARTs

The IMM has two UARTs for serial communication which are 16550* compatible. UART#1 is used by the EMP interface of the module while UART#2 is used for an ICMB interface.

Note: The Emergency Management Port (EMP) interface does not use the DSR signal. When this module is used in conjunction with the 87427 SIO, the module EMP signals are connected in a null modem fashion to the SIO signals.

4.5.8 Interrupts

The module can receive interrupt events on the pins assigned to XINTx inputs. Two of the XINTs available on the Sahalee are used internally by the KVM and the private NIC function associated with the KVM. XINT2 is available for use by an interrupting event.

4.5.9 GPIO Pins and LED Drivers

Many of the external pins of the IMM integrated peripheral devices can be alternatively used as programmatically controlled general-purpose I/O pins. The pin states (inputs) can be read at all times. The output source function is selected via mux control that selects between the peripheral and general purpose I/O (GPIO) functions at the I/O ring.

The GPIO-enabled output buffers can be configured for either totem pole or open-drain operation. A weak pull-up (minimum value of 12K ohm, maximum value of 48K ohm) connected to digital VDD is incorporated in each of these buffers. The power-up default of these pins is the GPIO function configured as an open-drain output in high-impedance mode. The functionality of the GPIO pins is unaltered by an IMM reset. All IMM signal pins are 5V tolerant, as long as the two VDD 5V pins are connected to a 5V power supply. The IMM contains seven LED drive level (12mA sink current at 0.4V, 12mA source current at 2.8V) output buffers.

4.5.10 Sleep States Supported

The ICH5R controls the system sleep states. States S0, S1, S4 and S5 are supported. Either the BIOS or an operating system invokes the sleep states. This is done in response to a power button being pressed or an inactivity timer countdown. Normally the operating system determines which sleep state to transition into. However a 4-second power button over-ride event places the system immediately into S5. When transitioning into a software-invoked sleep-state, the ICH5R will attempt to gracefully put the system to sleep by first going into the CPU C2 state.

4.5.10.1 S0 State

This is the normal operating state, even though there are some power savings modes in this state using CPU Halt and Stop Clock (CPU C1 and C2 states). S0 affords the fastest wake up response time of any sleep state because the system remains fully powered and memory is intact.

4.5.10.2 S1 State

The S1 state is entered via a CPU Sleep signal from the ICH5R (CPU C3 state). The system remains fully powered and memory contents remain intact, but the CPUs enter their lowest power state. The operating system uses ACPI drivers to disable bus masters for uni-processor configurations, while the operating system flushes and invalidates caches before entering this state in multiprocessor configurations. Wake latency is slightly longer in this state than S0, however power savings are quite improved from S0.

4.5.10.3 S2 State

The S2 state is not supported.

4.5.10.4 S3 State

The S3 state is called Suspend to RAM (STR). It is not supported.

4.5.10.5 S4 State

The S4 state is called Suspend to Disk. From a hardware perspective, it is equivalent to an S5 state. The operating system is responsible for saving the system context in a special partition on the hard drive. Although the system must power up and fully boot, boot time to an application is reduced because the computer is returned to the same system state it had prior to the power-off.

4.5.10.6 S5 State

This State is the normal off state whether entered through the power button or Soft Off. All power is shut off except for the logic required to restart. In this state, several "wake-up events" are supported. The system only remains in the S5 State while the power supply is plugged into the wall. If the power supply is unplugged from the wall, this is considered a Mechanical OFF or G3.

4.5.11 Wake Events

The types of wake events and wake up latencies are related to the actual power rails available to the system in a particular sleep state as well as to the location in which the system context is stored. Regardless of the Sleep State, wake on the power button is always supported except in a 'mechanical off' situation. When in a Sleep State the system complies with the *PCI 2.2 Specification* by supplying the optional 3.3V standby voltage to each PCI slot as well as the PME signal. This enables any compliant PCI card to wake the system up from any sleep state except mechanical off.

4.5.11.1 Wake from S1 Sleep State

During S1, the system is fully powered permitting support for wake on USB, wake on PS2 keyboard/mouse, wake on RTC Alarm, and wake on PCI PME. wake on USB, wake on PS2 keyboard/mouse and wake on RTC Alarm are not supported by POE BIOS.

4.5.11.2 Wake from S4 and S5 States

Power button and LAN events are used to wake from S4 and S5.

4.5.12 AC Power Failure Recovery

The design supports two modes of operation with regard to AC power recovery. The user can select (via a BIOS Setup Screen) whether the system should power back up or remain off after AC is restored. The ICH5R does not rely on BIOS to boot and check system status in the case of AC failure. The ICH contains a register variable named “afterG3” which BIOS can set based on user configuration input. The ICH internally examines after it detects an AC Recovery.

4.5.13 PCI Power Management Support

The *PCI Power Management Specification* calls out three areas to be compliant: the system reset signal must be held low when in a sleep state, the system must support the PCI PME signal and the system should provide 3.3v standby to the PCI slots. The design complies with the PCI Power Management Specification and the *PCI 2.2 Specification* for optional 3.3V standby voltage to be supplied to each PCI, PCI-X, and PCI Express slots. This support allows any compliant PCI, PCI-X, and PCI Express adapter card to wake the system up from any sleep state except mechanical off. Because of the limited amount of power available on 3.3V standby, the user and the operating system must configure the system carefully following the *PCI Power Management Specification*.

4.5.13.1 Power Management Event (PME)#

PME# signals from PCI-X slots on each PCI-X buses are connected to the PXH PME# signals. These

PME# signals from both PCI-X buses are also ANDed and then wire-ORed with PCI Express slots and then routed to a ICH GPIO. This GPI is ACPI-compliant, (i.e. the Status and Enable bits reside in ACPI I/O space). This is used to exit sleep states (S1-S5). PCI 32/33 PME signal is connected to ICH PME signal.

4.5.13.2 RESET# Control

The ICH always drives the PCI Reset signal (LOW or HIGH), even when the system is in a sleep state. This is required for PCI power management. Any device that may be active will be able to sample this signal to know that the system is in a reset condition.

4.5.13.3 PCI Vaux

All PCI, PCI-X, and PCI Express slots are provided with a 3.3V auxiliary power to support wake events from all sleep states. The EPS12V power supply delivers 2A of 5VSB, which in turn is regulated to 3.3VSB when the system is in S4 or S5 sleep state.

4.6 System Status Indicators/LEDs

The standard system status LEDs for PWR/SLP, HDD and other LEDs as specified in SSI EEB are supported on the front panel header. A dual color LED can be used for the PWR/SLP LED to distinguish between System Power On (Green) and System Sleep (Yellow). The PWR/SLP LED signals are driven by the ICH and conditioned by logic on the server board before they are sent to the front panel connector. The single HDD LED represents any hard drive activity in the system whether from SCSI or IDE hard drives.

For 10/100 LAN, status LEDs are supported through the back panel 10/100 RJ45 Jack and the front panel per SSI-EEB specification. The Green LED indicates the LAN speed at either 10Mbit/s (Off) or 100Mbit/s (On). The Yellow LED represents both Link Integrity (On – good, Off – bad) as well as LAN activity (Blinking).

For 10/100/1000 LAN status LEDs are supported through the back panel 10/100/1000 RJ-45 Jack and the front panel per SSI-EEB specification. The dual color LED indicates the LAN speed at 10Mbit/s (Off), 100Mbit/s (Green) or 1000 Mbit/s (Yellow). The Green Link LED represents both Link Integrity (On – good, Off – bad) as well as LAN activity (Blinking).

4.6.1 Front Panel

The front panel functionality/implementation is the same as that in the SSI-EEB 3.5 specification. As such, it will have:

- Five LEDs configured as:
 - Power/Sleep
 - Network Activity #1
 - Network Activity #2
 - Hard Drive Activity
 - Status
- Reset button
- Power button
- Sleep button
 - Hidden NMI switch
 - USB port
 - Chassis intrusion
 - SMBus

The Server Board SE7520BD2 can also be converted into a rack installation. In this configuration, the following are also supported on the front panel, but are not accessible from or visible in the pedestal chassis.

- Identification switch
- Identification LED

The front panel has a built-in temperature sensor (DS1621) that communicates via the SMB port at Address 9A.

While the Server Board SE7520BD2 complies with SSI-EEB, the front panel implements the recommended features in SSI-EEB and adds additional features not covered in the specification.

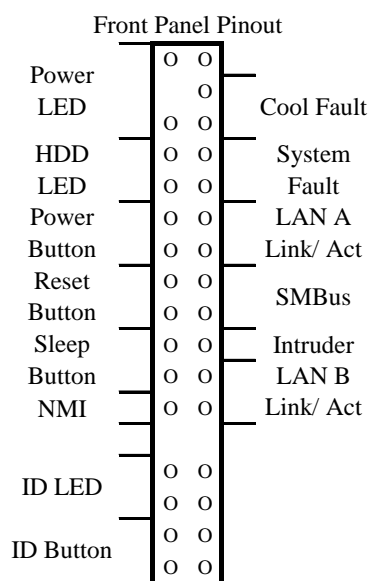


Figure 19. Front Panel Pinout

Table 57. Front Panel Color Attributes

Name	Color	Condition	Description
Power/Sleep	Green	ON	Power On
	Green	BLINK	Sleep (S1)
	-	OFF	Power Off (also S4)
Status	Green	ON	System Ready / No Alarm
	Green	BLINK	System Ready but degraded: some CPU Fault, DIMM killed
	Amber	ON	Critical Alarm: critical power module failure, critical fan failure, voltage (power supply), critical temperature and voltage
	Amber	BLINK	Non-critical Alarm: redundant fan failure, redundant power module failure, non-critical temperature and voltage
	-	OFF	System Not Ready: POST error/NMI event/CPU or terminator missing
HDD	Green	BLINK	Hard Disk Drive Access

Name	Color	Condition	Description
	Amber	ON	HDD Fault
	-	OFF	No Access and No HDD Fault
LAN#1-Activity	Green	ON	LAN Link / No Access
	Green	BLINK	LAN Access
	-	OFF	Idle
LAN#2-Activity	Green	ON	LAN Link / no Access
	Green	BLINK	LAN Access
	-	OFF	Idle
Identification	Blue	BLINK	Unit Selected for Identification
	-	OFF	No Identification

Requirements:

- To support the front panel connectivity, a 2 x 17 0.1-inch pitch non-shrouded polarized header is required. The first 24 pins (2x12) follow the *SSI-EEB Specification* for pin-out definition and functionality. Pins 25/26 of the header are not installed to allow a 2x12 connector (as specified in the SSI-EEB) to plug in. LED power can be supplied to the front panel through 5V, 3.3V either active or standby. The only front panel aspects that must be powered when the system is in a sleep state are the power/sleep LED, and the SMBus.
- It is also required that sufficient clearance (6mm or greater) be given around the front panel header to allow proper insertion/extraction of the front panel cable.
- The board is required to have a single 2x5 (with pin 9 not installed) 0.1-inch pitch header to support the cabling of the USB 2.0 port to the front of the chassis. The connector pin-out/type is detailed in the *SSI-EEB specification*.

One USB port is accessible from the front via the bezel. This port is cabled from the board to the front of the system. This port is USB 2.0 compliant and does not have wake capability.

5. Error Reporting and Handling

5.1 Error Propagation

When errors are encountered during POST, error messages or codes are either displayed to the video screen, or if prior to video initialization, reported through a series of audio beep codes.

The error codes are defined by Intel and whenever possible are backward compatible with error codes used on earlier platforms.

5.2 Fault Resilient Booting (FRB)

5.2.1 FRB-3 – BSP Reset Failures

The BIOS and firmware provide a feature to guarantee that the system boots, even if one or more processors fail during POST. The BMC contains two watchdog timers that can be configured to reset the system upon time-out. The first timer (FRB-3) starts counting down whenever the system comes out of hard reset. If the BSP successfully resets and begins executing, the BIOS disables the FRB-3 timer in the BMC and the system continues executing POST. If the timer expires because of the BSP's failure to fetch or execute BIOS code, the BMC resets the system and disables the failed processor. The BMC continues to change the bootstrap processor until the BIOS successfully disables the FRB-3 timer. The BMC sounds beep codes on the system speaker if it fails to find a good processor. It will continue to cycle until it finds a good processor. The process of cycling through all the processors is repeated upon system reset or power cycle. Soft resets do not affect the FRB-3 timer. The duration of the FRB3 timer is set by system firmware.

