Intel® Compute Module MFS2600KI

Technical Product Specification

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Enterprise Platforms and Services Division

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Date	Revision Number	Modifications
April, 2012	0.5	Initial release.
June, 2012	1.0	Corrected BMC LAN settings.

Disclaimers

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1. Introduction

This Technical Product Specification (TPS) provides board-specific information detailing the features, functionality, and high-level architecture of the Intel® Compute Module MFS2600KI.

1.1 Chapter Outline

This document is divided into the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Product Overview
- Chapter 3 – Functional Architecture
- Chapter 4 – System Security
- Chapter 5 – Connector/Header Locations and Pin-outs
- Chapter 6 – Jumper Block Settings
- Chapter 7 – Product Regulatory Requirements
- Appendix A – Integration and Usage Tips
- Appendix B – POST Code Diagnostic LED Decoder
- Appendix C – Post Error Code
- Appendix D – Supported Intel® Modular Server System
- Glossary
- Reference Documents

2. Product Overview

The Intel® Compute Module MFS2600KI is a monolithic printed circuit board with features that were designed to support the high-density compute module market.

2.1 Intel® Compute Module MFS2600KI Feature Set

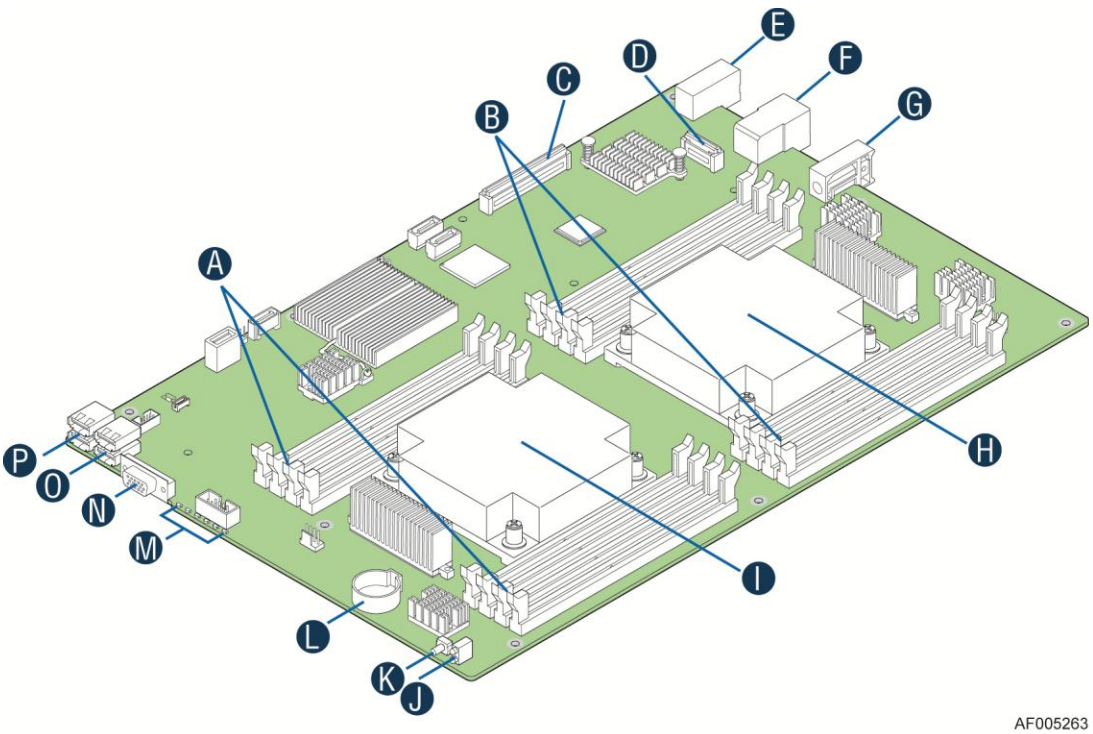
Table 1. Intel® compute module MFS2600KI Feature Set

Feature	Description
Processors	Support for one or two Intel® Xeon® Processor E5-2600 series with up to 95W Thermal Design Power (TDP). ▪ 8.0 GT/s, and 6.4 GT/s Intel® QuickPath Interconnect (Intel® QPI) ▪ Enterprise Voltage Regulator-Down (EVRD) 12.0
Memory	Support for 1067/1333/1600 MT/s ECC registered (RDIMM), unbuffered (UDIMM) and LRDIMM DDR3 memory. 16 DIMMs total across 8 memory channels (4 channels per processor). Note: Mixed memory is not tested or supported. Non-ECC memory is not tested and is not supported in a server environment.
Chipset	▪ Intel® C602-J Chipset
On-board Connectors/Headers	External connections: ▪ Four USB 2.0 ports ▪ DB-15 Video connector Internal connectors/headers: ▪ One low-profile USB Type-A connector to support low-profile USB solid state drives ▪ One internal 7pin SATA connector for embedded SATA Flash Drive ▪ One eUSB for embedded USB device ▪ Intel® I/O Mezzanine connectors supporting Dual Gigabit NIC Intel® I/O Expansion Module (Optional)
On-board Video	Integrated Matrox* G200 Core, one DB15 Video port (Front)
On-board Hard Drive Controller	LSI* 1064e SAS controller
LAN	Intel® I350 Dual 1GbE Network Controller

2.2 Compute Module Layout

2.2.1 Connector and Component Locations

The following figure shows the board layout of the Intel® Compute Module MFS2600KI. Each connector and major component is identified by a number or letter. A description of each identified item is provided below the figure.

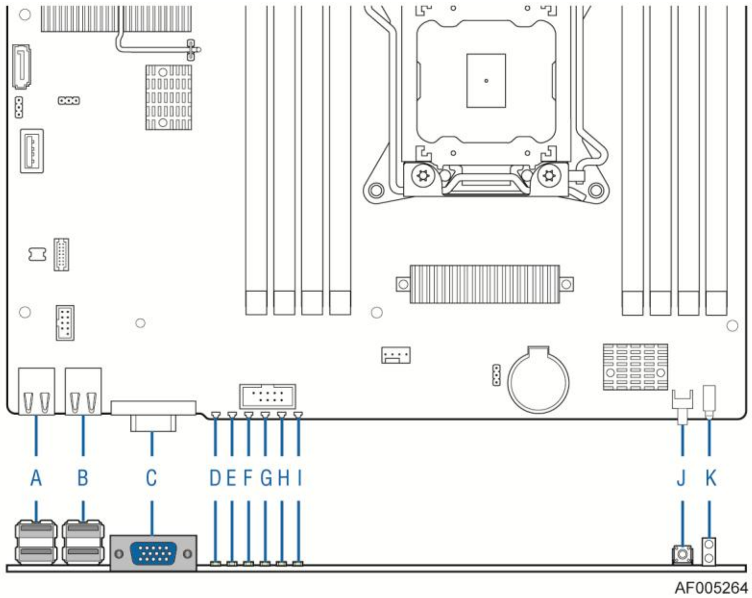


A	CPU 1 DIMM Slots	I	CPU 1 Socket
B	CPU 2 DIMM Slots	J	Power/Fault LEDs
C	Mezzanine Card Connector 1	K	Power Button
D	Mezzanine Card Connector 2	L	Battery
E	Midplane Power Connector	M	Activity and ID LEDs
F	Midplane Signal Connector	N	Video Connector
G	Midplane Guide Pin Receptacle	O	USB Ports 2 and 3
H	CPU 2 Socket	P	USB1 Ports 0 and 1

Figure 1. Component and Connector Location Diagram

2.2.3 External I/O Connector Locations

The following drawing shows the layout of the external I/O components for the Intel® Compute Module MFS2600KI.



A	USB ports 0 and 1	G	NIC 1 LED
B	USB ports 2 and 3	H	Hard Drive Activity LED
C	Video	I	ID LED
D	I/O Mezzanine NIC 4 LED	J	Power button
E	I/O Mezzanine NIC 3 LED	K	Power and Fault LEDs
F	NIC 2 LED		

Figure 2. Intel® Compute Module MFS2600KI Front Panel Layout

3. Functional Architecture

The architecture of the Intel® Compute Module MFS2600KI is developed around the integrated features and functions of the Intel® Xeon® processor E5-2600 product family the Intel® C602-J chipset, the Intel® Ethernet Controller I350 GbE controller chip and the Baseboard Management Controller.

The following diagram provides an overview of the compute module architecture, showing the features and interconnects of each of the major sub-system components.

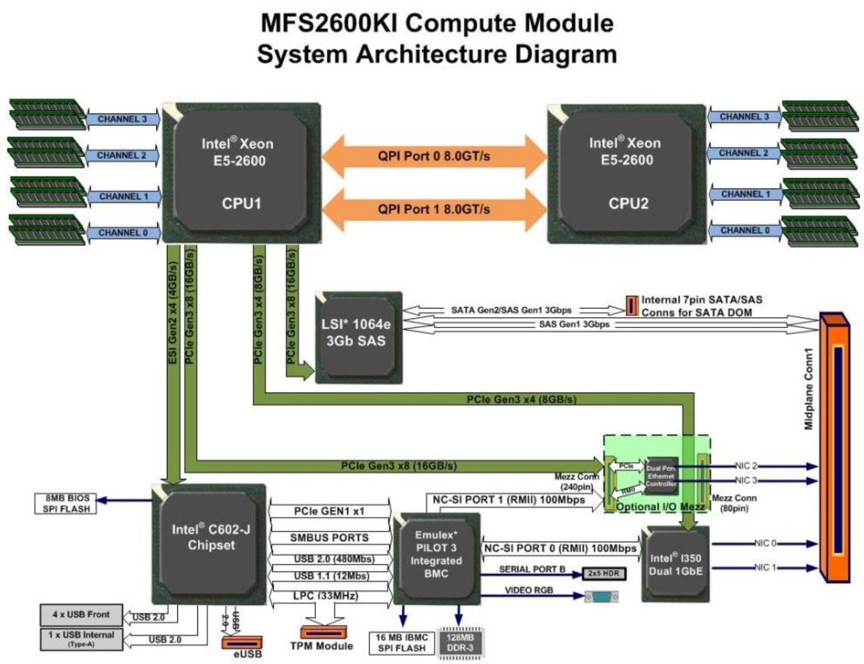


Figure 3. Intel® Compute Module MFS2600KI Functional Block Diagram

3.1 Intel® Xeon® processor

3.1.1 Processor Support

The compute module includes two Socket-R (LGA2011) processor sockets and can support one or two of the Intel® Xeon® processor E5-2600 product family, with a Thermal Design Power (TDP) of up to 95W processors.

3.1.1.1 Processor Socket Assembly

Each processor socket of the server board is pre-assembled with an Independent Latching Mechanism (ILM) and Back Plate which allow for secure placement of the processor and processor heat to the server board.

The illustration below identifies each sub-assembly component.

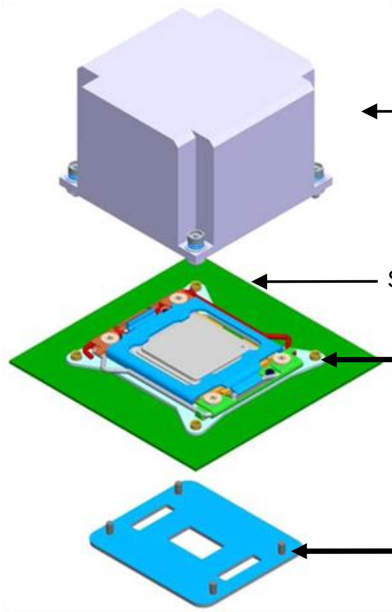


Figure 4. Processor Socket Assembly

3.1.1.2 Processor Population Rules

Note: Although the Compute Module does support dual-processor configurations consisting of different processors that meet the defined criteria below, Intel® does not perform validation testing of this configuation. For optimal performance in dual-processor configurations, Intel® recommends that identical processors be installed.