5.2.2 FRB-2 – BSP POST Failures

The second timer (FRB-2) is set to several minutes by BIOS and is designed to guarantee that the system completes POST. The FRB-2 timer is enabled just before the FRB-3 timer is disabled to prevent any "unprotected" window of time. Near the end of POST, the BIOS disables the FRB-2 timer. If the system contains more than 1GB of memory and the user chooses to test every DWORD of memory, the watchdog timer is extended before the extended memory test starts, because the memory test can exceed the timer duration. The BIOS will also disable the watchdog timer before prompting the user for a boot password. If the system hangs during POST, before the BIOS disables the FRB-2 timer, the BMC generates an asynchronous system reset (ASR). The BMC retains status bits that can be read by the BIOS later in the POST for the purpose of disabling the previously failing processor, logging the appropriate event into the System Event Log (SEL), and displaying an appropriate error message to the user.

Options are provided by the BIOS to control the policy applied to FRB-2 failures. By default, an FRB-2 failure results in the failing processor being disabled during the next reboot. This policy can be overridden to prevent BSP from ever being disabled due to the FRB-2 failure or a policy resulting in disabling the BSP after three consecutive FRB-2 failures can be selected. These options may be useful in systems that experience fatal errors during POST that are not indicative of a bad processor. Selection of this policy should be considered an advanced feature and should only be modified by a qualified system administrator. If supported by the specific platform, these options can be found in BIOS Setup.

5.2.3 FRB-1 – BSP Self-Test Failures

In addition to the FRB-3 and FRB-2 timers, the BIOS provides an FRB-1 watchdog timer. Early in POST, the BIOS checks the Built-in Self Test (BIST) results of the BSP. If the BSP fails BIST, the BIOS requests the BMC to disable the BSP. The BMC disables the BSP, selects a new BSP and generates a system reset. If there is no alternate processor available, the BMC beeps the system speaker and halts the system.

The BIST failure is indicated to the user by displaying a message during POST and logging an error to the SEL.

5.2.4 OS Boot Timer - OS Load Failures

The BIOS provides an OS Boot Timer to provide Fault Resilient Booting to the operating system. The BIOS enables this watchdog timer in the BMC with the number of minutes as set in BIOS Setup. This option is disabled by default. It is the responsibility of the operating system or an application to disable this timer once it has successfully loaded.

Warning: Enabling this option without first installing an operating system or a server management application that supports this feature will cause the system to reboot when the timer expires. Consult your application or operating system vendor to see if this feature is supported.

5.2.5 Application Processor (AP) Failures

The BIOS and BMC implement additional safeguards to detect and disable the application processors (AP) in a multiprocessor system. If an AP fails to complete initialization within a certain timeframe, it is assumed to be non-functional. If the BIOS detects that an AP has failed BIST or is non-functional, it requests the BMC to disable that processor. Processors disabled by the BMC are not available for use by the BIOS or the operating system. Since the processors are unavailable, they are not listed in any configuration tables including the SMBIOS tables.

5.2.6 Treatment of Failed Processors

All failures (FRB-3, FRB-2, FRB-1, and AP failures) including the failing processor are recorded in the system event log (SEL). The FRB-3 failure is recorded automatically by the BMC while the FRB-2, FRB-1, and AP failures are logged to the SEL by the BIOS. In the case of an FRB-2 failure, some systems will log additional information into the OEM data byte fields of the SEL entry. This additional data indicates the last POST task that was executed before the FRB-2 timer expired. This information may be useful for failure analysis.

Note: The BMC maintains a failure history table for each processor in nonvolatile storage. Once a processor is marked failed, it remains failed until the user selects the “Retest Processors” option in the <F2>BIOS Setup Utility which forces the system to retest the processor and clear the log.

The BIOS reminds the user about a previous processor failure during each boot cycle until all processors have been retested and successfully pass the FRB tests or AP initialization. If all the processors are bad, the system does not alter the BSP and attempts to boot from the original BSP. Error messages are displayed on the console, and errors are logged in the event log of a processor failure.

If the user replaces a processor that has been marked bad by the system, the system must be informed about this change by running BIOS Setup and selecting that processor to be retested. If a bad processor is removed from the system and is replaced with a terminator module, the BMC automatically detects this condition and clears the status flag for that processor during the next boot.

There are three possible states for each processor slot:

- Processor installed (status only, indicates processor has passed BIOS POST).
- Processor failed. The processor may have failed FRB-2, FRB-3, or BIST, and has been disabled.
- Processor not installed (status only, indicates the processor slot has no processor in it).

Additional information on FRB may be found in the Sahalee Baseboard Management Controller EPS.

5.3 Error Messages and Error Codes

5.3.1 POST Error Codes and Messages

The BIOS will output the current boot progress codes on the video screen. Progress codes are 32-bit quantities plus optional data. The 32-bit number includes class, sub-class and operation information. Class and sub-class point to the type of hardware that is being initialized, where as the operation field represents the specific initialization activity. Based upon the data bit availability to display a progress code, progress codes can be customized to fit the data width. The higher the data bit, the higher the granularity of information. Progress codes may be reported by either the system BIOS or option ROMs.

The Response section in the following table is divided into three different types:

- **Warning** – The message is displayed on the screen and an error is logged to the SEL. The system will continue booting with a degraded state. The user may want to replace the erroneous unit
- **Pause** – The message is displayed on the screen and user input is required to continue. The user can take immediate corrective action or can choose to continue booting.
- **Halt** – The system cannot boot unless the error is resolved. The user needs to replace the faulty part and restart the system.

Table 58. Error Codes and Messages

Error Code	Error Message	Response
0000	Timer Error	Warning
0003	CMOS Battery Low	Warning
0004	CMOS Settings Wrong	Warning
0005	CMOS Checksum Bad	Warning
0008	Unlock Keyboard	Warning
0009	Keyboard Error	Warning
000A	KBC BAT Test failed	Warning
000B	CMOS Memory Size Wrong	Warning
000C	RAM R/W test failed	Warning
000E	A: Drive Error	Warning
000F	B: Drive Error	Warning
0010	Floppy Controller Failure	Warning
0012	CMOS Date/Time Not Set	Warning
0040	Refresh timer test failed	Halt
0042	CMOS Display Type Wrong	Pause
0043	<INS> Pressed	Warning
0044	DMA Controller Error	Warning
0045	DMA-1 Error	Warning
0046	DMA-2 Error	Warning
0048	Password check failed	Halt
004A	Unknown BIOS error. Error code = (ADM_MODULE_ERR)	Warning
004B	Unknown BIOS error. Error code = (LANGUAGE_MODULE_ERR)	Warning
004C	Keyboard/Interface Error	Warning
004D	Primary Master Hard Disk Error	Pause
004E	Primary Slave Hard Disk Error	Pause
0055	Primary Master Drive - ATAPI Incompatible	Pause
0056	Primary Slave Drive - ATAPI Incompatible	Pause
005D	S.M.A.R.T. Status BAD, Backup and Replace	Warning
005E	Password check failed	Warning
0120	Thermal Trip Failure	Warning
0150	BSP Processor failed BIST	Warning
0160	Processor missing microcode	Warning
0180	BIOS does not support current stepping	Pause
0192	L2 cache size mismatch	Pause
0193	CPUID, Processor stepping are different	Pause
0194	CPUID, Processor family are different	Pause
0195	Front side bus mismatch. System halted.	Pause
0196	CPUID, Processor Model are different	Pause
0197	Processor speeds mismatched	Pause
5120	CMOS Cleared By Jumper	Warning
8103	Warning! Unsupported USB device found and disabled !!!	Warning

Error Code	Error Message	Response
8104	Warning! Port 60h/64h emulation is not supported by this USB Host Controller !!!	Warning
8105	Warning! EHCI controller disabled. It requires 64bit data support in the BIOS.	Warning
8120	Processor 01: Thermal trip failure	Warning
8130	Processor 01: Disabled	Warning
8140	Processor 01: failed FRB level 3 timer	Warning
8170	Processor 01 failed BIST	Warning
8190	Watchdog timer failed on last boot	Warning
8198	OS boot watchdog timer failure	Warning
8300	BaseBoard Management Controller failed Self Test	Pause
8301	Front Panel Controller failed to function	Pause
8305	Primary Hot swap Controller failed to function	Warning
8306	Power Share Controller failed to function	Warning
84F2	BaseBoard Management Controller failed to respond	Pause
84F3	BaseBoard Management Controller in Update Mode	Pause
84F4	Sensor Data Record Empty	Pause
84FF	System Event Log Full	Warning

The following table lists error codes that are sent to the MM for error logging as BMC pass-through commands. All commands are of type "Error". The syntax of error logging is different between the MM and SEL (that is, the same error is logged differently depending upon whether it is posted to the SEL or the MM).

Table 59. Error Codes Sent to Management Module

POST Error Code	POST Error Data
161	Bad CMOS Battery
301	Keyboard failure
102	System Board failure (Timer tick 2 test failure)
106	Diskette Controller Failure
604	Diskette Drive ? failure
163	Time of the day not set
01298000	The BIOS does not support the current stepping of Processor P0
01298001	The BIOS does not support the current stepping of Processor P1
196	Processor cache mismatch detected.
198	Processor speed mismatch detected.
00019700	Processor P0 failed BIST.
00019701	Processor P1 failed BIST.
00150100	Multi-bit error occurred: forcing NMI DIMM = ??
00150100	Multi-bit error occurred: forcing NMI DIMM = ?? DIMM = ?? (could not isolate)
289	DIMM D?? is Disabled.
00150900	SERR/PERR Detected on PCI bus (no source found)
00151100	MCA: Recoverable Error Detected Proc = ??
00151200	MCA: Unrecoverable Error Detected Proc = ??

POST Error Code	POST Error Data
00151300	MCA: Excessive Recoverable Errors Proc = ??
00151350	Processor MachineCheck Data a Bank = ?? APIC ID = ?? CR4 = ???? ?????
00151351	Processor MachineCheck Data b Address = ???? ????? ????? Time Stamp = ???? ????? ?????
00151352	Processor MachineCheck Data b Status = ???? ????? ?????
00151500	Excessive Single Bit Errors Detected
00151720	Parity Error Detected on Processor bus
00151730	IMB Parity/CRC Error
00151700	Started Hot Spare memory Copy. Failed row/rows = ?? and ?? copied to spare row/rows = ?? and ?? (used on CMIC-HE box)
00151710	Completed Hot Spare memory Copy. Failed row/rows = ?? and ?? copied to spare row/rows = ?? and ?? (used on CMIC-HE box)

5.3.2 POST Error Beep Codes

The following table lists POST error beep codes. Prior to system video initialization, the BIOS uses beep codes to inform the user of error conditions. For BMC-generated beep codes, see the BMC EPS.

Table 60. POST Error Beep Codes

Number of Beeps	Description
1	Memory refresh timer error.
3	Main memory read / write test error.
6	Keyboard controller BAT test error.

Table 61. Troubleshooting BIOS Beep Codes

Number of Beeps	Troubleshooting Action
1, 2 or 3	Reseat the memory, or replace with known good modules.
4-7, 9-11	<p>Fatal error indicating a serious problem with the system. Consult your system manufacturer.</p> <p>Before declaring the motherboard beyond all hope, eliminate the possibility of interference by a malfunctioning add-in card. Remove all expansion cards except the video adapter.</p> <ul style="list-style-type: none">- If the beep codes are generated even when all other expansion cards are absent, the motherboard has a serious problem. Consult your system manufacturer.- If the beep codes are not generated when all other expansion cards are absent, one of the add-in cards is causing the malfunction. Insert the cards back into the system one at a time until the problem happens again. This will reveal the malfunctioning add-in card.
8	If the system video adapter is an add-in card, replace or reseat the video adapter. If the video adapter is an integrated part of the system board, the board may be faulty.

5.3.3 Checkpoints

5.3.3.1 System ROM BIOS POST Task Test Point (Port 80h Code)

The BIOS will send a 1-byte hex code to the port 80 before each task.

The port 80 codes provide a troubleshooting method in the event of a system hang during POST

The value of port 80h will be sent to four tri-color LEDs. This diagnostic LED feature consists of a hardware decoder and four dual-color LEDs located on the server board. During POST, the LEDs display all normal POST progress codes representing the progress of the BIOS POST. Each code is represented by a combination of colors from the four LEDs. The LEDs are in pairs of green and red. The POST progress codes are broken into two nibbles, an upper and a lower nibble. Each bit in the upper nibble is represented by a red LED; each bit in the lower nibble is represented by a green LED. If both bits are set in the upper and lower nibble then both red and green LEDs are lit, resulting in an amber color. Likewise, if both bits are clear then both the red and green LEDs are off.

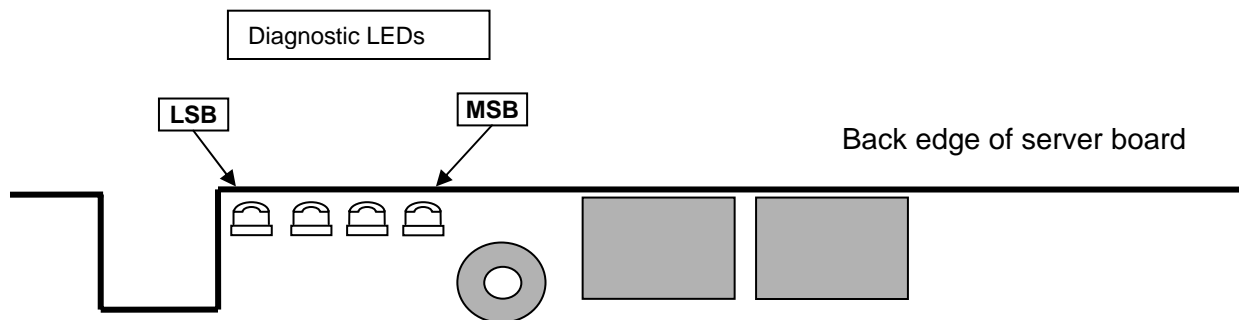
In the following example, the BIOS sends a value of ACh to the LEDs. The LEDs are decoded as follows:

- Red bits = 1010b = Ah
- Green bits = 1100b = Ch

Since the red bits correspond to the upper nibble and the green bits correspond to the lower nibble, the two are concatenated to be ACh.

Table 62. POST Progress Code LED Example

LEDs	Red	Green	Red	Green	Red	Green	Red	Green
ACh	1	1	0	1	1	0	0	0
Result	Amber		Green		Red		Off	
	MSB						LSB	



5.3.3.2 Memory Error Codes

These memory error shown by the following table are written to the SEL during POST.

Table 63. Memory Error Codes

Tpoint	Description
001h	MEM_ERR_CHANNEL_B_OFF (DIMM mismatch forced Channel B disabled)
002h	MEM_ERR_CK_PAIR_OFF (Slow DIMM(s) forced clock pair disabled)
0E1h	MEM_ERR_NO_DEVICE (No memory installed)
0E2h	MEM_ERR_TYPE_MISMATCH
0E3h	MEM_ERR_UNSUPPORTED_DIMM (Unsupported DIMM type)
0E4h	MEM_ERR_CHL_MISMATCH
0E5h	MEM_ERR_SIZE_MISMATCH
0E8h	MEM_ERR_ROW_ADDR_BITS
0E9h	MEM_ERR_INTERNAL_BANKS
0EAh	MEM_ERR_TIMING
0EBh	MEM_ERR_REG_CAS_3
0ECh	MEM_ERR_NONREG_MIX
0EDh	MEM_ERR_CAS_LATENCY
0EEh	MEM_ERR_SIZE_NOT_SUPPORTED
0EFh	MEM_ERR_POPULATION_ORDER
0F0h	SYS_FREQ_ERR (Flag for Unsupported System Bus Freq)
0F1h	DIMM_ERR_CFG_MIX (Unsupported DIMM mix)
0F2h	DQS_FAILURE (indicates DQS failure)
0F3h	MEM_ERR_MEM_TEST_FAILURE (Error code for unsuccessful Memory Test)
0F4h	MEM_ERR_ECC_INIT_FAILURE (Error code for unsuccessful ECC and Memory Initialization)
0F5h	MEM_ERR_RCVDLA_FAILURE

5.3.3.3 POST Error Pause

In case of POST error(s), which occur during system boot-up, the BIOS will stop and wait for the user to press an appropriate key before booting the operating system or entering BIOS Setup.

5.4 Error Logging

5.4.1 Error Sources and Types

One of the major requirements of server management is to correctly and consistently handle system errors. System errors can be categorized as follows:

- PCI bus
- Memory single- and multi-bit errors
- Sensors
- Processor internal errors, bus/address errors, thermal trip errors, temperatures and voltages, and GTL voltage levels
- Errors detected during POST and logged as 'POST errors'

Some system errors can be Enabled/Disabled individually (e.g., PCI Errors, FSB Errors and Memory Errors) by the user in BIOS Setup.

Sensors are managed by the BMC. The BMC is capable of receiving event messages from individual sensors and logging system events.

The BIOS logs system errors to the SEL. Be aware that error numbers for the same error may be different depending upon whether the error was logged to the SEL or to the management module (MM).

5.4.2 SMI Handler

The SMI handler is used to handle and log system level events that are not visible to the server management firmware. If the SEL Error Logging in Setup is disabled, no SMI signals are generated on system errors. If enabled, the SMI handler preprocesses all system errors, even those that are normally considered to generate an NMI. The SMI handler sends a command to the BMC to log the event and provides the data to be logged. For example, BIOS programs the hardware to generate an SMI on a single-bit memory error and logs the location of the failed DIMM in the SEL. System events that are handled by the BIOS generate an SMI.

5.4.2.1 PCI Bus Error

The PCI bus defines two error pins, PERR# for reporting parity errors, and SERR# for reporting system errors. The BIOS can be instructed to enable or disable reporting PERR# and SERR# errors through an NMI². For PERR #, the PCI bus master has the option to retry the offending transaction, or to report it using SERR#. All other PCI-related errors are reported by SERR#. SERR# is routed to the NMI if bit 2 of I/O register 61 is set to 0. If SERR# is enabled in BIOS Setup, all PCI-to-PCI bridges will generate an SERR# on the primary interface whenever an SERR# occurs on the secondary side of the bus. The same is true for PERR#s.

² Disabling NMI for PERR# and/or SERR# also disables logging of the corresponding event.

5.4.2.2 Processor Bus Error

The BIOS enables the error correction and detection capabilities of the processors by setting appropriate bits in the processor model specific register (MSR) and appropriate bits inside the chipset.

In the case of irrecoverable errors on the host processor bus, proper execution of the SMI handler cannot be guaranteed and the SMI handler cannot be relied upon to log such conditions. The BIOS SMI handler will record the error to the SEL only if the system has not experienced a catastrophic failure that compromises the integrity of the SMI handler.

5.4.2.3 Memory Bus Error

The hardware is programmed to generate an SMI on single-bit data errors in the memory array if ECC memory is installed. The SMI handler records the error and the DIMM location to the SEL. Double-bit errors in the memory array are mapped to the SMI because the BMC cannot determine the location of the bad DIMM. The double-bit errors may have corrupted the contents of SMRAM. The SMI handler will log the failing DIMM number to the BMC if the SMRAM contents are still valid. The ability to isolate the failure down to a single DIMM may not be available on certain platforms, and/or during early POST.

5.4.2.4 System Limit Error

The BMC monitors system operational limits. It manages the A/D converter, defining voltage and temperature limits as well as fan sensors and chassis intrusion. Any sensor values outside of specified limits are fully handled by the BMC. The BIOS does not generate an SMI to the host processor for these types of system events.

See the *Baseboard Management Controller External Product Specification* for details on sensors and how they are managed.

5.4.2.5 Processor Failure

The BIOS detects processor BIST failure and logs this event. The failed processor can be identified by the first OEM data byte field in the log. For example, if processor 0 fails, the first OEM data byte will be 0. The BIOS depend upon the BMC to log the watchdog timer reset event.

If an operating system device driver is using the watchdog timer to detect software or hardware failures and that timer expires, an Asynchronous Reset (ASR) is generated, which is equivalent to a hard reset. The POST portion of the BIOS can query the BMC for a watchdog reset event as the system reboots and log this event to the SEL.

5.4.2.6 Boot Event

For systems with a BMC, the BIOS downloads the system date and time to the BMC during POST and logs a boot event. This record does not indicate an error, and software that parses the event log should treat it as such.

5.4.3 Logging Format Conventions

The BIOS event log data in SEL is compliant with the IPMI specification. IPMI requires use of all but two bytes in each event log entry, called Event Data 2 and Event Data 3. An event generator can specify that these bytes contain OEM-specified values. The system BIOS uses these two bytes to record additional information about the error.

The format of the OEM data bytes (Event Data 2 and Event Data 3) for memory errors, PCI bus errors and FRB-2 errors is described in the following three tables. This format is supported by all platforms that are IPMI version 1.0 (or later) compliant.

Bits 3:1 of the generator ID field define the format revision. The system software ID is a 7-bit quantity. For events covered in this document, the system software ID will be within the range 0x18-0x1F. A system software ID of 0x18 indicates that OEM data bytes 2 and 3 are encoded using data format scheme revision 0. Note that the system software IDs in the range 0x10-0x1f are reserved for the SMI handler. The IPMI specification reserves two distinct ranges for the BIOS and SMI handler. Since the distinction between the two is not very important, the same values of generator IDs are used for the BIOS as well as the SMI handler. Technically, the FRB-2 event is not logged by the SMI handler, but it will use the same generator ID range as memory errors.

5.4.3.1 Memory Error Events

Table 64. Memory Error Events

Field	IPMI Definition	Server Board SE7520BD2 BIOS-Specific Implementation
Generator ID	7:1 System software ID or IPMB slave address. 1=ID is system software ID 0=ID is IPMB slave address.	7:4 0x3 for system BIOS 3:1 0 Format revision, Revision of the data format for OEM data bytes 2 and 3, Set this field to 0. All other revisions are reserved. 0 1 = ID is system software ID. As a result, the generator ID byte will start from 0x31 and go up to 0x3f, in increments of 2 for events logged by the BIOS.
Sensor Type	See Table 30.3 in the IPMI 1.1 specification.	0xC for memory errors
Sensor Number	Number of sensor that generated this event	Unique value for each type of event because IPMI specification requires it that way. This field has no other significance. Should not be displayed to the end user if the event is logged by BIOS.
Type Code	0x6F if event offsets are specific to the sensor	0x6F

Field	IPMI Definition	Server Board SE7520BD2 BIOS-Specific Implementation
Event Data 1	7:6 00 = unspecified byte 2 10 = OEM code in byte 2. 5:4 00 = unspecified byte 3 10 = OEM code in byte 3 The BIOS will not use encodings 01 and 11 for errors covered by this document.. 3:0 Offset from Event Trigger for discrete event state	Follow IPMI definition. If either of the two data bytes following this do not have any data, that byte should be set to 0xff, and the appropriate filed in event data 1 should indicate that that it is unspecified. According to Table 30.3 in the IPMI 1.1 specification, 3:0 is 0 for single bit error and 1 for multi-bit error.
Event Data 2	7:0 OEM code 2 or unspecified	For format rev 0, if this byte is specified, 7:6 Zero based Memory card number. Matches the number of Type 16 entry in SMBIOS table. For example, card 0 corresponds to the first Type 16 entry in SMBIOS tables. If all DIMMs are onboard, this field will always be 0. 5:0 Zero based DIMM number on the card. DIMM 0 corresponds to the first Type 17 record in the SMBIOS tables for that memory card.
Event Data 3	7:0 OEM code 3 or unspecified	If format rev is 0 and if this byte is specified, Syndrome Byte.

Table 65. Examples of Event Data Field Contents for Memory Errors

Error Type	Event Data 1	Event Data 2	Event Data 3
Single-bit error; no information about the error is available.	00	0xFF	0xFf
Multi-bit memory error, failed DIMM is the fifth DIMM on the second memory card.	0x81	0x44 (Bits 7:6 = 01 Bits 5:0 = 04)	0xFF
Single-bit error. Syndrome is 0x54, DIMM location is not known.	0x20	0xFF	0x54
Multi-bit error, Syndrome byte is 0x1c. DIMMs are onboard, and the second DIMM has failed.	0xA1	0x01 (Bits 7:6 = 00 Bits 5:0 = 01)	0x1C

5.4.3.2 PCI Error Events

Table 66. PCI Error Events

Field	IPMI Definition	Server Board SE7520BD2 BIOS Specific Implementation
Generator ID	7:1 System software ID or IPMB slave address. 1=ID is system software ID 0=ID is IPMB slave address.	7:4 0x3 for system BIOS 3:1 0 Format revision, Revision of the data format for OEM data bytes 2 and 3, For this revision of the specification, set this field to 0. All other revisions are reserved for now. 0 1=ID is system software ID As a result, the generator ID byte will start from 0x31 and go up to 0x3f, in increments of 2 for events logged by the BIOS.
Sensor Type	See Table 30.3 in the IPMI 1.1 specification.	0x13 for critical interrupt
Sensor number	Number of sensor that generated this event	Unique value for each type of event because IPMI specification requires it that way. This field has no other significance. Should not be displayed to the end user if the event is logged by BIOS.
Type code	0x6F if event offsets are specific to the sensor	0x6F
Event Data 1	7:6 00 = unspecified byte 2 10 = OEM code in byte 2. 5:4 00 = unspecified byte 3 10 = OEM code in byte 3. The BIOS will not use encodings 01 and 11 for errors covered by this document. 3:0 Offset from Event Trigger for discrete event state.	Follow IPMI definition. If either of the two data bytes following this do not have any data, that byte should be set to 0xff, and the appropriate field in event data 1 should indicate that that it is unspecified. According to Table 30.3 in the IPMI 1.1 specification, 3:0 is 04 for PCI PERR and 05 for PCI SERR.
Event Data 2	7:0 OEM code 2 or unspecified	For format rev 0, if this byte is specified, it contains the PCI bus number on which the failing device resides. If the source of the PCI error cannot be determined, this byte contains 0xff and the event data 1 byte indicates that byte 2 is unspecified.
Event Data 3	7:0 OEM code 3 or unspecified.	For format rev 0, if this byte is specified, it contains the PCI device/function address in the standard format: 7:3 Device number of the failing PCI device 2:0 PCI function number. Will always contain a zero if the device is not a multifunction device. If the source of the PCI error cannot be determined, this byte contains 0xff and the event data 1 byte indicates that byte 3 is unspecified.