When using a single processor configuration, the processor must be installed into the processor socket labeled CPU1.

When two processors are installed, the following population rules apply:

- Both processors must be of the same processor family.
- Both processors must have the same number of cores.
- Both processors must have the same cache sizes for all levels of processor cache memory.
- Processors with different core frequencies can be mixed in a system, given the prior rules are met. If this condition is detected, all processor core frequencies are set to the lowest common denominator (highest common speed) and an error is reported.

- Processors which have different Intel® Quickpath (QPI) Link Frequencies may operate together if they are otherwise compatible and if a common link frequency can be selected. The common link frequency would be the highest link frequency that all installed processors can achieve.
- Processor stepping within a common processor family can be mixed as long as it is listed in the processor specification updates published by Intel Corporation.

3.1.2 Processor Initialization Error Summary

The following table describes mixed processor conditions and recommended actions for the MFS2600KIdesigned around the Intel® Xeon® processor E5-2600 product family and Intel® C602-J chipset product family architecture. The errors fall into one of the following categories:

- **Fatal:** If the system can boot, it pauses at a blank screen with the text **"Unrecoverable fatal error found. System will not boot until the error is resolved"** and **"Press <F2> to enter setup"**, regardless of whether the "Post Error Pause" setup option is enabled or disabled.

  When the operator presses the <F2> key on the keyboard, the error message is displayed on the Error Manager screen, and an error is logged to the System Event Log (SEL) with the POST Error Code.

  The system cannot boot unless the error is resolved. The user needs to replace the faulty part and restart the system.

  For Fatal Errors during processor initialization, the System Status LED will be set to a steady Amber color, indicating an unrecoverable system failure condition.

- **Major:** If the "Post Error Pause" setup option is enabled, the system goes directly to the Error Manager to display the error, and logs the POST Error Code to SEL. Operator intervention is required to continue booting the system.

  Otherwise, if "POST Error Pause" is disabled, the system continues to boot and no prompt is given for the error, although the Post Error Code is logged to the Error Manager and in a SEL message.

- **Minor:** The message is displayed on the screen or on the Error Manager screen, and the POST Error Code is logged to the SEL. The system continues booting in a degraded state. The user may want to replace the erroneous unit. The POST Error Pause option setting in the BIOS setup does not have any effect on this error.

Table 2. Mixed Processor Configurations

Error	Severity	System Action
Processor family not Identical	Fatal	The BIOS detects the error condition and responds as follows: ▪ Logs the POST Error Code into the System Event Log (SEL). ▪ Alerts the BMC to set the System Status LED to steady Amber. ▪ Displays "**0194: Processor family mismatch detected**" message in the Error Manager. ▪ Takes Fatal Error action (see above) and will not boot until the fault condition is remedied.
Processor model not Identical	Fatal	The BIOS detects the error condition and responds as follows: ▪ Logs the POST Error Code into the System Event Log (SEL). ▪ Alerts the BMC to set the System Status LED to steady Amber. ▪ Displays "**0196: Processor model mismatch detected**" message in the Error Manager. ▪ Takes Fatal Error action (see above) and will not boot until the fault condition is remedied.
Processor cores/threads not identical	Fatal	The BIOS detects the error condition and responds as follows: ▪ Logs the POST Error Code into the SEL. ▪ Alerts the BMC to set the System Status LED to steady Amber. ▪ Displays "**0191: Processor core/thread count mismatch detected**" message in the Error Manager. ▪ Takes Fatal Error action (see above) and will not boot until the fault condition is remedied.
Processor cache not identical	Fatal	The BIOS detects the error condition and responds as follows: ▪ Logs the POST Error Code into the SEL. ▪ Alerts the BMC to set the System Status LED to steady Amber. ▪ Displays "**0192: Processor cache size mismatch detected** message in the Error Manager. ▪ Takes Fatal Error action (see above) and will not boot until the fault condition is remedied.
Processor frequency (speed) not identical	Fatal	The BIOS detects the processor frequency difference, and responds as follows: ▪ Adjusts all processor frequencies to the highest common frequency. ▪ No error is generated – **this is not an error condition.** ▪ Continues to boot the system successfully. If the frequencies for all processors **cannot be adjusted to be the same,** then this **is** an error, and the BIOS responds as follows: ▪ Logs the POST Error Code into the SEL. ▪ Alerts the BMC to set the System Status LED to steady Amber. ▪ Does not disable the processor. ▪ Displays "**0197: Processor speeds unable to synchronize**" message in the Error Manager. Takes Fatal Error action (see above) and will not boot until the fault condition is remedied.

Error	Severity	System Action
Processor Intel® QuickPath Interconnect link frequencies not identical	Fatal	The BIOS detects the QPI link frequencies and responds as follows: ▪ Adjusts all QPI interconnect link frequencies to highest common frequency. ▪ No error is generated – **this is not an error condition.** ▪ Continues to boot the system successfully. If the link frequencies for all QPI links **cannot be adjusted to be the same,** then this ***is*** an error, and the BIOS responds as follows: ▪ Logs the POST Error Code into the SEL. ▪ Alerts the BMC to set the System Status LED to steady Amber. ▪ Displays "**0195: Processor Intel® QPI link frequencies unable to synchronize**" message in the Error Manager. ▪ Does not disable the processor. Takes Fatal Error action (see above) and will not boot until the fault condition is remedied.

3.2 Processor Functions Overview

With the release of the Intel® Xeon® processor E5-2600 product family, several key system components, including the CPU, Integrated Memory Controller (IMC), and Integrated IO Module (IIO), have been combined into a single processor package and feature per socket; two Intel® QuickPath Interconnect point-to-point links capable of up to 8.0 GT/s, up to 40 lanes of Gen 3 PCI Express* links capable of 8.0 GT/s, and 4 lanes of DMI2/PCI Express* Gen 2 interface with a peak transfer rate of 5.0 GT/s. The processor supports up to 46 bits of physical address space and 48-bit of virtual address space.

The following sections will provide an overview of the key processor features and functions that help to define the architecture, performance and supported functionality of the server board. For more comprehensive processor specific information, refer to the Intel® Xeon® processor E5-2600 product family documents listed in the Reference Document list in Chapter 1.

Processor Core Features:

- Up to 8 execution cores
- Each core supports two threads (Intel® Hyper-Threading Technology), up to 16 threads per socket
- 46-bit physical addressing and 48-bit virtual addressing
- 1 GB large page support for server applications
- A 32-KB instruction and 32-KB data first-level cache (L1) for each core
- A 256-KB shared instruction/data mid-level (L2) cache for each core
- Up to 20 MB last level cache (LLC): up to 2.5 MB per core instruction/data last level cache (LLC), shared among all cores

Supported Technologies:

- Intel® Virtualization Technology (Intel® VT)
- Intel® Virtualization Technology for Directed I/O (Intel® VT-d)

- Intel® Trusted Execution Technology (Intel® TXT)
- Intel® 64 Architecture
- Intel® Streaming SIMD Extensions 4.1 (Intel® SSE4.1)
- Intel® Streaming SIMD Extensions 4.2 (Intel® SSE4.2)
- Intel® Advanced Vector Extensions (Intel® AVX)
- Intel® Hyper-Threading Technology
- Execute Disable Bit
- Intel® Turbo Boost Technology
- Intel® Intelligent Power Technology
- Enhanced Intel® SpeedStep Technology

3.2.1 Intel® QuickPath Interconnect

The Intel® QuickPath Interconnect (QPI) is a high speed, packetized, point-to-point interconnect used in the processor. The narrow high-speed links stitch together processors in distributed shared memory and integrated I/O platform architecture. It offers much higher bandwidth with low latency. The Intel® QuickPath Interconnect has an efficient architecture allowing more interconnect performance to be achieved in real systems. It has a snoop protocol optimized for low latency and high scalability, as well as packet and lane structures enabling quick completions of transactions. Reliability, availability, and serviceability features (RAS) are built into the architecture.

The physical connectivity of each interconnect link is made up of twenty differential signal pairs plus a differential forwarded clock. Each port supports a link pair consisting of two uni-directional links to complete the connection between two components. This supports traffic in both directions simultaneously. To facilitate flexibility and longevity, the interconnect is defined as having five layers: Physical, Link, Routing, Transport, and Protocol.

The Intel® QuickPath Interconnect includes a cache coherency protocol to keep the distributed memory and caching structures coherent during system operation. It supports both low-latency source snooping and a scalable home snoop behavior. The coherency protocol provides for direct cache-to-cache transfers for optimal latency.

3.2.2 Intel® Hyper-Threading Technology

Most Intel® Xeon® processors support Intel® Hyper-Threading Technology. The BIOS detects processors that support this feature and enables the feature during POST.

If the processor supports this feature, the BIOS Setup provides an option to enable or disable this feature. The default is enabled.

3.3 Processor Integrated I/O Module (IIO)

The processor's integrated I/O module provides features traditionally supported through chipset components. The integrated I/O module provides the following features:

3.3.1 PCI Express Interfaces

The integrated I/O module incorporates the PCI Express interface and supports up to 40 lanes of PCI Express. The following tables list the CPU PCIe port connectivity of the Intel® Compute Module MFS2600KI.

Table 3. Intel® Compute Module MFS2600KI PCIe Bus Segment Characteristics

CPU#	Device	Physical Connector	Electrical Width
CPU1	Intel® C602-J	N/A	x4 Gen2
CPU1	IO Mezzanine Card	120 pin Mezzanine Card Connector	x8 Gen2
CPU1	Intel® I350 NIC	N/A	x4 Gen2
CPU1	LSI* 1064e SAS	N/A	x8 Gen1

3.3.2 DMI2 Interface to the PCH

The platform requires an interface to the legacy Southbridge (PCH) which provides basic, legacy functions required for the server platform and operating systems. Since only one PCH is required and allowed for the system, CPU2 which does not connect to PCH would use this port as a standard x4 PCI Express 2.0 interface.

3.3.3 Integrated IOAPIC

Provides support for PCI Express devices implementing legacy interrupt messages without interrupt sharing.

3.3.4 Intel® QuickData Technology

Used for efficient, high bandwidth data movement between two locations in memory or from memory to I/O.

3.4 Memory Subsystem

3.4.1 Integrated Memory Controller (IMC) and Memory Subsystem

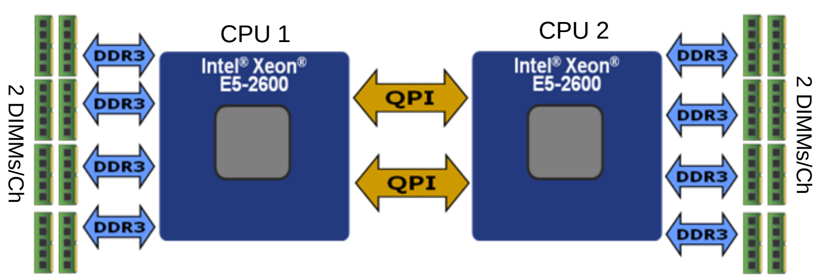


Figure 5. Intergrated Memory Controller (IMC) and Memory Subsystem

Integrated into the processor is a memory controller. Each processor provides four DDR3 channels that support the following:

- Unbuffered DDR3 and registered DDR3 DIMMs
- LR DIMM (Load Reduced DIMM) for buffered memory solutions demanding higher capacity memory subsystems

- Independent channel mode or lockstep mode
- Data burst length of eight cycles for all memory organization modes
- Memory DDR3 data transfer rates of 800, 1066, 1333, and 1600 MT/s
- 64-bit wide channels plus 8-bits of ECC support for each channel
- DDR3 standard I/O Voltage of 1.5 V and DDR3 Low Voltage of 1.35 V
- 1-Gb, 2-Gb, and 4-Gb DDR3 DRAM technologies supported for these devices:
  - UDIMM DDR3 – SR x8 and x16 data widths, DR – x8 data width
  - RDIMM DDR3 – SR,DR, and QR – x4 and x8 data widths
  - LRDIMM DDR3 – QR – x4 and x8 data widths with direct map or with rank multiplication
- Up to eight ranks supported per memory channel, 1, 2 or 4 ranks per DIMM
- Open with adaptive idle page close timer or closed page policy
- Per channel memory test and initialization engine can initialize DRAM to all logical zeros with valid ECC (with or without data scrambler) or a predefined test pattern
- Isochronous access support for Quality of Service (QoS)
- Minimum memory configuration: independent channel support with 1 DIMM populated
- Integrated dual SMBus* master controllers
- Command launch modes of 1n/2n
- RAS Support:
  - Rank Level Sparing and Device Tagging
  - Demand and Patrol Scrubbing
  - DRAM Single Device Data Correction (SDDC) for any single x4 or x8 DRAM device. Independent channel mode supports x4 SDDC. x8 SDDC requires lockstep mode
  - Lockstep mode where channels 0 and 1 and channels 2 and 3 are operated in lockstep mode
  - Data scrambling with address to ease detection of write errors to an incorrect address.
  - Error reporting through Machine Check Architecture
  - Read Retry during CRC error handling checks by iMC
  - Channel mirroring within a socket
    - CPU1 Channel Mirror Pairs (A,B) and (C,D)
    - CPU2 Channel Mirror Pairs (E,F) and (G,H)
  - Error Containment Recovery
- Improved Thermal Throttling with dynamic Closed Loop Thermal Throttling (CLTT)
- Memory thermal monitoring support for DIMM temperature

3.4.1.1 Intel® Compute Module MFS2600KI Supported Memory

Each processor provides four banks of memory, each capable of supporting up to two DIMMs.

- DIMMs are organized into physical slots on DDR3 memory channels that belong to processor sockets.
- The memory channels from processor socket 1 are identified as Channel A, B, C, and D. The memory channels from processor socket 2 are identified as Channel E, F, G, and H.

- The silk screened DIMM slot identifiers on the board provide information about the channel, and therefore the processor to which they belong. For example, DIMM_A1 is the first slot on Channel A on processor 1; DIMM_E1 is the first DIMM socket on Channel E on processor 2.
- The memory slots associated with a given processor are unavailable if the corresponding processor socket is not populated.
- A processor may be installed without populating the associated memory slots provided and a second processor is installed with associated memory. In this case, the memory is shared by the processors. However, the platform suffers performance degradation and latency due to the remote memory.
- Processor sockets are self-contained and autonomous. However, all memory subsystem support (such as Memory RAS, Error Management,) in the BIOS setup are applied commonly across processor sockets.

For a complete list of supported memory for the Intel® Compute Module MFS2600KI, refer to the Tested Memory List published in the Intel® Server Configurator Tool.

Table 4. UDIMM Support Guidelines (Preliminary. Subject to Change)

Ranks Per DIMM and Data Width	Memory Capacity Per DIMM1			Speed (MT/s) and Voltage Validated by Slot per Channel (SPC) and DIMM Per Channel (DPC)2,3					
				1 Slot per Channel		2 Slots per Channel			
				1DPC		1DPC	2DPC		
				1.35V	1.5V	1.35V	1.5V	1.35V	1.5V
SRx8 Non-ECC	1GB	2GB	4GB	n/a	1066, 1333, 1600	n/a	1066, 1333	n/a	1066, 1333
DRx8 Non-ECC	2GB	4GB	8GB	n/a	1066, 1333, 1600	n/a	1066, 1333	n/a	1066, 1333
SRx16 Non-ECC	512MB	1GB	2GB	n/a	1066, 1333, 1600	n/a	1066, 1333	n/a	1066, 1333
SRx8 ECC	1GB	2GB	4GB	1066, 1333	1066, 1333, 1600	1066	1066, 1333	1066	1066, 1333
DRx8 ECC	2GB	4GB	8GB	1066, 1333	1066, 1333, 1600	1066	1066, 1333	1066	1066, 1333

Notes:

1. Supported DRAM Densities are 1Gb, 2Gb, and 4Gb. Only 2Gb and 4Gb are validated by Intel®
2. Command Address Timing is 1N for 1DPC and 2N for 2DPC
3. No Support for 3DPC when using UDIMMs

(green)	Supported and Validated
(orange)	Supported but not Validate

Table 5. RDIMM Support Guidelines (Preliminary. Subject to Change)

Ranks Per DIMM and Data Width	Memory Capacity Per DIMM1			Speed (MT/s) and Voltage Validated by Slot per Channel (SPC) and DIMM Per Channel (DPC)2					
				1 Slot per Channel		2 Slots per Channel			
				1DPC		1DPC		2DPC	
				1.35V	1.5V	1.35V	1.5V	1.35V	1.5V
SRx8	1GB	2GB	4GB	1066, 1333	1066, 1333, 1600	1066, 1333	1066, 1333	1066	1066, 1333
DRx8	2GB	4GB	8GB	1066, 1333	1066, 1333, 1600	1066, 1333	1066, 1333	1066	1066, 1333
SRx4	2GB	4GB	8GB	1066, 1333	1066, 1333, 1600	1066, 1333	1066, 1333	1066	1066, 1333
DRx4	4GB	8GB	16GB	1066, 1333		1066, 1333	1066, 1333	1066	1066, 1333
QRx4	8GB	16GB	32GB	800	1066	800	1066	800	800
QRx8	4GB	8GB	16GB	800	1066	800	1066	800	800

Notes:

1. Supported DRAM Densities are 1Gb, 2Gb, and 4Gb. Only 2Gb and 4Gb are validated by Intel®.
2. Command Address Timing is 1N

Green	Supported and Validated
Orange	Supported but not Validate
Yellow	TBD

Table 6. LRDIMM Support Guidelines (Preliminary. Subject to Change)

Ranks Per DIMM and Data Width1	Memory Capacity Per DIMM2		Speed (MT/s) and Voltage Validated by Slot per Channel (SPC) and DIMM Per Channel (DPC)3,4,5			
			1 Slot per Channel		2 Slots per Channel	
			1DPC		1DPC and 2DPC	
			1.35V	1.5V	1.35V	1.5V
QRx4 (DDP)6	16GB	32GB	1066, 1333	1066, 1333	1066	1066, 1333
QRx8 (P)6	8GB	16GB	1066, 1333	1066, 1333	1066	1066, 1333

Notes:

1. Physical Rank is used to calculate DIMM Capacity
2. Supported and validated DRAM Densities are 2Gb and 4Gb
3. Command address timing is 1N
4. The speeds are estimated targets and will be verified through simulation
5. For 3SPC/3DPC – Rank Multiplication (RM) >=2
6. DDP – Dual Die Package DRAM stacking. P – Planar monolithic DRAM Dies.

	Supported and Validated

3.4.2 Publishing Compute Module Memory

- The BIOS displays the "Total Memory" of the compute module during POST if Display Logo is disabled in the BIOS setup. This is the total size of memory discovered by the BIOS during POST, and is the sum of the individual sizes of installed DDR3 DIMMs in the system.
- The BIOS displays the "Effective Memory" of the compute module in the BIOS setup. The term Effective Memory refers to the total size of all DDR3 DIMMs that are active (not disabled) and not used as redundant units.
- The BIOS provides the total memory of the compute module in the main page of the BIOS setup. This total is the same as the amount described by the first bullet above.
- If Display Logo is disabled, the BIOS displays the total system memory on the diagnostic screen at the end of POST. This total is the same as the amount described by the first bullet above.

3.4.3 Memory Map and Population Rules

The following are generic DIMM population requirements that generally apply to the Intel® Compute Module MFS2600KI.

- DIMM slots on any memory channel must be filled following the "farthest fill first" rule.
- A maximum of eight ranks can be installed on any one channel, counting all ranks in each DIMM on the channel.
- DIMM types (UDIMM, RDIMM, LRDIMM) must not be mixed within or across processor sockets.
- Mixing ECC with non-ECC DIMMs (UDIMMs) is not supported within or across processor sockets.
- Mixing Low Voltage (1.35V) DIMMs with Standard Voltage (1.5V) DIMMs is not supported within or across processor sockets.
- Mixing DIMMs of different frequencies and latencies is not supported within or across processor sockets.
- LRDIMM Rank Multiplication Mode and Direct Map Mode must not be mixed within or across processor sockets.
- Only ECC UDIMMs support Low Voltage 1.35V operation.
- QR RDIMMs may only be installed in DIMM Slot 1 or 2 on a channel.
- Two DPC QR Low Voltage RDIMMs are not supported.
- In order to install 3 QR LRDIMMs on the same channel, they must be operated with Rank Multiplication as RM = 2.
- RAS Modes Lockstep, Rank Sparing, and Mirroring are mutually exclusive in this BIOS. Only one operating mode may be selected, and it will be applied to the entire system.
- If a RAS Mode has been configured, and the memory population will not support it during boot, the system will fall back to Independent Channel Mode and log and display errors

- Rank Sparing Mode is only possible when all channels that are populated with memory meet the requirement of having at least two SR or DR DIMM installed, or at least one QR DIMM installed, on each populated channel.
- Lockstep or Mirroring Modes require that for any channel pair that is populated with memory, the memory population on both channels of the pair must be identically sized.

DIMM population rules require that DIMMs within a channel be populated starting with the BLUE DIMM slot or DIMM farthest from the processor in a “fill-farthest” approach. In addition, when populating a Quad-rank DIMM with a Single- or Dual-rank DIMM in the same channel, the Quad-rank DIMM must be populated farthest from the processor.

Table 7. DDR3 RDIMM Population within a Channel

Configuration Number	Speed	1N or 2N	DIMM 2	DIMM 1 (Blue Slot)
1	DDR3-1333, and 1066	1N	Empty	Single-rank
2	DDR3-1333, and 1066	1N	Empty	Dual-rank
3	DDR3-1066	1N	Empty	Quad-rank
4	DDR3-1333, and 1066	1N	Single-rank	Single-rank
5	DDR3-1333, and 1066	1N	Single-rank	Dual-rank
6	DDR3-1333, and 1066	1N	Dual-rank	Dual-rank
7	DDR3-800	1N	Single-rank	Quad-rank
8	DDR3-800	1N	Dual-rank	Quad-rank
9	DDR3-800	1N	Quad-rank	Quad-rank
10	DDR3-800	1N	Single-rank	Single-rank
11	DDR3-800	1N	Single-rank	Dual-rank
12	DDR3-800	1N	Dual-rank	Dual-rank
13	DDR3-800	1N	Dual-rank	Dual-rank
14	DDR3-800	1N	Single-rank	Quad-rank
15	DDR3-800	1N	Dual-rank	Quad-rank
16	DDR3-800	1N	Dual-rank	Quad-rank

Table 8. DDR3L Low Voltage RDIMM Population within a Channel

Configuration Number	Speed	1N or 2N	DIMM 2	DIMM 1 (Blue Slot)
1	DDR3L-1333, 1066	1N	Empty	Single-rank
2	DDR3L-1333, 1066	1N	Empty	Dual-rank
3	DDR3L-800	1N	Empty	Quad-rank
4	DDR3L-1066	1N	Single-rank	Single-rank
5	DDR3L-1066	1N	Single-rank	Dual-rank
6	DDR3L-1066	1N	Dual-rank	Dual-rank
7	DDR3L- 800	1N	Single-rank	Quad-rank