Table 67. Examples of Event Data Field Contents for PCI Errors

Error Type	Event Data 1	Event Data 2	Event Data 3
PCI PERR, failing device is not known	04	0xFF	0xFF
PCI SERR, failing device is not known	05	0xFF	0xFF
PCI PERR, device 3, function 1 on PCI bus 5 reported the error	0xA4	0x05	0x19 (Bits 7:3 = 03 Bits 2:0 = 01)
An unknown device on PCI bus 0 reported the SERR	0x85	0x00	0xFF

5.4.3.3 FRB-2 Error Events**Table 68. FRB-2 Error Events**

Field	IPMI Definition	Server Board SE7520BD2 BIOS Specific Implementation
Generator ID	7:1 System software ID or IPMB slave address. 1=ID is system software ID 0=ID is IPMB slave address	7:4 0x3 for system BIOS 3:1 0 Format revision, Revision of the data format for OEM data bytes 2 and 3, For this revision of the specification, set this field to 0. All other revisions are reserved for now. 0 1=ID is system software ID As a result, the generator ID byte will start from 0x31 and go up to 0x3f, in increments of 2 for events logged by the BIOS.
Sensor Type	See Table 30.3 in the IPMI 1.1 specification.	0x7 for processor related errors
Sensor number	Number of sensor that generated this event	Unique value for each type of event because IPMI specification requires that. This field has no other significance, and it should not be displayed to the end user if the event is logged by BIOS.
Type code	0x6F if event offsets are specific to the sensor	0x6F
Event Data 1	7:6 00 = unspecified byte 2 10 = OEM code in byte 2. 5:4 00 = unspecified byte 3 10 = OEM code in byte 3. The BIOS will not use encodings 01 and 11 for errors covered by this document. 3:0 Offset from Event Trigger for discrete event state.	If Event data 2 and event data 3 contain OEM codes, bits 7:6 and bits 5:4 contain 10. For platforms that do not include the POST code information with FRB-2 log, both these fields will be 0. BIOS either should specify both bytes or should mark both bytes as unspecified. According to the IPMI 1.0 specification, Table 30.3, Byte 3:0 is 03 for FRB-2 failure during POST.
Event Data 2	7:0 OEM code 2 or unspecified.	For format rev 0, if this byte is specified, it contains bits 7:0 of the POST code at the time FRB-2 reset occurred (port 80 code)
Event Data 3	7:0 OEM code 3 or unspecified.	For format rev 0, if this byte is specified, it contains bits 15:8 of the POST code at the time FRB-2 reset occurred (port 81 code). If the BIOS only uses one byte POST codes, this byte will always be zero.

Table 69. Examples of Event Data Field Contents for FRB-2 Errors

Error type	Event Data 1	Event Data 2	Event Data 3
FRB-2 error, failing POST code information not available	0x03	0xFF	0xFF
FRB-2 error, BIOS uses one byte POST codes. The last POST code before FRB-2 reset was 0x60.	0xA3	0x60	0x0
FRB-2 error, BIOS uses one byte POST codes. The last POST code before FRB-2 reset was 0x1942.	0xA3	0x42	0x19

5.4.4 POST Code Checkpoints

Table 70. POST Code Checkpoints

Checkpoint	Diagnostic LED Decoder				Description
	G=Green, R=Red, A=Amber				
	MSB			LSB	
03	OFF	OFF	G	G	Disable NMI, parity, video for EGA, and DMA controllers. Initialize BIOS, POST, Run-time data area. Initialize BIOS modules on POST entry and GPNV area. Initialized CMOS as mentioned in the Kernel Variable "wCMOSFlags."
04	OFF	G	OFF	OFF	Check CMOS diagnostic byte to determine if battery power is OK and CMOS checksum is OK. Verify CMOS checksum manually by reading storage area. If the CMOS checksum is bad, update CMOS with power-on default values and clear passwords. Initialize status register A. Initializes data variables that are based on CMOS setup questions. Initializes both the 8259 compatible PICs in the system
05	OFF	G	OFF	G	Initializes the interrupt controlling hardware (generally PIC) and interrupt vector table.
06	OFF	G	G	OFF	Do R/W test to CH-2 count reg. Initialize CH-0 as system timer. Install the POSTINT1Ch handler. Enable IRQ-0 in PIC for system timer interrupt. Traps INT1Ch vector to "POSTINT1ChHandlerBlock."
08	G	OFF	OFF	OFF	Initializes the CPU. The BAT test is being done on KBC. Program the keyboard controller command byte is being done after Auto detection of KB/MS using AMI KB-5.
C0	R	R	OFF	OFF	Early CPU Init Start -- Disable Cache - Init Local APIC
C1	R	R	OFF	G	Set up boot strap processor Information
C2	R	R	G	OFF	Set up boot strap processor for POST
C5	R	A	OFF	G	Enumerate and set up application processors
C6	R	A	G	OFF	Re-enable cache for boot strap processor
C7	R	A	G	G	Early CPU Init Exit
0A	G	OFF	G	OFF	Initializes the 8042 compatible Key Board Controller.
0B	G	OFF	G	G	Detects the presence of PS/2 mouse.
0C	G	G	OFF	OFF	Detects the presence of Keyboard in KBC port.
0E	G	G	G	OFF	Testing and initialization of different Input Devices. Also, update the Kernel Variables. Traps the INT09h vector, so that the POST INT09h handler gets control for IRQ1. Uncompress all available language, BIOS logo, and Silent logo modules.

Checkpoint	Diagnostic LED Decoder				Description
	G=Green, R=Red, A=Amber				
	MSB			LSB	
13	OFF	OFF	G	A	Early POST initialization of chipset registers.
24	OFF	G	R	OFF	Uncompress and initialize any platform specific BIOS modules.
30	OFF	OFF	R	R	Initialize System Management Interrupt.
2A	G	OFF	A	OFF	Initializes different devices through DIM. See DIM Code Checkpoints section of document for more information.
2C	G	G	R	OFF	Initializes different devices. Detects and initializes the video adapter installed in the system that have optional ROMs.
2E	G	G	A	OFF	Initializes all the output devices.
31	OFF	OFF	R	A	Allocate memory for ADM module and uncompress it. Give control to ADM module for initialization. Initialize language and font modules for ADM. Activate ADM module.
33	OFF	OFF	A	A	Initializes the silent boot module. Set the window for displaying text information.
37	OFF	G	A	A	Displaying sign-on message, CPU information, setup key message, and any OEM specific information.
38	G	OFF	R	R	Initializes different devices through DIM. See DIM Code Checkpoints section of document for more information.
39	G	OFF	R	A	Initializes DMAC-1 and DMAC-2.
3A	G	OFF	A	R	Initialize RTC date/time.
3B	G	OFF	R	A	Test for total memory installed in the system. Also, Check for DEL or <Esc> keys to limit memory test. Display total memory in the system.
3C	G	G	R	R	Mid POST initialization of chipset registers.
40	OFF	R	OFF	OFF	Detect different devices (Parallel ports, serial ports, and coprocessor in CPU, etc.) successfully installed in the system and update the BDA, EBD, etc.
50	OFF	R	OFF	R	Programming the memory hole or any kind of implementation that needs an adjustment in system RAM size if needed.
52	OFF	R	G	R	Updates CMOS memory size from memory found in memory test. Allocates memory for Extended BIOS Data Area from base memory.
60	OFF	R	R	OFF	Initializes NUM-LOCK status and programs the KBD typematic rate.
75	OFF	A	R	A	Initialize Int-13 and prepare for IPL detection.
78	G	R	R	R	Initializes IPL devices controlled by BIOS and option ROMs.
7A	G	R	A	R	Initializes remaining option ROMs.
7C	G	A	R	R	Generate and write contents of ESCD in NVRam.
84	R	G	OFF	OFF	Log errors encountered during POST.
85	R	G	OFF	G	Display errors to the user and gets the user response for error.
87	R	G	G	G	Execute BIOS setup if needed / requested.
8C	A	G	OFF	OFF	Late POST initialization of chipset registers.
8D	A	G	OFF	G	Build ACPI tables (if ACPI is supported)
8E	A	G	G	OFF	Program the peripheral parameters. Enable/Disable NMI as selected
90	R	OFF	OFF	R	Late POST initialization of system management interrupt.
A0	R	OFF	R	OFF	Check boot password if installed.
A1	R	OFF	R	G	Clean-up work needed before booting to operating system.

Checkpoint	Diagnostic LED Decoder				Description
	G=Green, R=Red, A=Amber				
	MSB			LSB	
A2	R	OFF	A	OFF	Takes care of runtime image preparation for different BIOS modules. Fill the free area in F000h segment with 0FFh. Initializes the Microsoft IRQ Routing Table. Prepares the runtime language module. Disables the system configuration display if needed.
A4	R	G	R	OFF	Initialize runtime language module.
A7	R	G	A	G	Displays the system configuration screen if enabled. Initialize the CPU's before boot, which includes the programming of the MTRR's.
A8	A	OFF	R	OFF	Prepare CPU for operating system boot including final MTRR values.
A9	A	OFF	R	G	Wait for user input at config display if needed.
AA	A	OFF	A	OFF	Uninstall POST INT1Ch vector and INT09h vector. Deinitializes the ADM module.
AB	A	OFF	A	G	Prepare BBS for Int 19 boot.
AC	A	G	R	OFF	End of POST initialization of chipset registers.
B1	R	OFF	R	A	Save system context for ACPI.
00	OFF	OFF	OFF	OFF	Passes control to OS Loader (typically INT19h).

5.4.5 Boot Block Initialization Code Checkpoints

The boot block initialization code sets up the chipset, memory and other components before system memory is available. The following table describes the type of checkpoints that may occur during the boot block initialization portion of the BIOS.

Table 71. Boot block Initialization Code Checkpoints

Checkpoint	Diagnostic LED Decoder				Description
	G=Green, R=Red, A=Amber				
	MSB			LSB	
Before D1					Early chipset initialization is done. Early super I/O initialization is done including RTC and keyboard controller. NMI is disabled.
D1	R	R	OFF	A	Perform keyboard controller BAT test. Check if waking up from power management suspend state. Save power-on CPUID value in scratch CMOS.
D0	R	R	OFF	R	Go to flat mode with 4GB limit and GA20 enabled. Verify the boot block checksum.
D2	R	R	G	R	Disable CACHE before memory detection. Execute full memory sizing module. Verify that flat mode is enabled.
D3	R	R	G	A	If memory sizing module not executed, start memory refresh and do memory sizing in Boot block code. Do additional chipset initialization. Re-enable CACHE. Verify that flat mode is enabled.
D4	R	A	OFF	R	Test base 512KB memory. Adjust policies and cache first 8MB. Set stack.
D5	R	A	OFF	A	Boot block code is copied from ROM to lower system memory and control is given to it. BIOS now executes out of RAM.
D6	R	A	G	R	Both key sequence and OEM specific method is checked to determine if BIOS recovery is forced. Main BIOS checksum is tested. If BIOS recovery is necessary, control flows to checkpoint E0. See Boot block Recovery Code Checkpoints section of document for more information.

Checkpoint	Diagnostic LED Decoder				Description
	G=Green, R=Red, A=Amber				
	MSB			LSB	
D7	R	A	G	A	Restore CPUID value back into register. The Boot block-Runtime interface module is moved to system memory and control is given to it. Determine whether to execute serial flash.
D8	A	R	OFF	R	The Runtime module is uncompressed into memory. CPUID information is stored in memory.
D9	A	R	OFF	A	Store the Uncompressed pointer for future use in PMM. Copying Main BIOS into memory. Leaves all RAM below 1MB Read-Write including E000 and F000 shadow areas but closing SMRAM.
DA	A	R	G	R	Restore CPUID value back into register. Give control to BIOS POST (ExecutePOSTKernel). See POST Code Checkpoints section of document for more information.

5.4.6 Boot Block Recovery Code Checkpoint

The boot block recovery code gets control when the BIOS determines that a BIOS recovery needs to occur because the user has forced the update or the BIOS checksum is corrupt. The following table describes the type of checkpoints that may occur during the boot block recovery portion of the BIOS.

Table 72. Boot Block Recovery Code Checkpoint

Checkpoint	Diagnostic LED Decoder				Description
	G=Green, R=Red, A=Amber				
	MSB			LSB	
E0	R	R	R	OFF	Initialize the floppy controller in the super I/O. Some interrupt vectors are initialized. DMA controller is initialized. 8259 interrupt controller is initialized. L1 cache is enabled.
E9	A	R	R	G	Set up floppy controller and data. Attempt to read from floppy. Determine information about root directory of recovery media.
EA	A	R	A	OFF	Enable ATAPI hardware. Attempt to read from ARMD and ATAPI CD-ROM. Determine information about root directory of recovery media.
EB	A	R	A	G	Disable ATAPI hardware. Jump back to checkpoint E9.
EF	A	A	A	G	Read error occurred on media. Jump back to checkpoint EB.
F0	R	R	R	R	Search for pre-defined recovery file name in root directory.
F1	R	R	R	A	Recovery file not found.
F2	R	R	A	R	Start reading FAT table and analyze FAT to find the clusters occupied by the recovery file.
F3	R	R	A	A	Start reading the recovery file cluster by cluster.
F5	R	A	R	A	Disable L1 cache.
FA	A	R	A	R	Check the validity of the recovery file configuration to the current configuration of the flash part.
FB	A	R	A	A	Make flash write enabled through chipset and OEM specific method. Detect proper flash part. Verify that the found flash part size equals the recovery file size.
F4	R	A	R	R	The recovery file size does not equal the found flash part size.
FC	A	A	R	R	Erase the flash part.
FD	A	A	R	A	Program the flash part.

Checkpoint	Diagnostic LED Decoder				Description
	G=Green, R=Red, A=Amber				
	MSB			LSB	
FF	A	A	A	A	The flash has been updated successfully. Make flash write disabled. Disable ATAPI hardware. Restore CPUID value back into register. Give control to F000 ROM at F000:FFF0h.

Table 73. Boot Block Recovery Beep Code

Beep Code	Description
1	Insert diskette in drive A:
2	'AMIBOOT.ROM' file not found in root directory
3	Change Floppy Disk
4	Flash program successful
5	Floppy read error
7	No flash present
8	Floppy controller error
10	Flash erase error
11	Flash program error
12	Wrong bios file size
13	ROM image mismatch
Infinite long beep	Recovery successful

5.4.7 DIM Code Checkpoints

The Device Initialization Manager (DIM) module gets control at various times during BIOS POST to initialize different Buses. The following table describes the main checkpoints where the DIM module is accessed.

Table 74. DIM Code Checkpoints

Checkpoint	Description
2A	Initialize different buses and perform the following functions: <ul style="list-style-type: none"> ▪ Reset, Detect, and Disable (function 0). Function 0 disables all device nodes, PCI devices, and PnP ISA cards. It also assigns PCI bus numbers. ▪ Static Device Initialization (function 1). Function 1 initializes all static devices that include manual configured onboard peripherals, memory and I/O decode windows in PCI-PCI bridges, and noncompliant PCI devices. Static resources are also reserved. ▪ Boot Output Device Initialization (function 2). Function 2 searches for and initializes any PnP, PCI, or AGP video devices.
38	Initialize different buses and perform the following functions: <ul style="list-style-type: none"> ▪ Boot Input Device Initialization (function 3). Function 3 searches for and configures PCI input devices and detects if system has standard keyboard controller. ▪ IPL Device Initialization (function 4). Function 4 searches for and configures all PnP and PCI boot devices. ▪ General Device Initialization (function 5). Function 5 configures all onboard peripherals that are set to an automatic configuration and configures all remaining PnP and PCI devices.

5.4.8 Single-bit ECC Error Throttling Prevention

The system detects, corrects, and logs correctable errors. As long as these errors occur infrequently, the system should continue to operate without a problem.

Occasionally, correctable errors are caused by a persistent failure of a single component. For example, a broken data line on a DIMM would exhibit repeated errors until replaced. Although these errors are correctable, continual calls to the error logger can throttle the system, preventing any further useful work from being performed. For this reason, the system counts certain types of correctable errors and disables reporting if they occur too frequently.

When Error Logging is disabled, correction remains enabled but error reporting and logging is disabled for all further events. For example, if DIMM 1 has persistent failure and Event Logging is disabled, system BIOS will not log errors of all DIMMs in the memory. The system BIOS implements this feature for correctable memory errors. If ten errors occur in a single wall-clock hour, the corresponding error handler disables further reporting of the error. This allows the system to continue running, despite a persistent correctable failure. The BIOS adds an entry to the event log to indicate that logging for that type of error has been disabled as per the IPMI specification. Such an entry indicates a serious hardware problem that must be repaired at the earliest possible time.

The BIOS re-enables logging and SMIs the next time the system is rebooted.

5.5 Reliability, Availability and Serviceability (RAS) Features

5.5.1 Memory RAS Features

The MCH is designed to bring enterprise level reliability, availability, serviceability, usability, and manageability to the DP server platform. The MCH supports ACPI power management, and wake-from-LAN to maximize platform stand-by flexibility.

RAS features include:

- Data protection: All internal data buses have some form of data protection
 - FSB Address and Data parity protection
 - Hublink even parity protection
 - Memory interface
- DRAM ECC
- Memory Scrubbing
- DDR2 memory mirroring
- Sparing

5.5.1.1 Memory Scrubbing

Periodically, a memory scrubbing unit will walk through all DRAM doing reads ever 32K clocks. Correctable errors found by the read are corrected and then the good data written back to DRAM. This scrubbing does not cause any noticeable degradation to memory bandwidth, although they will cause a greater latency for that one very infrequent read that is delayed due to the scrub write cycle.

5.5.1.2 Memory Sparing

The MCH included specialized hardware to support fail-over to a spare DIMM device in the event that a primary DIMM in use exceeds a specified threshold of runtime errors. This prevents a failing DIMM with increasing error frequency from causing a catastrophic failure. This feature is an alternative to memory mirroring.

5.5.1.3 DDR266 and DDR333 Memory Mirroring

Mirroring is a way for hardware to maintain two copies of all data in the memory subsystem. This feature protects the system from failure, since an uncorrectable memory is no longer fatal to the system. When an uncorrectable error occurs during normal operation, hardware retrieves the mirror copy of the corrupted data. The case when both primary and mirror copies of the same data are corrupted simultaneously is statistically very unlikely. Mirroring reduces total memory capacity to half of the installed memory. No additional hardware support is required for mirroring support.

5.5.2 PCI Express*

In the PCI Express interface there are several pieces to the reliability of the data transferred. The initial piece referred to as training is to establish the highest common bus width (x1, x4, or x8) that the devices on the bus can communicate. Once the devices on the bus can communicate, it can be determined via software why the devices failed to train at a higher data width.

When the hardware detects that a packet is corrupted, a link level retry mechanism is used to perform a retry of the packet that was corrupted and all the following packets. Although this interrupts the delivery of packets and slows down communication, it does maintain link integrity.

If it is determined that too many errors have occurred, the hardware may determine that the quality of the connection is a problem. At this point the devices will enter a quick training sequence known as recovery. Note that the width of the connection is not renegotiated, but the adjustment of skew between lanes may occur.

If the hardware is unable to perform a successful recovery as described above, then the link will automatically revert to the polling state and initiate a full retraining sequence. The occurrence of a retraining is a drastic event which initiates a reset to the downstream device and all devices below that and is logged to the MCH as a “link down” error. Although data will be lost and processes will need to be restarted, it is preferred to taking the system down.

For data packet protection a 32-bit CRC protection scheme is used (smaller link packets use 16-bit CRC). Also, since packets utilize 8-bit/10-bit encoding and not all encoding is used, further data protection is provided as illegal codes can be detected.

5.5.3 RAS Features of the Front Side Bus (FSB)

The FSB incorporates parity protection for the data pins of the FSB. There is no ECC for FSB signals.

5.5.4 PCI-X*

PCI-X provides two signals for detection and signaling of two kinds of errors. This includes data parity and system errors.

The first of these is PERR# (parity error reporting), which is used for signaling data parity errors on all transactions except special cycle transactions.

The second of these is SERR# (system error reporting). SERR# is asserted if the device's parity checking logic detects an error in a single address cycle or in either address phase of a dual address cycle or, as mentioned above, a data parity error is detected during a special cycle transaction. SERR# may optionally be used to report other internal errors that might impact the system or data integrity. Note that SERR# will generate a critical system interrupt (non-maskable interrupt) and is, therefore, fatal.

5.5.5 RMC Connector Utilization

The 8-pin RMC connector provides an interface to server management sensors that a third-party server management product can query over the SMBus interface. This SMBus is internally known as the peripheral SMBus.

5.5.5.1 SMBus Interface

The SMBus devices available are dependent on the platform being used, but share the same 8-pin connector. It is left to the RMC vendor to properly monitor the sensors on the server board as desired (voltage, fan, temperature, etc.). In addition, this interface can also reset and power down the system. The SMBus on the server board is pulled up to 3.3V standby and requires the RMC not to pull up this open-drain bus. Having duplicate pull-ups may break the signal integrity timing characteristics required by the SMBus protocol.

5.5.5.2 Power-up Sequence

During power-up, there are default SMBus transactions that occur. The mBMC does not support multi-master and requires that the RMC not initiate any transactions until the POST_STATUS signal of the 8-pin connector is asserted high. This signal is controlled by the BIOS as an indicator that BIOS POST has finished. This signal is driven directly from the chipset as a 3.3V signal.

After POST is complete, there are no baseboard communications on this SMBus and the RMC is the only SMBus master. Fans and other sensors are set to default conditions and are monitored by the baseboard server management.

5.5.5.3 Power Supply

Power to the RMC is available through two pins. Standard 5V is available only when the system is fully powered up. 5VSB is available when the AC power is available and required to be less than 200mA.

5.5.5.4 Inputs

The POWER_OFF# signal is an input to turn off DC power to the unit. It is passed to the system as if a front panel power button had been pressed. Pulse width must be greater than 16ms for ICH debounce circuitry.

The PCIRST# signal is an input to reset the system. It is passed to the system as if a front panel reset button had been pressed. Pulse width must be greater than 16ms for ICH debounce circuitry.

5.5.6 Rolling BIOS

The system flash can accommodate up to two BIOS images. Each image will reside in distinct logical partitions. The partition whose BIOS image controls the boot is called the primary partition and the other partition is called the secondary partition. During each boot, the system BIOS will check to see if a BIOS update has occurred during the previous boot. If so, the BIOS will seek the intervention of the SIO3 to boot to the new partition. If the transition is successful, the primary and secondary partitions swap roles. This process is termed as a “Rolling BIOS.” It is automatic and seamless.

If a load to the newly updated BIOS is not successful, the SIO3 will use the previous BIOS in the other partition. Since the boot block of the primary partition is always ensured to be secure, a BIOS recovery can be performed to restore the system, if necessary.

6. Connector Pin-outs and Jumper Blocks

6.1 Board Connector Pin-outs

Table 75. Board Connector Matrix

Connector	Quantity	Connector Type	Pin Count
Memory	6	DIMM Sockets	240
PCI Express	2	Card Edge	98
PCI X 133MHz	1	Card Edge	184
PCI X 100MHz	2	Card Edge	184
PCI 32	1	Card Edge	124
IDE	1	Shrouded Header	40
SCSI LED	2	Header	4
Fans	8	Header	3
Battery	1	Battery Holder	3
Power supply	3	EPS12V Power	8 24 5
Keyboard/Mouse	1	PS2, stacked	12
Rear USB	1	External, Stacked	12
Serial Port	1	External, D-Sub	9
Video connector	1	External, D-Sub	15
Dual LAN connector 10/100/1000	1	Dual LAN connector with in-built magnetic	38
Floppy drive	1	Header	34
Front panel, main	1	Header	34
Front panel, USB	1	Header	10
Intrusion detect	1	Header	2
SCSI connector	2	Header	80
Mini-PCI	1	Card Edge	124
Serial ATA	2	Header	7

Table 76. Test Support Connector

Connector	Quantity	Connector Type	Pin Count
XDP	1	Header	30

Table 77. OEM RMC 8-pin (Remote Management Card Support)

Name	Pin	Description
SMBUS_SDA	1	SMBus data on baseboard peripheral bus. This allows direct access to HECETA through the open-drain SMBus v2.0 specification. There is a baseboard pull-up, and RMC (Remote Management Card) should not be pulling should not be pulling this up.
GND	2	System ground
SMBUS_SCL	3	SMBus clock on baseboard peripheral bus. This allows direct access to HECETA through the open-drain SMBus v2.0 specification. There is a baseboard pull-up, and RMC should not be pulling should not be pulling this up.
5VSB	4	5V standby supply <200mA
POST_STATU S	5	Output from Intel chipset BIOS indicating POST has completed. Upon assertion, mBMC on peripheral bus will cease master transactions. This is a GPO from ICH and will be a high of 3.3V. It is assumed this meets the VIH of the OEM input buffer. This is an active high signal, and when this signal is low, the OEM RMC card should not be issuing any transactions on the SMBus
PCIRST#	6	Input from RMC card. This is fed into a 5V tolerant AND gate that logically ORs the front panel reset button into the ICH system reset input. There is a 1Kohm pull-up to 5Vstandby on the baseboard, so an open drain buffer could be used.
5VCC	7	5V supply <1A max based on pin connector characteristics
POWER_OFF#	8	Power down input from RMC. Asserted low will power down the system. This is fed into a 5V tolerant gate. There is a 1Kohm pull-up to 5Vstandby on the baseboard, so an open drain buffer could be used.