Table 9. DDR3 UDIMM Population within a Channel

Configuration Number	Speed	1N or 2N	DIMM 2	DIMM 1 (Blue Slot)
1	DDR3-1333, and 1066	1N	Empty	Single-rank
2	DDR3-1333, and 1066	1N	Empty	Dual-rank
3	DDR3-1333, and 1066	2N	Single-rank	Single-rank
4	DDR3-1333, and 1066	2N	Single-rank	Dual-rank
5	DDR3-1333, and 1066	2N	Dual-rank	Dual-rank

Table 10. DDR3L Low Voltage UDIMM Poplulation within a Channel

Configuration Number	Speed	1N or 2N	DIMM 2	DIMM 1 (Blue Slot)
1	DDR3-1333,1066	1N	Empty	Single-rank
2	DDR3-1333, 1066	1N	Empty	Dual-rank
3	DDR3-1066	2N	Single-rank	Single-rank
4	DDR3-1066	2N	Single-rank	Dual-rank
5	DDR3-1066	2N	Dual-rank	Dual-rank

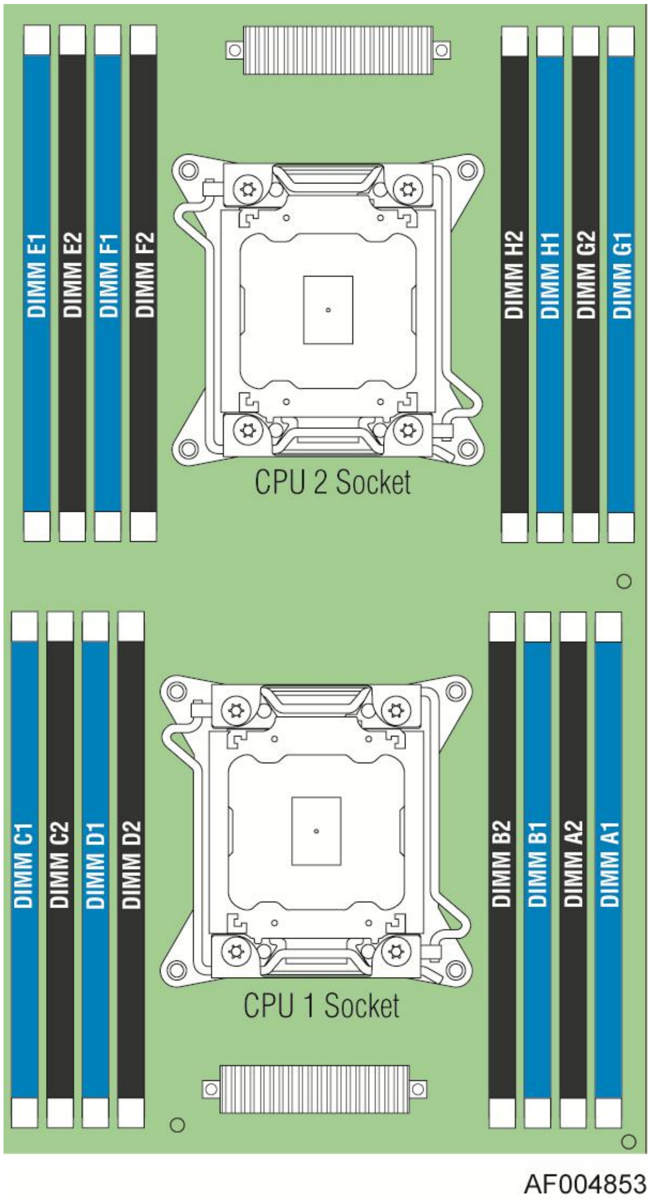


Figure 6. DIMM Slot Order

3.4.3.1 Memory Subsystem Nomenclature

The nomenclature for DIMM sockets implemented on the Intel® Compute Module MFS2600KI is detailed in the following table.

Table 11. Intel® Compute Module MFS2600KI DIMM Nomenclature

Processor Socket 1								Processor Socket 2							
(0) Channel A		(1) Channel B		(2) Channel C		(3) Channel D		(0) Channel E		(1) Channel F		(2) Channel G		(3) Channel H	
A1	**A2**	**B1**	**B2**	**C1**	**C2**	**D1**	**D2**	**E1**	**E2**	**F1**	**F2**	**G1**	**G2**	**H1**	**H2**

3.4.3.2 Publishing System Memory

The BIOS displays the "Total Memory" of the system during POST if Quite Boot is disabled in the BIOS setup. This is the total size of memory discovered by the BIOS during POST, and is the sum of the individual sizes of installed DDR3 DIMMs in the system.

The BIOS displays the "Effective Memory" of the system in the BIOS setup. The term Effective Memory refers to the total size of all DDR3 DIMMs that are active (not disabled) and not used as redundant units.

The BIOS provides the total memory of the system in the main page of the BIOS setup. This total is the same as the amount described by the first bullet above.

If Quite Boot is disabled, the BIOS displays the total system memory on the diagnostic screen at the end of POST. This total is the same as the amount described by the first bullet above.

3.4.4 Memory RAS

3.4.4.1 RAS Features

The Compute Module supports the following memory RAS features:

- Independent Channel Mode
- Rank Sparing Mode
- Mirrored Channel Mode
- Lockstep Channel Mode

Regardless of RAS mode, the requirements for populating within a channel given in the section 3.3.3 must be met at all times. Note that support of RAS modes that require matching DIMM population between channels (Mirrored and Lockstep) require that ECC DIMMs be populated. Independent Channel Mode is the only mode that supports non-ECC DIMMs in addition to ECC DIMMs.

For RAS modes that require matching populations, the same slot positions across channels must hold the same DIMM type with regards to size and organization. DIMM timings do not have to match but timings will be set to support all DIMMs populated (that is, DIMMs with slower timings will force faster DIMMs to the slower common timing modes).

3.4.4.2 Independent Channel Mode

Channels can be populated in any order in Independent Channel Mode. All four channels may be populated in any order and have no matching requirements. All channels must run at the same interface frequency but individual channels may run at different DIMM timings (RAS latency, CAS Latency, and so forth).

3.4.4.3 Rank Sparing Mode

In Rank Sparing Mode, one rank is a spare of the other ranks on the same channel. The spare rank is held in reserve and is not available as system memory. The spare rank must have identical or larger memory capacity than all the other ranks (sparing source ranks) on the same channel. After sparing, the sparing source rank will be lost.

3.4.4.4 Mirrored Channel Mode

In Mirrored Channel Mode, the memory contents are mirrored between Channel 0 and Channel 2 and also between Channel 1 and Channel 3. As a result of the mirroring, the total physical memory available to the system is half of what is populated. Mirrored Channel Mode requires that Channel 0 and Channel 2, and Channel 1 and Channel 3 must be populated identically with regards to size and organization. DIMM slot populations within a channel do not have to be identical but the same DIMM slot location across Channel 0 and Channel 2 and across Channel 1 and Channel 3 must be populated the same.

3.4.4.5 Lockstep Channel Mode

In Lockstep Channel Mode, each memory access is a 128-bit data access that spans Channel 0 and Channel 1, and Channel 2 and Channel 3. Lockstep Channel mode is the only RAS mode that allows SDDC for x8 devices. Lockstep Channel Mode requires that Channel 0 and Channel 1, and Channel 2 and Channel 3 must be populated identically with regards to size and organization. DIMM slot populations within a channel do not have to be identical but the same DIMM slot location across Channel 0 and Channel 1 and across Channel 2 and Channel 3 must be populated the same.

3.5 Intel® C602-J Chipset Overview

The Intel® C602-J chipset in the Intel® Compute Module MFS2600KI provide a connection point between various I/O components and Intel® Xeon E5-2600 processors, which includes the following core platform functions:

- Digital Media Interface (DMI)
- PCI Express* Interface
- Serial ATA (SATA) Controller
- Serial Attached SCSI (SAS)/SATA Controller
- AHCI
- Rapid Storage Technology
- PCI Interface
- Low Pin Count (LPC) Interface
- Serial Peripheral Interface (SPI)
- Compatibility Modules (DMA Controller, Timer/Counters, Interrupt Controller)
- Advanced Programmable Interrupt Controller (APIC)
- Universal Serial Bus (USB) Controllers
- Gigabit Ethernet Controller
- RTC
- GPIO
- Enhanced Power Management
- Intel® Active Management Technology (Intel® AMT)
- Manageability
- System Management Bus (SMBus* 2.0)
- Integrated NVSRAM controller
- Virtualization Technology for Directed I/O (Intel® VT-d)

- JTAG Boundary-Scan
- KVM/Serial Over LAN (SOL) Function

3.5.1 Digital Media Interface (DMI)

Digital Media Interface (DMI) is the chip-to-chip connection between the processor and Intel® C602-J chipset. This high-speed interface integrates advanced priority-based servicing allowing for concurrent traffic and true isochronous transfer capabilities. Base functionality is completely software-transparent, permitting current and legacy software to operate normally.

3.5.2 PCI Express* Interface

The Intel® C602-J chipset provides up to eight PCI Express Root Ports, supporting the PCI Express Base Specification, Revision 2.0. Each Root Port x1 lane supports up to 5 Gb/s bandwidth in each direction (10 Gb/s concurrent). PCI Express Root Ports 1-4 or Ports 5-8 can independently be configured to support four x1s, two x2s, one x2 and two x1s, or one x4 port widths.

3.5.3 Serial ATA (SATA) Controller

The Intel® C602-J chipset has two integrated SATA host controllers that support independent DMA operation on up to six ports and supports data transfer rates of up to 6.0 Gb/s (600 MB/s) on up to two ports (Port 0 and 1 Only) while all ports support rates up to 3.0 Gb/s (300 MB/s) and up to 1.5 Gb/s (150 MB/s). The SATA controller contains two modes of operation – a legacy mode using I/O space, and an AHCI mode using memory space. Software that uses legacy mode will not have AHCI capabilities.

The Intel® C602-J chipset supports the Serial ATA Specification, Revision 3.0. The Intel® C602-J also supports several optional sections of the Serial ATA II: Extensions to Serial ATA 1.0 Specification, Revision 1.0 (AHCI support is required for some elements).

3.5.4 Low Pin Count (LPC) Interface

The Intel® C602-J chipset implements an LPC Interface as described in the LPC 1.1 Specification. The Low Pin Count (LPC) bridge function of the Intel® C602-J 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.

3.5.5 Serial Peripheral Interface (SPI)

The Intel® C602-J chipset implements an SPI Interface as an alternative interface for the BIOS flash device. The SPI flash is required to support Gigabit Ethernet and Intel® Active Management Technology. The Intel® C602-J chipset supports up to two SPI flash devices with speeds up to 50 MHz.

3.5.6 Advanced Programmable Interrupt Controller (APIC)

In addition to the standard ISA compatible Programmable Interrupt controller (PIC) described in the previous section, the Intel® C602-J incorporates the Advanced Programmable Interrupt Controller (APIC).

3.5.7 Universal Serial Bus (USB) Controllers

The Intel® C602-J chipset has up to two Enhanced Host Controller Interface (EHCI) host controllers that support 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 Intel® C602-J chipset supports up to fourteen USB 2.0 ports. All fourteen ports are high-speed, full-speed, and low-speed capable.

- Four external connectors are located on the front of the compute module.
- One internal 2x5 header is provided, capable of supporting a low-profile USB solid state drive.
- Two ports are routed to the Integrated BMC to support rKVM.

3.6 Integrated Baseboard Management Controller Overview

The Intel® Computer Module MFS2600KI utilizes the I/O controller, Graphics Controller, and Baseboard Management features of the Emulex* Pilot-III Management Controller. The following is an overview of the features as implemented on the server board from each embedded controller.

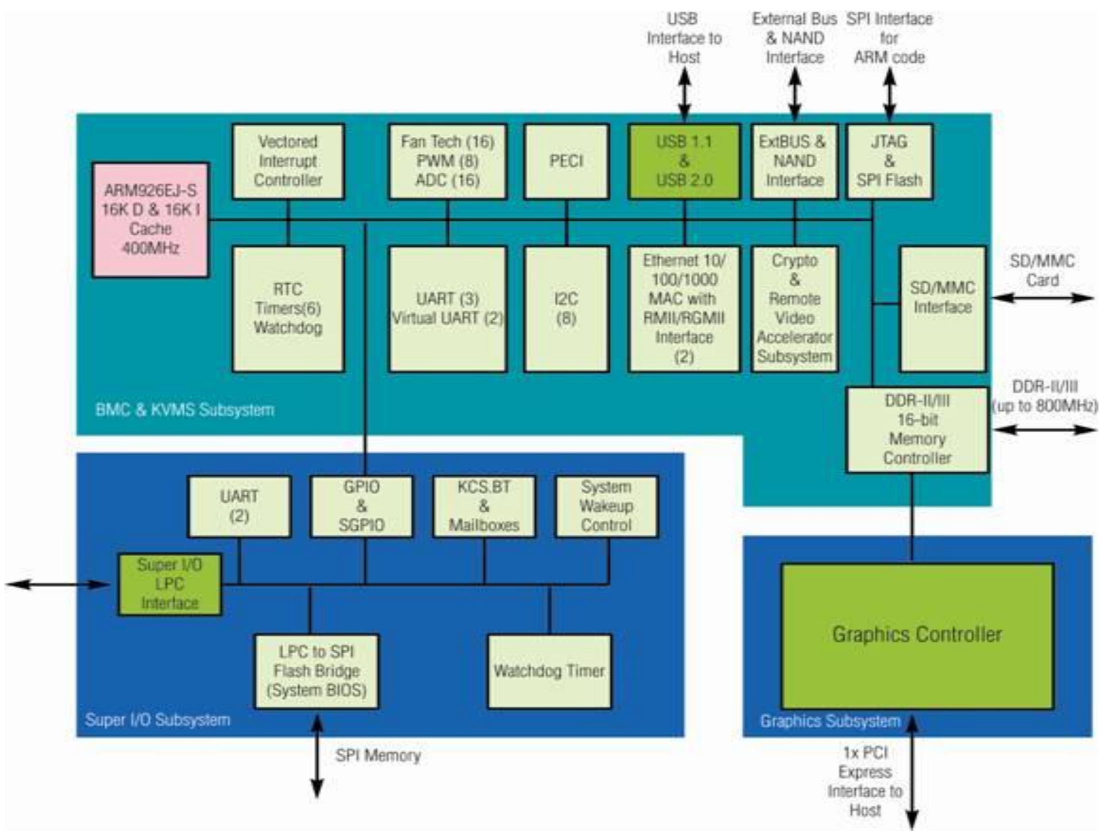


Figure 7. Integrated BMC Functional Block Diagram

3.6.1 Super I/O Controller

The integrated super I/O controller provides support for the following features as implemented on the server board:

- Two Fully Functional Serial Ports, compatible with the 16C550
- Serial IRQ Support
- Up to 16 Shared direct GPIO's
- Serial GPIO support for 80 general purpose inputs and 80 general purpose outputs available for host processor
- Programmable Wake-up Event Support
- Plug and Play Register Set
- Power Supply Control
- Host SPI bridge for system BIOS support

3.6.1.1 Keyboard and Mouse Support

The Intel® Computer Module MFS2600KI does not support PS/2 interface keyboards and mice. However, the system BIOS recognizes USB specification-compliant keyboard and mice.

3.6.1.2 Wake-up Control

The super I/O contains functionality that allows various events to power on and power off the system.

3.6.2 Graphics Controller and Video Support

The integrated graphics controller provides support for the following features as implemented on the server board:

- Integrated Graphics Core with 2D Hardware accelerator
- DDR-3 memory interface with 16 MB of memory allocated and reported for graphics memory
- High speed Integrated 24-bit RAMDAC
- Single lane PCI-Express host interface running at Gen 1 speed

The integrated video controller supports all standard IBM VGA modes. The following table shows the 2D modes supported for both CRT and LCD:

Table 12. Video Modes

2D Mode	2D Video Mode Support			
	8 bpp	16 bpp	24 bpp	32 bpp
640x480	X	X	X	X
800x600	X	X	X	X
1024x768	X	X	X	X
1152x864	X	X	X	X
1280x1024	X	X	X	X
1600x1200**	X	X		

** Video resolutions at 1600x1200 and higher are only supported through the external video connector located on the rear I/O section of the server board. Utilizing the optional front panel video connector may result in lower video resolutions.

The server board provides two video interfaces. The primary video interface is accessed using a standard 15-pin VGA connector found on the back edge of the server board. In addition, video signals are routed to a 14-pin header labeled “FP_Video” on the leading edge of the server board, allowing for the option of cabling to a front panel video connector. Attaching a monitor to the front panel video connector will disable the primary external video connector on the back edge of the board.

The BIOS supports dual-video mode when an add-in video card is installed.

- In the single mode (dual monitor video = disabled), the on-board video controller is disabled when an add-in video card is detected.
- In the dual mode (on-board video = enabled, dual monitor video = enabled), the on-board video controller is enabled and is the primary video device. The add-in video card is allocated resources and is considered the secondary video device. The BIOS Setup utility provides options to configure the feature as follows:

Table 13. Video mode

On-board Video	**Enabled** Disabled	
Dual Monitor Video	**Enabled** Disabled	Shaded if on-board video is set to "Disabled"

3.6.3 Baseboard Management Controller

The server board utilizes the following features of the embedded baseboard management controller.

- IPMI 2.0 Compliant
- 400MHz 32-bit ARM9 processor with memory management unit (MMU)
- Two independent10/100/1000 Ethernet Controllers with RMII/RGMII support
- DDR2/3 16-bit interface with up to 800 MHz operation
- 12 10-bit ADCs
- Fourteen fan tachometers
- Eight Pulse Width Modulators (PWM)
- Chassis intrusion logic
- JTAG Master
- Eight I2C interfaces with master-slave and SMBus* timeout support. All interfaces are SMBus* 2.0 compliant.
- Parallel general-purpose I/O Ports (16 direct, 32 shared)
- Serial general-purpose I/O Ports (80 in and 80 out)
- Three UARTs
- Platform Environmental Control Interface (PECI)
- Six general-purpose timers

- Interrupt controller
- Multiple SPI flash interfaces
- NAND/Memory interface
- Sixteen mailbox registers for communication between the BMC and host
- LPC ROM interface
- BMC watchdog timer capability
- SD/MMC card controller with DMA support
- LED support with programmable blink rate controls on GPIOs
- Port 80h snooping capability
- Secondary Service Processor (SSP), which provides the HW capability of off-loading time critical processing tasks from the main ARM core.

3.6.3.1 Remote Keyboard, Video, Mouse, and Storage (KVMS) Support

- USB 2.0 interface for Keyboard, Mouse and Remote storage such as CD/DVD ROM and floppy
- USB 1.1/USB 2.0 interface for PS2 to USB bridging, remote Keyboard and Mouse
- Hardware Based Video Compression and Redirection Logic
- Supports both text and Graphics redirection
- Hardware assisted Video redirection using the Frame Processing Engine
- Direct interface to the Integrated Graphics Controller registers and Frame buffer
- Hardware-based encryption engine

3.6.3.2 Integrated BMC Embedded LAN Channel

The Integrated BMC hardware includes two dedicated 10/100 network interfaces. These interfaces are not shared with the host system. At any time, only one dedicated interface may be enabled for management traffic. The default active interface is the NIC 1 port.

3.7 Network Interface Controller (NIC)

Network interface support is provided from the on-board Intel® I350 NIC, which is a single, compact component with two fully integrated GbE Media Access Control (MAC) and Physical Layer (PHY) ports. The on-board Intel® I350 NIC provides the Compute Module with support for dual LAN ports designed for 1000 Mbps operation.

The Intel® I350 device provides two standard IEEE 802.3 Ethernet interface through its SERDES interfaces. Each network interface controller (NIC) drives two LEDs (1 per port) located on the front panel. The LED indicates transmit/receive activity when blinking.

Table 14. NIC LED BEHAVIOR

LED Color	LED State	NIC State
Green	On	Link
	Blinking	Transmit / Receive activity

Intel® I350 NIC will be used in conjunction with the Emulex* Pilot-III Management Controller for out of band Management traffic. The BMC will communicate with Intel® I350 NIC over a NC-SI interface (RMII physical). Intel® I350 NIC will be on standby power so that the BMC can send management traffic over the NC-SI interface to the network during sleep state S5.

3.8 Intel® Virtualization Technology for Directed I/O (Intel® VT-d)

The Intel® C602-J chipset provides hardware support for implementation of Intel® Virtualization Technology with Directed I/O (Intel® VT-d). Intel® VT-d consists of technology components that support the virtualization of platforms based on Intel® Architecture Processors. Intel® VT-d Technology enables multiple operating systems and applications to run in independent partitions. A partition behaves like a virtual machine (VM) and provides isolation and protection across partitions. Each partition is allocated its own subset of host physical memory.

4. System Security

4.1 BIOS Password Protection

The BIOS uses passwords to prevent unauthorized tampering with the server setup. Passwords can restrict entry to the BIOS Setup, restrict use of the Boot Popup menu, and suppress automatic USB device reordering.

There is also an option to require a Power On password entry in order to boot the system. If the Power On Password function is enabled in Setup, the BIOS will halt early in POST to request a password before continuing POST.

Both Administrator and User passwords are supported by the BIOS. An Administrator password must be installed in order to set the User password. The maximum length of a password is **14 characters**. A password can have alphanumeric (a-z, A-Z, 0-9) characters and it is case sensitive. Certain special characters are also allowed, from the following set:

! @ # $ % ^ & * ( ) - _ + = ?

The Administrator and User passwords must be different from each other. An error message will be displayed if there is an attempt to enter the same password for one as for the other. The use of “Strong Passwords” is encouraged, but not required. In order to meet the criteria for a “Strong Password”, the password entered must be at least 8 characters in length, and must include at least one each of alphabetic, numeric, and special characters. If a “weak” password is entered, a popup warning message will be displayed, although the weak password will be accepted.

Once set, a password can be cleared by changing it to a null string. This requires the Administrator password, and must be done through BIOS Setup or other explicit means of changing the passwords. Clearing the Administrator password will also clear the User password.

Alternatively, the passwords can be cleared by using the Password Clear jumper if necessary. Resetting the BIOS configuration settings to default values (by any method) has no effect on the Administrator and User passwords.

Entering the User password allows the user to modify only the System Time and System Date in the Setup Main screen. Other setup fields can be modified only if the Administrator password has been entered. If any password is set, a password is required to enter the BIOS setup.

The Administrator has control over all fields in the BIOS setup, including the ability to clear the User password and the Administrator password.

It is strongly recommended that at least an Administrator Password be set, since not having set a password gives everyone who boots the system the equivalent of Administrative access. Unless an Administrator password is installed, any User can go into Setup and change BIOS settings at will.

In addition to restricting access to most Setup fields to viewing only when a User password is entered, defining a User password imposes restrictions on booting the system. In order to simply boot in the defined boot order, no password is required. However, the F6 Boot popup prompts for a password, and can only be used with the Administrator password. Also, when a User password is defined, it suppresses the USB Reordering that occurs, if enabled, when a new USB boot device is attached to the system. A User is restricted from booting in anything other than the Boot Order defined in the Setup by an Administrator.

As a security measure, if a User or Administrator enters an incorrect password three times in a row during the boot sequence, the system is placed into a halt state. A system reset is required to exit out of the halt state. This feature makes it more difficult to guess or break a password.