Table 78. EPS12V 2x12 Connector

Pin No.	Signal Name	Pin No.	Signal Name
1	+3.3V	13	+3.3V
2	+3.3V	14	-12V
3	GND	15	GND
4	+5V	16	PS_ON
5	GND	17	GND
6	+5V	18	GND
7	GND	19	GND
8	PWR_GD	20	NC
9	SB5V	21	+5V
10	+12V	22	+5V
11	+12V	23	+5V
12	+3.3V	24	GND

Table 79. EPS12V 2x4 Connector

Pin No.	Signal Name
1	GND
2	GND
3	GND
4	GND
5	+12V
6	+12V
7	+12V

Table 80. EPS12V 1x5 Connector

Pin No.	Signal Name
1	SMBus clock
2	SMBus Data
3	NC
4	GND Return Sense
5	+3.3V Sense

Table 81. Primary IDE Connector

Signal Name	Pin	Pin	Signal Name
IDE_RST_N	1	2	GND
ICH5_PDD7	3	4	ICH5_PDD8
ICH5_PDD6	5	6	ICH5_PDD9
ICH5_PDD5	7	8	ICH5_PDD10
ICH5_PDD4	9	10	ICH5_PDD11
ICH5_PDD3	11	12	ICH5_PDD12
ICH5_PDD2	13	14	ICH5_PDD13
ICH5_PDD1	15	16	ICH5_PDD14
ICH5_PDD0	17	18	ICH5_PDD15
GND	19	20	KEY
ICH5_PDDREQ	21	22	GND
ICH5_PDIOW_N	23	24	GND
ICH5_PDIOB_N	25	26	GND
ICH5_PDIORDY	27	28	GND (CSEL)
ICH5_PDDACK_N	29	30	GND
ICH5_IRQ14_N	31	32	IOCS16
ICH5_PDA1	33	34	CABLE SENSE
ICH5_PDA0	35	36	ICH5_PDA2
ICH5_PDCS1_N	37	38	ICH5_PDCS3_N
ICH5_LED1_N	39	40	GND

Table 82. Front Panel Connector

Signal Name	Pin	Pin	Signal Name
P5V	1	2	P5V_STBY
KEY	3	4	P5V_STBY
FP_PWR_LED_N	5	6	FP_COOL_FLT_LED_N
P5V	7	8	FP_SYS_FLT_STATUS_LED_N
HD_LED_ACT_N	9	10	P5V_STBY
FP_PWR_BTN_N	11	12	NICA_ACT_LED_N
GND	13	14	NICA_LINK_LED_N
FP_RST_BTN_N	15	16	ICH5_SMBDAT
GND	17	18	ICH5_SMBCLK
FP_SLPBTN_N	19	20	FP_CHASSIS_INTRUDER_N
GND	21	22	NICB_ACT_LED_N
FP_NMI_BTN_N	23	24	NICB_LINK_LED_N
KEY	25	26	KEY
P5V_STBY	27	28	P5V_STBY
FP_ID_LED_N	29	30	FP_SYS_READY_LED_N
FP_ID_BTN_N	31	32	TP_FP_CONN_32
GND	33	34	DPP_FAULT_LED_N

Table 83. USB Front Connector

Signal Name	Pin
USB_PWR	1
Not used	2
USB_ICH5_P0N_IND	3
Not used	4
USB_ICH5_P0P_IND	5
Not used	6
GND	7
Not used	8
KEY	9
Not used	10

Table 84. USB Rear Connector

Signal Name	Pin
USB2_OC2_FB	1
USB2_P2N_FB	2
USB2_P2P_FB	3
GND	4
USB3_OC3_FB	5
USB3_P3N_FB	6
USB2_P3P_FB	7
GND	8
Shield GND	9
Shield GND	10
Shield GND	11

Table 85. SATA Connector

Signal Name	Pin
GND	1
S-ATA0_RX_P	2
S-ATA0_RX_N	3
GND	4
S-ATA0_TX_P	5
S-ATA0_TX_N	6

Table 86. Battery Holder

Signal Name	Pin
VBAT	1
VBAT	2
GND	3

Table 87. Piezo* Speaker

Signal Name	Pin
SPEAKER_OUT	1
GND	2

Table 88. SCSI LED Connector

Signal Name	Pin
GND	1
SCSI_CONN_LED_N	2
SCSI_CONN_LED_N	3

Table 89. PLL Multiplier Selection Bit 0

Signal Name	Pin
MCH_PLLSEL0	1
GND	2

Table 90. PLL Multiplier Selection Bit 1

Signal Name	Pin
MCH_PLLSEL1	1

Table 91. CPU 1 and CPU 2 3-pin Fans

Signal Name	Pin
Ground	1
Fan Power	2
Fan Tach	3

Table 92. CPU 1 and CPU 2 4-pin Fans for DDR2 Boards

Signal Name	Pin
Ground	1
Fan Power	2
Fan Tach	3

Table 93. System Fan 1 and System Fan 2 (3-pin plus 2-pin)

System Fan 1 Signal Name	Pin
Ground	1
Fan Power	2
Fan Tach	3
System Fan 2 Signal Name	Pin
Fan LED	1

Table 94. System Fan 3 and System Fan 4

Signal Name	Pin
Fan LED	1
Fan Presence	2
PWM	3
Ground	4
Fan Power	5
Fan Tach	6

Table 95. System Fan 5 and System Fan 6

Signal Name	Pin
PWM	1
Ground	2
Fan Power	3

6.2 Jumper Blocks

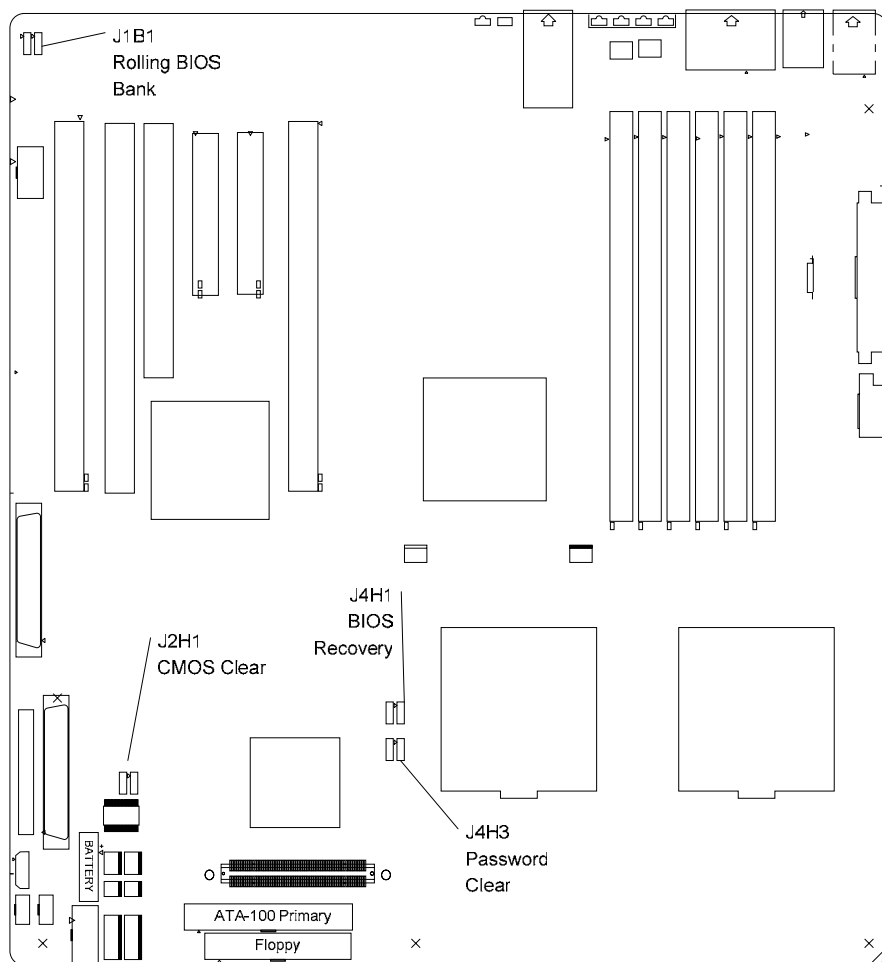


Figure 20. Jumper Locations

6.2.1 Rolling BIOS Bank Selection Jumper

A single jumper on a two-pin header offers two possible positions: jumper on or jumper off. Jumper on indicates a Flash Recovery and jumper off indicates normal operation.

Table 96. BIOS Bank Selection Jumper

Jumper	Description	Setting
J1B1	Sets the BIOS flash device to boot from either the upper or lower banks of the flash device.	Normal Operation – Pins 1-2 (Default) Force to lower bank – Pins 2-3

6.2.2 BIOS Recovery

A single jumper on a two-pin header offers two possible positions, jumper on or jumper off. Jumper on indicates a Flash Recovery and jumper off indicates normal operation.

Table 97. BIOS Recovery Jumper Setting

Jumper	Description	Setting
J4H1	Recovery Operation	Jumper On: Recovery operation Jumper Off: Normal boot (default)

6.2.3 Password Clear

If the User or Administrator password(s) is lost or forgotten, both passwords may be cleared by moving the password clear jumper into the “clear” position. The BIOS determines if the password clear jumper is in the “clear” position during BIOS POST and clears any passwords if set. The password clear jumper must be restored to its original position before a new password(s) can be set.

Table 98. Password Clear Jumper Setting

Jumper	Description	Setting
J4H3	Password Clear	Jumper On: Password Clear Jumper Off: Normal boot (default)

6.2.4 CMOS Clear

Table 99. CMOS Clear Jumper Setting

Jumper	Description	Setting
J2H1	CMOS Clear	1-2: CMOS Clear by BMC (default) 2-3: CMOS Clear Force Erase Procedure for CMOS Clear by BMC: Push power button to power off, and then pressed the reset button continually, then push the power button once.

7. Replacing the Back up Battery

The lithium battery on the server board powers the real time clock (RTC) for up to 10 years in the absence of power. When the battery starts to weaken, it loses voltage, and the server settings stored in CMOS RAM in the RTC (for example, the date and time) may be wrong. Contact the customer service representative or dealer for a list of approved devices.

WARNING

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the equipment manufacturer. Discard used batteries according to manufacturer's instructions.

ADVARSEL!

Lithiumbatteri - Eksplosjonsfare ved feilagtig håndtering. Utskiftning må kun ske med batteri af samme fabrikat og type. Levér det brugte batteri tilbage til leverandøren.

ADVARSEL

Lithiumbatteri - Eksplosjonsfare. Ved utskifting benyttes kun batteri som anbefalt av apparatfabrikanten. Brukt batteri returneres apparatleverandøren.

WARNING

Explosionsfara vid felaktigt batteribyte. Använd samma batterityp eller en ekvivalent typ som rekommenderas av apparattillverkaren. Kassera använt batteri enligt fabrikantens instruktion.

VAROITUS

Paristo voi räjähtää, jos se on virheellisesti asennettu. Vaihda paristo ainoastaan laitevalmistajan suosittelemaan tyyppiin. Hävitä käytetty paristo valmistajan ohjeiden mukaisesti.