In addition, on the next successful reboot, the Error Manager displays a Major Error code 0048, which also logs a SEL event to alert the authorized user or administrator that a password access failure has occurred.

4.2 Trusted Platform Module (TPM) Support

The Trusted Platform Module (TPM) option is a hardware-based security device that addresses the growing concern on boot process integrity and offers better data protection. TPM protects the system start-up process by ensuring it is tamper-free before releasing system control to the operating system. A TPM device provides secured storage to store data, such as security keys and passwords. In addition, a TPM device has encryption and hash functions. The compute module implements TPM as per *TPM PC Client Specifications* revision 1.2 by the Trusted Computing Group (TCG).

A TPM device is optionally installed onto a high density 14-pin connector labeled “TPM” on the compute module, and is secured from external software attacks and physical theft. A pre-boot environment, such as the BIOS and operating system loader, uses the TPM to collect and store unique measurements from multiple factors within the boot process to create a system fingerprint. This unique fingerprint remains the same unless the pre-boot environment is tampered with. Therefore, it is used to compare to future measurements to verify the integrity of the boot process.

After the system BIOS completes the measurement of its boot process, it hands off control to the operating system loader and in turn to the operating system. If the operating system is TPM-enabled, it compares the BIOS TPM measurements to those of previous boots to make sure the system was not tampered with before continuing the operating system boot process. Once the operating system is in operation, it optionally uses TPM to provide additional system and data security (for example, Microsoft Vista* supports Bitlocker drive encryption).

4.2.1 TPM security BIOS

The BIOS TPM support conforms to the *TPM PC Client Implementation Specification* for Conventional BIOS and to the *TPM Interface Specification,* and the *Microsoft Windows BitLocker* Requirements*. The role of the BIOS for TPM security includes the following:

- Measures and stores the boot process in the TPM microcontroller to allow a TPM enabled operating system to verify system boot integrity.
- Produces EFI and legacy interfaces to a TPM-enabled operating system for using TPM.
- Produces ACPI TPM device and methods to allow a TPM-enabled operating system to send TPM administrative command requests to the BIOS.

- Verifies operator physical presence. Confirms and executes operating system TPM administrative command requests.
- Provides BIOS Setup options to change TPM security states and to clear TPM ownership.

For additional details, refer to the *TCG PC Client Specific Implementation Specification*, the *TCG PC Client Specific Physical Presence Interface Specification*, and the *Microsoft BitLocker* Requirement* documents.

4.2.2 Physical Presence

Administrative operations to the TPM require TPM ownership or physical presence indication by the operator to confirm the execution of administrative operations. The BIOS implements the operator presence indication by verifying the setup Administrator password.

A TPM administrative sequence invoked from the operating system proceeds as follows:

1. User makes a TPM administrative request through the operating system's security software.
2. The operating system requests the BIOS to execute the TPM administrative command through TPM ACPI methods and then resets the system.
3. The BIOS verifies the physical presence and confirms the command with the operator.
4. The BIOS executes TPM administrative command(s), inhibits BIOS Setup entry and boots directly to the operating system which requested the TPM command(s).

4.2.3 TPM Security Setup Options

The BIOS TPM Setup allows the operator to view the current TPM state and to carry out rudimentary TPM administrative operations. Performing TPM administrative options through the BIOS setup requires TPM physical presence verification.

Using BIOS TPM Setup, the operator can turn ON or OFF TPM functionality and clear the TPM ownership contents. After the requested TPM BIOS Setup operation is carried out, the option reverts to No Operation.

The BIOS TPM Setup also displays the current state of the TPM, whether TPM is enabled or disabled and activated or deactivated. Note that while using TPM, a TPM-enabled operating system or application may change the TPM state independent of the BIOS setup. When an operating system modifies the TPM state, the BIOS Setup displays the updated TPM state.

The BIOS Setup TPM Clear option allows the operator to clear the TPM ownership key and allows the operator to take control of the system with TPM. You use this option to clear security settings for a newly initialized system or to clear a system for which the TPM ownership security key was lost.

4.3 Intel® Trusted Execution Technology

The Intel® Xeon® Processor E5-2600 support Intel® Trusted Execution Technology (Intel® TXT), which is a robust security environment. Designed to help protect against software-based attacks, Intel® Trusted Execution Technology integrates new security features and capabilities into the processor, chipset and other platform components. When used in conjunction with Intel® Virtualization Technology, Intel® Trusted Execution Technology provides hardware-rooted trust for your virtual applications.

This hardware-rooted security provides a general-purpose, safer computing environment capable of running a wide variety of operating systems and applications to increase the confidentiality and integrity of sensitive information without compromising the usability of the platform.

Intel® Trusted Execution Technology requires a computer system with Intel® Virtualization Technology enabled (both VT-x and VT-d), an Intel® Trusted Execution Technology-enabled processor, chipset and BIOS, Authenticated Code Modules, and an Intel® Trusted Execution Technology compatible measured launched environment (MLE). The MLE could consist of a virtual machine monitor, an OS or an application. In addition, Intel® Trusted Execution Technology requires the system to include a TPM v1.2, as defined by *the Trusted Computing Group TPM PC Client Specifications*, Revision 1.2.

When available, Intel® Trusted Execution Technology can be enabled or disabled in the processor by a BIOS Setup option.

For general information about Intel® TXT, visit the Intel® Trusted Execution Technology website, http://www.intel.com/technology/security/.

5. Connector/Header Locations and Pin-outs

5.1 Board Connector Information

The following section provides detailed information regarding all connectors, headers, and jumpers on the compute module. The following table lists all connector types available on the board and the corresponding reference designators printed on the silkscreen.

Table 15. Board Connector Matrix

Connector	Quantity	Reference Designators
Power Connector	1	J1A1
Midplane Signal Connector	1	J3A1
CPU	2	CPU1(U6H1), CPU2(U7C1)
Main Memory	16	J9J2, J9J1, J8J2, J8J1, J5F1,J4F3, J4F2,J4F1, J4B1, J4B2, J4B3, J5B1, J8E1, J9E1, J9E2, and J9E3
I/O Mezzanine	2	J1D2, J2A1
Battery	1	BT7K1
TypeA USB	1	J1H3
Serial Port A	1	J4K1
Video connector	1	J2K1
USB connector	1	J1K2, J1K3
eUSB	1	J1K1
TPM	1	J1J2
SATA DOM	1	J1G1
Power button	1	S9K1

5.2 Power Connectors

The power connection is obtained using a 2x2 FCI Airmax* power connector. The following table defines the power connector pin-out.

Table 16. Power Connector Pin-out (J1A1)

Position	Signal
1	+12 Vdc
2	GND
3	GND
4	+12 Vdc

5.3 I/O Connector Pin-out Definition

5.3.1 VGA Connector

The following table details the pin-out definition of the VGA connector (J2K1).

Table 17. VGA Connector Pin-out (J2K1)

Pin	Signal Name	Description
1	V_IO_R_CONN	Red (analog color signal R)
2	V_IO_G_CONN	Green (analog color signal G)
3	V_IO_B_CONN	Blue (analog color signal B)
4	TP_VID_CONN_B4	No connection
5	GND	Ground
6	GND	Ground
7	GND	Ground
8	GND	Ground
9	P5V_VID_CONN_9	P5V
10	GND	Ground
11	TP_VID_CONN_B11	No connection
12	V_IO_DDCDAT	DDCDAT
13	V_IO_HSYNC_CONN	HSYNC (horizontal sync)
14	V_IO_VSYNC_CONN	VSYNC (vertical sync)
15	V_IO_DDCCLK	DDCCLK

5.3.2 I/O Mezzanine Card Connector

The compute module provides an internal 120-pin Tyco dual-row receptacle (J1D2) and a Tyco 40-pin dual-row receptacle (J2A1) to accommodate high-speed I/O expansion modules, which expands the I/O capabilities of the compute module. The following table details the pin-out of the Intel® I/O expansion module connector.

Table 18. 120-pin I/O Mezzanine Card Connector Pin-out

Signal Name	Pin	Signal Name	Pin
P5V	1	P5V	2
GND	3	GND	4
P3V3	5	P3V3	6
P3V3	7	P3V3	8
P3V3	9	P3V3	10
GND	11	GND	12
P3V3AUX	13	P3V3AUX	14
P3V3AUX	15	P3V3AUX	16
SMB_SDA	17	SMB_SCL	18
HSC0_LNK_LED	19	HSC0_ACT_LED	20
HSC1_LNK_LED	21	HSC1_ACT_LED	22
HSC2_LNK_LED	23	HSC2_ACT_LED	24
HSC3_LNK_LED	25	HSC3_ACT_LED	26
GND	27	WAKE_N	28
Rsvd	29	GND	30
Rsvd	31	GND	32
GND	33	PCIe_0_A_TXP	34
GND	35	PCIe_0_A_TXN	36
PCIe_0_A_RXP	37	GND	38
PCIe_0_A_RXN	39	GND	40
GND	41	PCIe_0_B_TXP	42
GND	43	PCIe_0_B_TXN	44
PCIe_0_B_RXP	45	GND	46
PCIe_0_B_RXN	47	GND	48
GND	49	PCIe_0_C_TXP	50
GND	51	PCIe_0_C_TXN	52
PCIe_0_C_RXP	53	GND	54
PCIe_0_C_RXN	55	GND	56
GND	57	PCIe_0_D_TXP	58
GND	59	PCIe_0_D_TXN	60
PCIe_0_D_RXP	61	GND	62
PCIe_0_D_RXN	63	GND	64
GND	65	PCIe_1_A_TXP	66
GND	67	PCIe_1_A_TXN	68
PCIe_1_A_RXP	69	GND	70
PCIe_1_A_RXN	71	GND	72
GND	73	PCIe_1_B_TXP	74
GND	75	PCIe_1_B_TXN	76
PCIe_1_B_RXP	77	GND	78
PCIe_1_B_RXN	79	GND	80
GND	81	PCIe_1_C_TXP	82
GND	83	PCIe_1_C_TXN	84
PCIe_1_C_RXP	85	GND	86
PCIe_1_C_RXN	87	GND	88

Signal Name	Pin	Signal Name	Pin
GND	89	PCIe_1_D_TXP	90
GND	91	PCIe_1_D_TXN	92
PCIe_1_D_RXP	93	GND	94
PCIe_1_D_RXN	95	GND	96
GND	97	Mezz_Present	98
GND	99	Reset_N	100
Clk0_100M_PCIE_P	101	GND	102
Clk0_100M_PCIE_N	103	GND	104
GND	105	Rsvd	106
GND	107	Rsvd	108
Rsvd	109	GND	110
Rsvd	111	Rsvd	112
Rsvd	113	Rsvd	114
P12V	115	P12V	116
P12V	117	P12V	118
P12V	119	P12V	120

Table 19. 120-pin I/O Mezzanine Card Connector Signal Definitions

Signal Name	Signal Description	Purpose	Connector Location
PCIe_0_A_TXP	PCIe TX+ of Lane A Link 0	Host connect	34
PCIe_0_A_TXN	PCIe TX- of Lane A Link 0	Host connect	36
PCIe_0_A_RXP	PCIe RX+ of Lane A Link 0	Host connect	37
PCIe_0_A_RXN	PCIe RX- of Lane A Link 0	Host connect	39
PCIe_0_B_TXP	PCIe TX+ of Lane B Link 0	Host connect	42
PCIe_0_B_TXN	PCIe TX- of Lane B Link 0	Host connect	44
PCIe_0_B_RXP	PCIe RX+ of Lane B Link 0	Host connect	45
PCIe_0_B_RXN	PCIe RX- of Lane B Link 0	Host connect	47
PCIe_0_C_TXP	PCIe TX+ of Lane C Link 0	Host connect	50
PCIe_0_C_TXN	PCIe TX- of Lane C Link 0	Host connect	52
PCIe_0_C_RXP	PCIe RX+ of Lane C Link 0	Host connect	53
PCIe_0_C_RXN	PCIe RX- of Lane C Link 0	Host connect	55
PCIe_0_D_TXP	PCIe TX+ of Lane D Link 0	Host connect	58
PCIe_0_D_TXN	PCIe TX- of Lane D Link 0	Host connect	60
PCIe_0_D_RXP	PCIe RX+ of Lane D Link 0	Host connect	61
PCIe_0_D_RXN	PCIe RX- of Lane D Link 0	Host connect	63
PCIe_1_A_TXP	PCIe TX+ of Lane A Link 1	Host connect	66
PCIe_1_A_TXN	PCIe TX- of Lane A Link 1	Host connect	68
PCIe_1_A_RXP	PCIe RX+ of Lane A Link 1	Host connect	69
PCIe_1_A_RXN	PCIe RX- of Lane A Link 1	Host connect	71
PCIe_1_B_TXP	PCIe TX+ of Lane B Link 1	Host connect	74
PCIe_1_B_TXN	PCIe TX- of Lane B Link 1	Host connect	76
PCIe_1_B_RXP	PCIe RX+ of Lane B Link 1	Host connect	78
PCIe_1_B_RXN	PCIe RX- of Lane B Link 1	Host connect	79
PCIe_1_C_TXP	PCIe TX+ of Lane C Link 1	Host connect	82

Signal Name	Signal Description	Purpose	Connector Location
PCIe_1_C_TXN	PCIe TX- of Lane C Link 1	Host connect	84
PCIe_1_C_RXP	PCIe RX+ of Lane C Link 1	Host connect	85
PCIe_1_C_RXN	PCIe RX- of Lane C Link 1	Host connect	87
PCIe_1_D_TXP	PCIe TX+ of Lane D Link 1	Host connect	90
PCIe_1_D_TXN	PCIe TX- of Lane D Link 1	Host connect	92
PCIe_1_D_RXP	PCIe RX+ of Lane D Link 1	Host connect	93
PCIe_1_D_RXN	PCIe RX- of Lane D Link 1	Host connect	95
Clk0_100M_PCIe_P	100MHz clk +	PCIe Clk	101
Clk0_100M_PCIe_N	100MHz clk -	PCIe Clk	103
SMB_SCL	SMBus* Clock	Mngt connect	18
SMB_SDA	SMBus* Data	Mngt connect	17
HSC_0_LNK_LED	HSC 0 Link LED driver	LED control	19
HSC_1_LNK_LED	HSC 1 Link LED driver	LED control	21
HSC_2_LNK_LED	HSC 2 Link LED driver	LED control	23
HSC_3_LNK_LED	HSC 3 Link LED driver	LED control	25
HSC_0_ACT_LED	HSC 0 Activity LED driver	LED control	20
HSC_1_ACT_LED	HSC 1 Activity LED driver	LED control	22
HSC_2_ACT_LED	HSC 2 Activity LED driver	LED control	24
HSC_3_ACT_LED	HSC 3 Activity LED driver	LED control	26
WAKE_N	PCIe WAKE_N signal	Wake on LAN	28
Reset_N	Reset signal (Active Low)	Mezz Reset	100
Mezz_PRES_N	Mezzanine Present signal (active Low)	Present indication	98
P12V	12V power	Power	115, 116, 117, 118, 119, 120
P3V3	3.3V Power	power	5, 6, 7, 8, 9, 10
P5V	5V power	power	1, 2
P3V3AUX	Auxiliary power	Aux power	13, 14, 15, 16
Rsvd	Reserved pins	Future use	29, 31, 106, 108, 109, 111, 112, 113, 114
GND	Ground		3, 4, 11, 12, 27, 30, 32, 33, 35, 38, 40, 41, 43, 46, 48, 49, 51, 54, 56, 57,59, 62, 64, 65, 67, 70, 72, 73, 75, 78, 80, 81, 83, 86, 88, 89, 91, 94, 96, 97, 99, 102, 104, 105, 107, 110

Table 20. 40-pin I/O Mezzanine Card Connector Pin-out

Signal Name	Connector Location	Signal Name	Connector Location
TP	1	GND	2
RMII_IBMC_IOMEZZ _CRS_DV	3	XE_B1_TXP	4
GND	5	XE_B1_TXN	6
XE_B1_RXP	7	GND	8
XE_B1_RXN	9	GND	10
GND	11	XE_B2_TXP	12
GND	13	XE_B2_TXN	14
XE_B2_RXP	15	GND	16
XE_B2_RXN	17	GND	18
GND	19	XE_D2_TXP	20
GND	21	XE_D2_TXN	22
XE_D1_RXP	23	GND	24
XE_D1_RXN	25	GND	26
GND	27	XE_D1_TXP	28
GND	29	XE_D1_TXN	30
XE_D2_RXP	31	GND	32
XE_D2_RXN	33	RMII_IBMC_IOME ZZ_TX_EN	34
GND	35	RMII_IBMC_IOME ZZ_TXD1	36
RMII_IBMC_IOMEZZ _RXD1	37	RMII_IBMC_IOME ZZ_TXD0	38
RMII_IBMC_IOMEZZ _RXD0	39	CLK_IOMEZZ_RMI I	40

5.3.3 Midplane Signal Connector

The compute module connects to the midplane through a 96-pin Airmax* connector (J3A1) (power is J1A1) to connect the various I/O, management, and control signals of the system.

Table 21. 96-pin Midplane Signal Connector Pin-out

Pin	Signal Name	Pin	Signal Name	Pin	Signal Name
A1	XE_P1_A_RXP	E1	XE_P2_D_RXN	I1	GND
A2	GND	E2	XE_P2_D_TXP	I2	SAS_P1_TXN
A3	XE_P1_B_RXP	E3	SMB_SDA_B	I3	GND
A4	GND	E4	FM_BL_X_SP	I4	XE_P2_C_TXN
A5	XE_P1_C_RXP	E5	XE_P2_B_RXN	I5	GND
A6	GND	E6	XE_P2_B_TXP	I6	SAS_P2_TXN
A7	XE_P1_D_RXP	E7	XE_P2_A_RXN	I7	GND
A8	GND	E8	XE_P2_A_TXP	I8	Fm_bl_slot_id5
B1	XE_P1_A_RXN	F1	GND	J1	SMB_SCL_A
B2	XE_P1_A_TXP	F2	XE_P2_D_TXN	J2	GND
B3	XE_P1_B_RXN	F3	GND	J3	FM_BL_SLOT_ID2

Pin	Signal Name	Pin	Signal Name	Pin	Signal Name
B4	XE_P1_B_TXP	F4	12V (BL_PWR_ON)	J4	GND
B5	XE_P1_C_RXN	F5	GND	J5	reserved
B6	XE_P1_C_TXP	F6	XE_P2_B_TXN	J6	GND
B7	XE_P1_D_RXN	F7	GND	J7	reserved
B8	XE_P1_D_TXP	F8	XE_P2_A_TXN	J8	GND
C1	GND	G1	SAS_P1_RXP	K1	SMB_SDA_A
C2	XE_P1_A_TXN	G2	GND	K2	FM_BL_SLOT_ID0
C3	GND	G3	XE_P2_C_RXP	K3	FM_BL_SLOT_ID3
C4	XE_P1_B_TXN	G4	GND	K4	FM_BL_SLOT_ID4
C5	GND	G5	SAS_P2_RXP	K5	reserved
C6	XE_P1_C_TXN	G6	GND	K6	reserved
C7	GND	G7	spare	K7	reserved
C8	XE_P1_D_TXN	G8	GND	K8	reserved
D1	XE_P2_D_RXP	H1	SAS_P1_RXN	L1	GND
D2	GND	H2	SAS_P1_TXP	L2	FM_BL_SLOT_ID1
D3	SMB_SCL_B	H3	XE_P2_C_RXN	L3	GND
D4	GND	H4	XE_P2_C_TXP	L4	FM_BL_PRES_N
D5	XE_P2_B_RXP	H5	SAS_P2_RXN	L5	GND
D6	GND	H6	SAS_P2_TXP	L6	reserved
D7	XE_P2_A_RXP	H7	spare	L7	GND
D8	GND	H8	spare	L8	reserved

5.3.4 Serial Port Connector

The compute module provides one internal 9-pin Serial port header (J4K1). The following table defines the pin-out.

Table 22. Internal 9-pin Serial Header Pin-out (J4K1)

Pin	Signal Name	Description
1	SPA_DCD	DCD (carrier detect)
2	SPA_DSR	DSR (data set ready)
3	SPA_SIN_L	RXD (receive data)
4	SPA_RTS	RTS (request to send)
5	SPA_SOUT_N	TXD (transmit data)
6	SPA_CTS	CTS (clear to send)
7	SPA_DTR	DTR (data terminal ready)
8	SPA_RI	RI (ring Indicate)
9	GND	Ground

5.3.5 USB 2.0 Connectors

The following table details the pin-out of the external USB connectors (J1K2, J1K3) found on the front edge of the compute module.

Table 23. External USB Connector Pin-out

Pin	Signal Name	Description
1	+5V	USB_PWR
2	USB_N	Differential data line paired with DATAH0
3	USB_P	(Differential data line paired with DATAL0
4	GND	Ground

5.3.6 Low Profile eUSB SSD Support

The system provides support for a low profile eUSB SSD storage device through a 2mm 2x5-pin connector (J1K1). The pin-out of the connector is detailed in the following table.

Table 24. Pin-out of Internal USB Connector for low-profile Solid State Drive (J1K1)

Pin	Signal Name	Pin	Signal Name
1	+5V	2	NC
3	USB_N	4	NC
5	USB_P	6	NC
7	GND	8	NC
9	Key Pin	10	LED#

eUSB features include:

- Two wire small form factor Universal Serial Bus 2.0 (Hi-Speed USB) interface to host.
- Read Speed up to 35 MB/s and write Speed up to 24 MB/s.
- Capacity range from 256GB to 32GB.
- Support USB Mass Storage Class requirements for Boot capability.

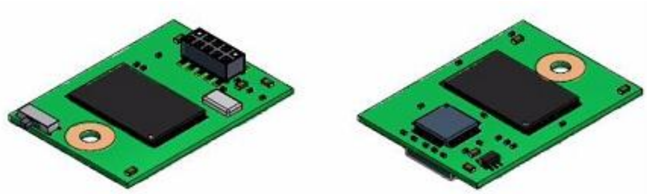


Figure 8. eUSB SSD Support

6. Jumper Block Settings

The compute module has several 3-pin jumper blocks that can be used to configure, protect, or recover specific features of the server board. Pin 1 on each jumper block is denoted by an "*" or "▼".