8. Environmental Specifications

8.1 Environmental Specifications and Cooling Requirements

Non-operating temperature requirements:

- From –40 degrees C to 70 degrees C

Operating temperature requirements:

- From 5 degrees C to 50 degrees C

Voltage tolerance of all system power supply rails:

- +/- 5%

Cooling requirements for various areas of board:

- CPU and CPU VR: 450LFM
- DIMM memory array: TBD
- MCH heatsink: TBD
- PXH heatsink: TBD

8.2 Power Supply Requirements

8.2.1 Server board Power Budget

Table 100. Server board Power Budget

Item	Quantity	Utilize Factor	Average Power	Output Average Current						
				+5V	+3.3V	+12V	+12VCPU	-12V	-5V	+5VSB
Server Board										
Processor Vcore	2		204.00				21.25			
Processor VRD Eff@ 80%		20%	51.00							
VTT 1.2V/ 3.5A		70%	2.94	0.98						
NB (Intel® E7520)										
Vcc Core: 1.5V / 5.11A	1	70%	5.37	1.34						
Vcc DDR: 2.5V /10W	1	70%	7.00			0.73				
1.5 V VRD Eff @80%		20%	1.34							
2.5 V VRD Eff @80%		20%	3.85							
ICH5										
V_CPU_IO: 0.0025 A		70%	0.0020			0.0002				0.0002
Vcore 1.5V: 0.971A		70%	0.38	0.25489						
VCC3.3V: 0.480 A		70%	0.50		0.336					
VCCSUS3.3V: 0.58 A		70%	1.34							0.4060
V5REF: 250uA		70%	0.0009	0.00018						0.10
V5REF_SUS: 200uA		70%	0.0007							0.0001
PXH	1									
3.3V / 1.17A		70%	2.70		1.080					
1.5V / 5 A		70%	5.25	1.3275						
1.5 V VRD Eff @80%		20%	0.68							
Memory DDR266	6									
DDR 2.5V (HIP6311))		70%	36.31			3.78				
Vtt 1.25V (Linear)			2.00			1.6				
2.5 V VRD Eff @80%		20%	9.08							
82541PI 3.3V / .025A, 1.8V / .21A, 1.2V / .45A		70%	0.70							0.480
88E8050	1	70%	1.33							0.266
VGA ATI_RAGE_XL	1	70%	2.10		0.420	0.07				

Item	Quantity	Utilize Factor	Average Power	Output Average Current						
Super I/O (W83627HF)										
VCC:5V/ 0.02A	1	70%	0.70	0.14						
VCC3.3V/.015 A	1	70%	0.03		0.011					
VS5V/.01 A	1	70%	0.04							0.01
SCSI (LSI* 1030)	1									
3.3V / 1A (LP3963)		70%	2.31	0.58						
1.8V / 1.8A (1587)		70%	2.27		0.859					
CLK3.3 (CY28329 Generator)	1	70%	0.81		0.245					
Video RAM (2MX 32)	1	70%	0.69		0.210					
System ROM (FWH)	1	70%	0.03		0.008					
mBMC AUX5V	1	70%	0.70							0.140
USB	5	40%	5.00	1.00						
Keyboard	1	50%	0.38	0.08						
Mouse	1	50%	0.31	0.06						
System Fan	2	100%	51.60			4.30				
CPU Fan	2	100%	38.40			0.48				
PCI 32 Bit (5V)	1	40%	10.00	2.00	2.280	0.40		0.20		0.375
PCI-X 100 (3.3V)	2	40%	20.00	4.00	4.560	0.40				0.040
PCI-X* (266/1.5V, 133/3.3V)	1	40%	10.00	2.00	2.280	0.40				0.020
PCI Express* (3.3V)	2	60%	30.00		6.000	2.94		0.30		0.040
Board Level Power			511							
Board Level Output Current				13.8	18.3	15.1	21.3	0.5		1.9

8.2.2 Voltages Supported

The EPS12V 550W power supply generates the following voltages: +5V, +3.3V, +12V, -12V and +5V standby. High-frequency processor support will need a ~650W power supply, which is not defined. Other voltages required by the design are derived from linear and switching regulators. See the power supply specification for additional information.

Table 101. Intel® Server Board SE7520BD2 Voltage Table

Voltage	Net Name	Source	Tolerance
+12V	P12V	Power Supply	+5% / -4%
+3.3V	P3V3	Power Supply	+5% / -3%
-12V	N12V	Power Supply	+9% / -5%
+5V	P5V	Power Supply	+5% / -4%
+5V Standby	P5V_STBY	Power Supply	+5% / -3%
+12V	P12V_CPU_0	Power Supply	+5% / -4%
+12V	P12V_CPU_1	Power Supply	+5% / -4%
+0V	GND	Power Supply	N/A
+3.3V Standby	P3V3_STBY	Linear Regulator from +5V Standby	+/-2.5%
+3.3V Auxiliary	P3V3_AUX	Switches between 3.3V main and standby power rail depending on normal operation and sleep states respectively	+/-3%
+1.2V	P_VTT	Linear Regulator from +1.8V	+/-3%
+1.5V	P1V5	Switching Regulator from +5V	+/-3%
+1.8V	P1V8_SCSI	Linear Regulator from +3.3V	+/-3%
+2.5V	P2V5_VIDEO	Linear Regulator from +5V	+/-3%
+2.5V	PV_SCSIA PV_SCSIB	Linear Regulator from +5V	+/-1%
+1.8V	P1V8	Switching Regulator from +12V	+/-3% (without power switches)
+1.8V DDR	P1V8_CHA P1V8_CHB MCH_VCCDDR	Switched rail from P1V8	+3/-3% (without power switches)
+1.8V Auxiliary	P1V8_NIC	Linear Regulator from +3.3V or +3.3V standby	+/-3%
+1.0V Auxiliary	P1V0_NIC	Linear Regulator from +3.3V or +3.3V Standby	+/-3%
+1.2V Auxiliary	Lan_V_1P2	Linear Regulator from +3.3V Standby	+/-3%
+2.5V Auxiliary	Lan_V_2P5	Linear Regulator from +3.3V Standby	+/-3%
+1.5V	P1V5_PXH	Linear Regulator from +3.3V	+/-3%
+1.5V or +3.3V	PCI_VIO	Switched rail from either 1.5V linear or 3.3V rail	+/-3%
VID CPU0	P_VCCP0	Switching Regulator from +12V	N/A
VID CPU1	P_VCCP1	Switching Regulator from +12V	N/A

8.2.3 Standby Powered Device Map

The following components on the Server Board SE7520BD2 require standby power when the system is in S4 or S5 sleep states:

- Server I/O: +3.3VSB
- Heceta 7: +3.3VSB
- All PCI/PCI-X slots: +3.3VSB
- All PCI Express slots: +3.3VSB
- Serial Port RS232 Converter: +5VSB
- ICH5R: +3.3VSB, SB1_5V (internally generated on ICH5R), +5VSB
- SM connector: +3.3VSB, +5VSB
- Battery circuit: +3.0VSB

8.2.4 System Reset Block Diagram

Note: Getting CPU_VRD_PWR_GD input to the ICH5R VRMPWRGD adds redundant logic as the CPU_VRD_PWR_GD is also routed to the ICH5R PWROK. The RTC power well isolation circuit for the RSMRST_N is NOT shown in the following diagram for simplicity. The Heceta 7 RESET_N is output on power up with an ~200ms delay and input after power on. The power ON reset also sets all Heceta 7 registers to their default values. Added the RSMRST_N generation circuitry (empty sites) shown in ICH5 DG. This circuitry will be required if the Heceta 7 is NOT available for power-ON.

There is a 1msec delay from the VTT_PWRGD generated from the P_VTT (1.2V) regulator power good signal to the SB_VTT_PWRGD, which is used for generating the VID_PWRGD for the CPUs. Similarly, there is a 1msec delay from the time the SB_VTT_PWRGD is generated to VRO_SYS_ENABLE. These details are not shown in the following diagram. This delay logic is inside the PLD.

The Intel® Xeon™ processor/Intel® E7520 chipset platform power sequence is as follows:

1. Chipset (MCH, PXH, ICH5R) and processors are powered up.
2. On-die power-detect circuitry initiates PLL locking. However, the absence of the reference clock at PLL input triggers the Low Frequency detect circuit, which shuts the PLL off.
3. Reference clocks are driven from the clock chips (CK409B/DB800). The clock chips drive output clocks only after the PLLs in these chips have locked. That is, they only drive good clocks.
4. Presence of a reference clock is detected by the Low Frequency Detect Circuit. PLL locking is re-initiated.
5. PLLs locked.
6. Chipset (MCH, PXH, ICH5R) and processors receive external PowerGood.
7. FSB VTT regulator power good to CPU VIDPWRGD delay needs to be 1msec to 10msec.
8. CPUVIDPWRGD to CPU Vcore delay needs to be at least 1msec.

Additional Details: SB_VTT_PWRGD is a delayed copy (minimum 1msec) of FSB VTT regulator VTT_PWRGD when the VTT_PWRGD transitions from low to high. VRO_SYS_ENABLE is generated based on the glue logic shown in the PLD plus SB_VTT_PWRGD plus an additional minimum 1msec delay. This delay logic is inside the PLD.

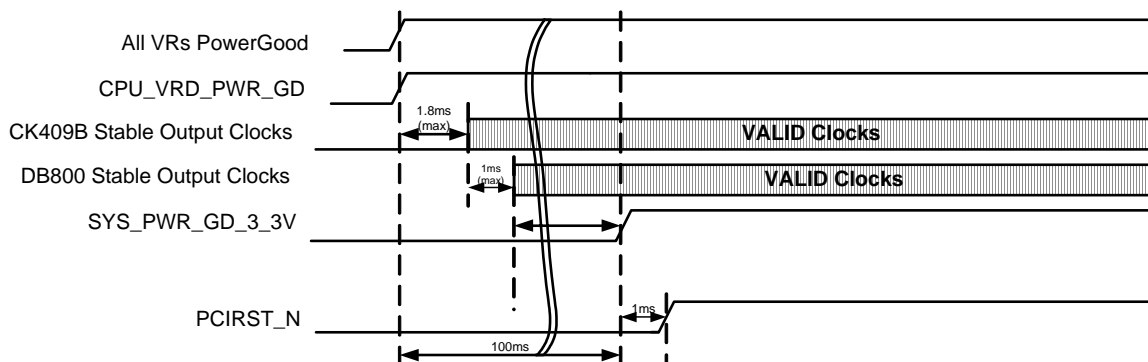


Figure 21. Reset and PowerGood Timings

8.2.4.1 Power Sequencing

The Power Good signal from the power supply starts the reset sequence in the system. The intent of the power good signal and the reset sequence is to ensure that all components are held in reset mode until power (and system clocks) have stabilized. The power good signal from the power supply will go true after all the output voltages have reached specified levels. Power Good will go false just previous to any voltage dropping below the specified level. See the EPS12V Power Supply Specification for further details.

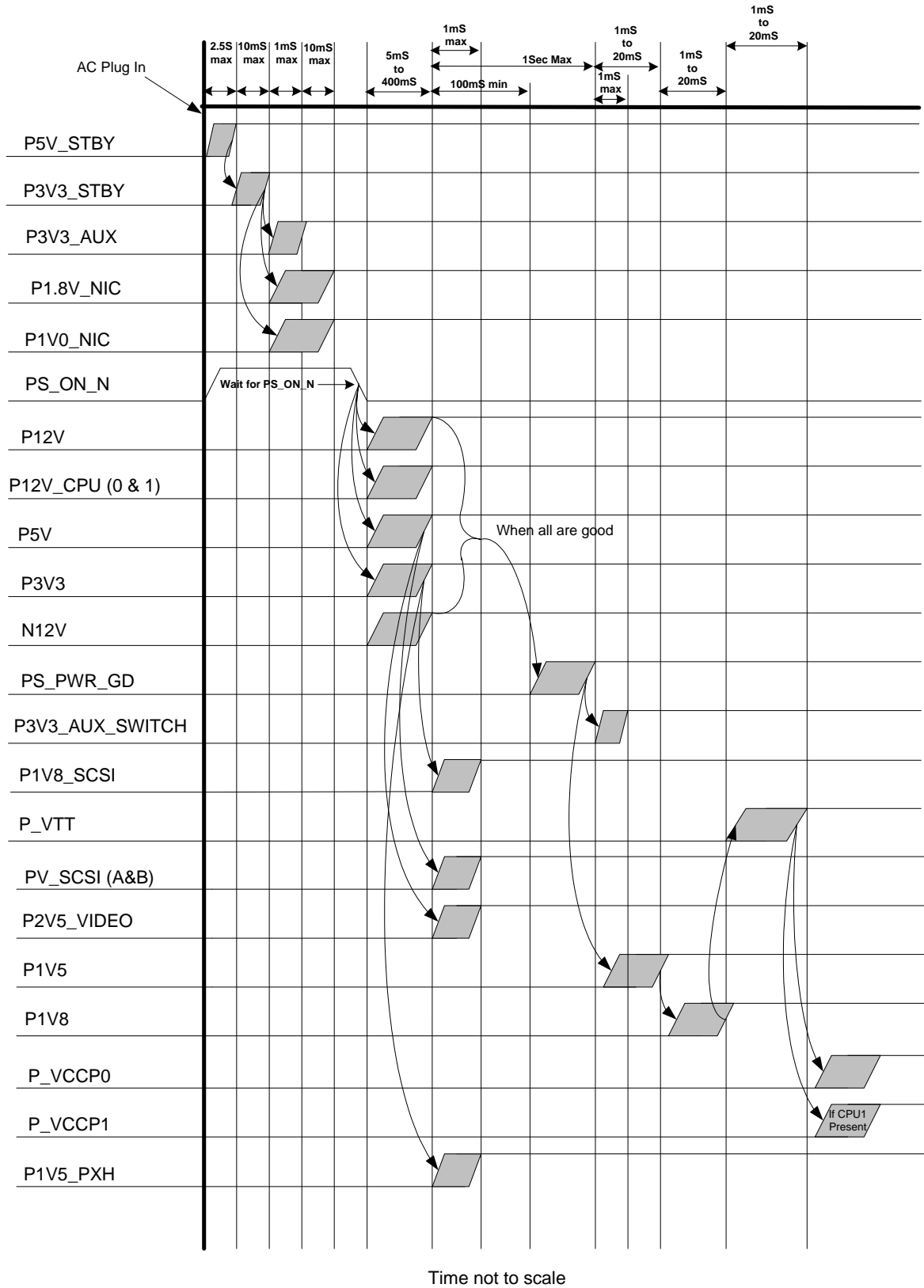


Figure 22. Intel® Server Board SE7520BD2 Power Sequencing Diagram

8.3 Airflow Requirements

8.3.1 Board Usage Disclaimer

Intel Corporation server baseboards contain a number of high-density VLSI and power delivery components that need adequate airflow to cool. Intel's own chassis are designed and tested to meet the intended thermal requirements of these components when the fully integrated system is used together. It is the responsibility of the system integrator that chooses not to use Intel developed server building blocks to consult vendor datasheets and operating parameters to determine the amount of airflow required for their specific application and environmental conditions. Intel Corporation cannot be held responsible if components fail or the server board does not operate correctly when used outside any of its published operating or non-operating limits.

8.4 Board-level Calculated MTBF

The predicted board Mean Time Between Failures is 102,000 hours of operation. As of this writing actual MTBF testing across multiple systems is complete with a demonstrated 32,656 hours. Since our validation test is only run up to about 32,000 hours across multiple servers, we still maintain that actual MTBF data will likely be over 102,000 hours of operation based on statistical regression.

8.4.1 Intel SpeedStep® Technology

Intel® Xeon™ processors support the “Geyserville3” (GV3) feature of Intel SpeedStep® Technology. This feature changes the processor operating ratio and voltage similar to the Thermal Monitor 2 (TM2) feature. The E7520 platforms support GV3 feature in conjunction with TM2 feature.

8.4.2 Intel® Extended Memory 64 Technology (Intel® EM64T)

The system BIOS on the SE7520BD2 server board supports the Intel Extended Memory 64 capability of the Intel® Xeon™ Processors. This capability does not need to be activated or deactivated in BIOS Setup. The system will be in IA-32 compatibility mode when booting an operating system. However, such operating systems like Red Hat 3.0 and SuSE 9.1 require a different kernel to access EMT64 capabilities.

9. Product Regulatory Compliance

9.1 Product Safety Compliance

The Intel® Server Board SE7520BD2 complies with the following safety requirements:

- UL60950 - CSA60950 (US/Canada) - Recognition
- EN 60950 (CENELEC Europe)
- IEC60950 (International)
- CE – Low Voltage Directive 73/23/EEE (CENELEC Europe)
- CB Certificate and Report, IEC60950 (report to include all country notional deviations)
- GOST R 50377-92 – License (Russia) ¹
- Belarus License (Belarus) ¹

Note 1: Certifications for boards in Russia and Belarus are not legal requirements; however, for ease of importing boards into these countries, the boards must be listed on the System-level GOST license. Alternatively, a voluntary GOST certification can be obtained for the board.

9.2 Product EMC Compliance

The Server Board SE7520BD2 system has been tested and verified to comply with the following electromagnetic compatibility (EMC) regulations when installed in a compatible Intel® host system. For information on compatible host system(s), contact your local Intel representative.

- FCC/ICES-003 Verification to Class A Emissions (USA/Canada)
- CISPR 22 - Class A Emissions (International)
- EN55022 - Class A Emissions (CENELEC Europe)
- EN55024 Immunity (CENELEC Europe)
- CE – EMC Directive 89/336/EEC (CENELEC Europe)
- VCCI Class A Emissions (Japan) – Verify Compliance Only
- AS/NZS 3548 Class A Emissions (Australia / New Zealand)
- BSMI CNS13438 Class A Emissions (Taiwan) – DOC
- GOST R 29216-91 Class A Emissions (Russia) ¹
- GOST R 50628-95 Immunity (Russia) ¹
- RRL MIC Notice No. 1997-41 (EMC) and 1997-42 (EMI) (Korea)

Note: Certifications for boards in Russia and Belarus are not legal requirements; however, for ease of importing boards into these countries, the boards must be listed on a System-level GOST license. Alternatively, voluntary GOST certification can be obtained for the board.

9.3 Mandatory/Standard: Certifications, Registration, Declarations

- UL Recognition (US/Canada)
- CE Declaration of Conformity (CENELEC Europe)
- FCC/ICES-003 Class A Verification (USA/Canada)
- VCCI Certification (Japan) – Verification Only
- C-Tick Declaration of Conformity (Australia)
- MOC Declaration of Conformity (New Zealand)
- BSMI Certification (Taiwan)
- GOST R Certification/License (Russia) ¹
- Belarus Certification/License (Russia) ¹
- RRL Certification (Korea)
- ECMA TR/70 Declaration (International)

Note: Certifications for boards in Russia and Belarus are not legal requirements; however, for ease of importing boards into these countries, the boards must be listed on a system-level GOST license. Alternatively, voluntary GOST certification can be obtained for the board.

9.4 Product Regulatory Compliance Markings

This product is provided with the following Product Certification Markings:

- cURus Recognition Mark
- CE Mark
- Russian GOST Mark
- Australian C-Tick Mark
- Korean RRL MIC Mark
- Taiwan BSMI Certification Number R33025 and BSMI EMC Warning

9.5 Electromagnetic Compatibility Notices

9.5.1 Europe (CE Declaration of Conformity)

This product has been tested in accordance to, and complies with the Low Voltage Directive (73/23/EEC) and EMC Directive (89/336/EEC). The product has been marked with the CE Mark to illustrate its compliance.

9.5.2 Australian Communications Authority (ACA) (C-Tick Declaration of Conformity)

This product has been tested to AS/NZS 3548, and complies with ACA emission requirements. The product has been marked with the C-Tick Mark to illustrate its compliance.

9.5.3 Ministry of Economic Development (New Zealand) Declaration of Conformity

This product has been tested to AS/NZS 3548, and complies with New Zealand Ministry of Economic Development emission requirements.

9.5.4 BSMI (Taiwan)

The BSMI Certification number R33025 is silk screened on the component side of the server board, and the following BSMI EMC warning is located on the solder side of the server board.

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

10. Other Useful Information

10.1 Platform Confidence Test (PCT)

See the *Intel® Server Deployment Toolkit CD* that came with the server board for the Platform Confidence Test. The executable is named BYOPCT.

Glossary

This appendix contains important terms used in the preceding chapters. For ease of use, numeric entries are listed first (e.g., “82460GX”) with alpha entries following (e.g., “AGP 4x”). Acronyms are then entered in their respective place, with non-acronyms following.

Word / Acronym	Definition
ACPI	Advanced Configuration and Power Interface
BMC	Baseboard Management Controller
CEK	Common Enabling Kit
DVI	Digital Video Interface
FML	Fast Management Link
IMM	Firmware management module
FSB	Front Side Bus
LPC	Low Pin Count
mBMC	Mini Baseboard Management Controller
MCH	Memory Controller Hub
NMI	Non-maskable Interrupt
PATA	Parallel ATA
PCB	Printed Circuit Board
PLL	Phase Lock Loop
PWM	Pulse Width Modulation
RTC	Real-time Clock
SATA	Serial ATA
SIO	Super I/O (Input / Output)
SM	System Management
SMC	System Management Controller
USB	Universal Serial Bus
VRD	Voltage Regulator Down

Reference Documents

See the following documents for additional information:

- *Advanced Configuration and Power Interface Specification*, Revision 1.0b 1996, 1997, 1998. Intel Corporation, Microsoft Corporation, Toshiba Corporation.
- *Design for Test R18*. BIOS/Firmware. Intel Corporation.
- *PC Address Allocation*, Revision 1.13. 1997. Intel Corporation.
- *Intelligent Platform Management Interface Specification*, Version 1.5. 2000. Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation.
- *Platform Management FRU Information Storage Definition*, Version 1.0. 1998. Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation. <http://developer.intel.com/design/servers/ipmi/spec.htm>
- *Server Power Control White Paper*, Revision 0.93. November 5, 1998. Intel Corporation.
- *The SMBus Specification*, Intel Corporation

Processor

- *Intel® Netburst™ Micro-Architecture BIOS Writer's Guide*, Confidential Document (OR-2445)
- Prescott, *Intel® Xeon™ and Potomac Processor BIOS Writer's Guide*, Confidential Document (13579)
- *Application Note AP-485 Intel Processor Identification and the CPUID Function*.
- <http://www.intel.com/design/xeon/applnots/241618.htm>

Chipset

- *RS-E7520 Memory Controller Hub (MCH) BIOS Specification*, Confidential Document (13090)
- *RS-Intel® I/O Controller Hub 5 (ICH5R) BIOS Specification*, Confidential Document (12630)
- *RS-Intel® ICH5R BIOS Specification*, Confidential Document (12939)
- *RS-Intel® PCI-X Hub (PXH)*

Standards

- *Advanced Configuration and Power Interface Specification*, Revision 1.0b, February 1999, <http://www.acpi.info/>
- *BIOS Boot Specification*, Version 1.01, January 11, 1996, <http://developer.intel.com/ial/WfM/wfm20/design/BIBLIOG.HTM>
- *El Torito CD-ROM Boot Specification*, Version 1.0., <http://www.phoenix.com/resources/specs-cdrom.pdf>

- *Extensible Firmware Interface Reference Specification*, Version 1.0., <http://www.intel.com/technology/efi/index.htm>
- *Extensible Firmware Interface Reference Specification*, Version 1.1, <http://www.intel.com/technology/efi/index.htm>
- *Specifications for Teac America 3.5 inch Desktop and Notebook Floppy Drives*, <http://www.teac.com/dsp/catalog.html>
- *Intelligent Platform Management Interface Specification*, Version 1.5, <http://developer.intel.com/design/servers/ipmi/spec.htm>
- *Multiprocessor Specification*, Revision 1.4, May 1997, <http://developer.intel.com/design/pro/datashts/242016.htm>
- *Microsoft Headless Design Guidelines*. <http://www.microsoft.com/HWDEV/PLATFORM/server/headless/default.asp>
- *Network PC System Design Guidelines*, Revision 1.0, <http://www.intel.com/managedpc/standard>
- *PC99 System Design Guide*, <http://www.pcdesguide.com/>
- *PC2001 System Design Guide*, <http://www.pcdesguide.com/>
- *PCI Local Bus Specification*, Revision 2.2, <http://www.pcisig.org/>
- *PCI to PCI Bridge Specification*, Revision 1.1, <http://www.pcisig.org/>
- *PCI BIOS Specification*, Revision 2.1, <http://www.pcisig.org/>
- *PCI Power Management Specification*, Revision 1.0, <http://www.pcisig.org/>
- *PCI IRQ Routing Table Specification*, Revision 1.0, Microsoft Corporation.
- *POST Memory Manager Specification*, Revision 1.01, <http://www.phoenix.com/techs/specs.html>
- *Plug and Play BIOS Specification*, Revision 1.0a, <http://www.microsoft.com/hwdev/respec/pnpspecs.htm> (relevant portions only).
- *System Management BIOS Reference Specification*, Version 2.3.1, <http://developer.intel.com/ial/WfM/wfm20/design/BIBLIOG.HTM>
- *SYSID BIOS Support Interface Requirement Specification*, Version 1.2, <http://developer.intel.com/ial/WfM/wfm20/design/BIBLIOG.HTM>
- *Universal Serial Bus Revision 1.1 Specification*, <http://www.usb.org/developers/docs.html>
- *Wired For Management Baseline Specification*, Revision 2.0, <http://developer.intel.com/ial/WfM/wfm20/design/BIBLIOG.HTM>
- *DMTF Systems Standard Groups Definition*, <http://developer.intel.com/ial/WfM/wfm20/design/BIBLIOG.HTM>