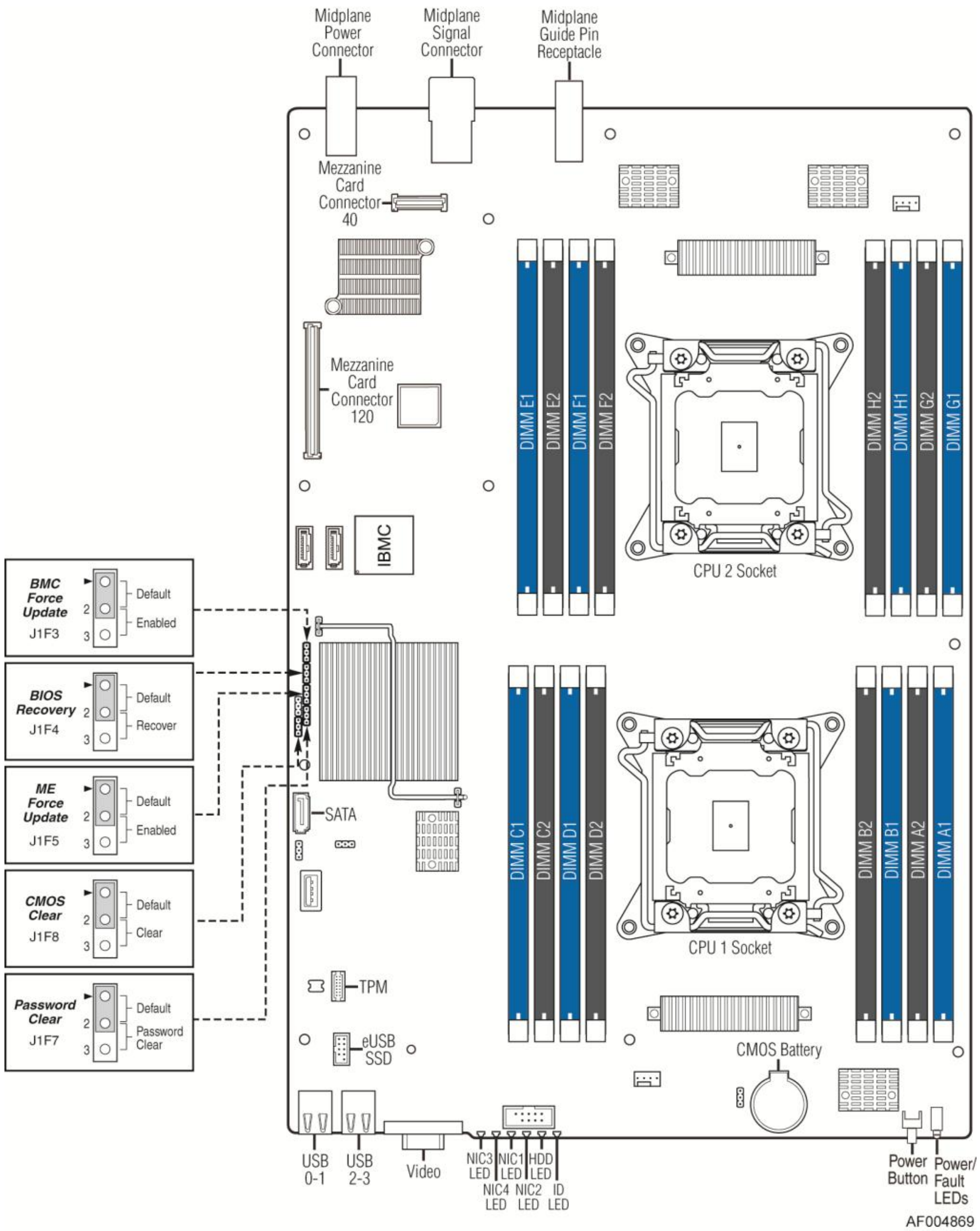


Figure 9. Recovery Jumper Blocks

Table 25. Recovery Jumpers

Jumper Name	Pins	What happens at system reset ...
J1F3: BMC Force Update	**1-2**	BMC Firmware Force Update Mode – Disabled **(Default)**
	2-3	BMC Firmware Force Update Mode – Enabled
J1F4: BIOS	**1-2**	These pins should have a jumper in place for normal operation. **(Default)**
	2-3	If these pins are jumpered, the compute module boots from the emergency BIOS image. These pins should **not** be jumpered for normal operation.
J1F5: ME Force	**1-2**	ME Firmware Force Update Mode – Disabled **(Default)**
	2-3	ME Firmware Force Update Mode – Enabled
J1F8: CMOS Clear	**1-2**	These pins should have a jumper in place for normal operation. **(Default)**
	2-3	If these pins are jumpered, the CMOS settings are cleared on the next boot. These pins should **not** be jumpered for normal operation
J1F9: Password	**1-2**	These pins should have a jumper in place for normal operation. **(Default)**
	2-3	To clear administrator and user passwords, power on the system with pins 2-3 connected. The administrator and user passwords clear in 5-10 seconds after power on. Pins 2-3 should not be connected for normal system operation..

6.1 CMOS Clear and Password Clear Usage Procedure

The CMOS Clear (J1F8) and Password Clear (J1F9) recovery features are designed such that the desired operation can be achieved with minimal system downtime. The usage procedure for these two features has changed from previous generation Intel® server boards. The following procedure outlines the new usage model.

1. Power down the compute module.
2. Remove the compute module from the modular server chassis.
3. Open the compute module.
4. Move jumper from the default operating position (pins 1-2) to the Clear position (pins 2-3).
5. Wait 5 seconds.
6. Move jumper back to the default position (pins 1-2).
7. Close the compute module.
8. Reinstall the compute module in the modular server chassis.
9. Power up the compute module.

Password and/or CMOS are now cleared and can be reset by going into the BIOS setup.

6.2 Integrated BMC Force Update Procedure

When performing a standard Integrated BMC firmware update procedure, the update utility places the Integrated BMC into an update mode, allowing the firmware to load safely onto the flash device. In the unlikely event that the Integrated BMC firmware update process fails due to the Integrated BMC not being in the proper update state, the compute module provides a BMC Force Update jumper (J1F3), which will force the Integrated BMC into the proper update state. The following procedure should be followed in the event the standard Integrated BMC firmware update process fails.

1. Power down the compute module.
2. Remove the compute module from the modular server chassis.
3. Open the compute module.
4. Move jumper from the default operating position (pins 1-2) to the “Enabled” position (pins 2-3)
5. Close the compute module.
6. Reinstall and power up the compute module.
7. Perform Integrated BMC firmware update procedure.
8. Power down the compute module.
9. Remove the compute module from the server system.
10. Move jumper from the “Enabled” position (pins 2-3) to the “Disabled” position (pins 1-2).
11. Close the compute module.
12. Reinstall the compute module into the modular server chassis.
13. Power up the compute module.

Note: Normal Integrated BMC functionality (for example, KVM, monitoring, and remote media) is disabled with the force BMC update jumper set to the “Enabled” position. The server should never be run with the BMC force update jumper set in this position and should only be used when the standard firmware update process fails. This jumper should remain in the default – disabled position when the server is running normally.

6.3 Integrated BMC Initialization

When the DC power is first applied to the compute module by installing it into a chassis, 5V-STBY is present, the Integrated BMC on the compute module requires 15-30 seconds to initialize. During this time, the power button functionality of the control panel is disabled, preventing the compute module from powering up.

6.4 ME Force Update Jumper

When performing the standard ME force update procedure, the update utility places the ME into an update mode, allowing the ME to load safely onto the flash device. In the unlikely event ME firmware update process fails due to ME not being in the proper update state, the compute module provides an Integrated BMC Force Update jumper, which forces the ME into the proper update state. The following procedure should be completed in the event the standard ME firmware update process fails.

1. Power down and remove the compute module from chassis.
2. Open the compute module enclosure
3. Move jumper from the default operating position (covering pins 1 and 2) to the enabled position (covering pins 2 and 3).
4. Close the compute module enclosure.
5. Reinsert the compute module and power up.
6. Perform the ME firmware update procedure as documented in the README.TXT file that is included in the given ME firmware update package (same package as BIOS).
7. Power down and remove the compute module.
8. Open the compute module enclosure.
9. Move jumper from the enabled position (covering pins 2 and 3) to the disabled position (covering pins 1 and 2).
10. Close the compute module enclosure.
11. Reinsert the compute module and power up.

6.5 BIOS Recovery Jumper

The following procedure boots the recovery BIOS and flashes the normal BIOS:

1. Turn off the system power.
2. Move the BIOS recovery jumper to the recovery state.
3. Insert a bootable BIOS recovery media containing the new BIOS image files.
4. Turn on the system power.

The BIOS POST screen will appear displaying the progress, and the system will boot to the EFI shell. The EFI shell then executes the Startup.nsh batch file to start the flash update process. The user should then switch off the power and return the recovery jumper to its normal position. The user should not interrupt the BIOS POST on the first boot after recovery.

When the flash update completes:

1. Remove the recovery media.
2. Turn off the system power.
3. Restore the jumper to its original position.
4. Turn on the system power.
5. Re-flash any custom blocks, such as user binary or language blocks.

The system should now boot using the updated system BIOS.

7. Product Regulatory Requirements

7.1 Product Regulatory Requirements

The Intel® Compute Module MFS2600KI is evaluated as part of the Intel® Modular Server System MFSYS25V2, which requires meeting all applicable system component regulatory requirements. Refer to the *Intel® Modular Server System Technical Product Specification* for a complete listing of all system and component regulatory requirements.

7.2 Product Regulatory Compliance and Safety Markings

No markings are required on the Intel® Compute Module MFS2600KI itself as it is evaluated as part of the Intel® Modular Server System MFSYS25V2.

7.3 Product Environmental/Ecology Requirements

The Intel® Compute Module MFS2600KI is evaluated as part of the Intel® Modular Server System MFSYS25V2, which requires meeting all applicable system component environmental and ecology requirements. For a complete listing of all system and component environment and ecology requirements and markings, refer to the *Intel® Modular Server System Technical Product Specification*.

Appendix A: Integration and Usage Tips

- When two processors are installed, both must be of identical revision, core voltage, and bus/core speed. Mixed processor steppings are supported as long as they are listed in the processor specification updates published by Intel Corporation. However, the stepping of one processor cannot be greater than one stepping back of the other.
- This server board supports The Intel® Xeon® Processor E5-2600 product family with a Thermal Design Power (TDP) of up to and including 95 Watts. Previous generations of the Intel® Xeon® processors are not supported.
- Processors must be installed in order. CPU 1 must be populated for the Compute Module to operate.
- On the front edge of the Compute Module are eight diagnostic LEDs that display a sequence of amber POST codes during the boot process. If the server board hangs during POST, the LEDs display the last POST event run before the hang.
- This server board only supports registered DDR3 DIMMs (RDIMMs) and unbuffered DDR3 DIMMs (UDIMMs). Mixing of RDIMMs and UDIMMs is not supported.
- For the best performance, the number of DDR3 DIMMs installed should be balanced across both processor sockets and memory channels. For example, a two-DIMM configuration performs better than a one-DIMM configuration. In a two-DIMM configuration, DIMMs should be installed in DIMM sockets A1 and E1. An eight-DIMM configuration (DIMM sockets A1, B1, C1, D1, E1, F1, G1, and H1) performs better than a four-DIMM configuration (DIMM sockets A1, B1, C1, and D1).
- Normal Integrated BMC functionality (for example, KVM, monitoring, and remote media) is disabled with the BMC Force Update jumper set to the “enabled” position (pins 2-3). The Compute Module should never be run with the BMC Force Update jumper set in this position and should only be used when the standard firmware update process fails. This jumper should remain in the default (disabled) position (pins 1-2) when the server is running normally.
- When performing a normal BIOS update procedure, the BIOS recovery jumper must be set to its default position (pins 1-2).

Appendix B: POST Code Diagnostic LED Decoder

During the system boot process, the BIOS executes a number of platform configuration processes, each of which is assigned a specific hex POST code number. As each configuration routine is started, the BIOS displays the POST code to the POST Code Diagnostic LEDs on the back edge of the server board. To assist in troubleshooting a system hang during the POST process, the Diagnostic LEDs can be used to identify the last POST process that was executed.

Each POST code is represented by a sequence of eight amber diagnostic LEDs. The POST codes are divided into two nibbles, an upper nibble and a lower nibble. The upper nibble bits are represented by diagnostic LEDs #4, #5, #6, and #7. The lower nibble bits are represented by diagnostics LEDs #0, #1, #2, and #3. If the bit is set in the upper and lower nibbles, then the corresponding LED is lit. If the bit is clear, then the corresponding LED is off.

The diagnostic LED #7 is labeled as “MSB”, and the diagnostic LED #0 is labeled as “LSB”.

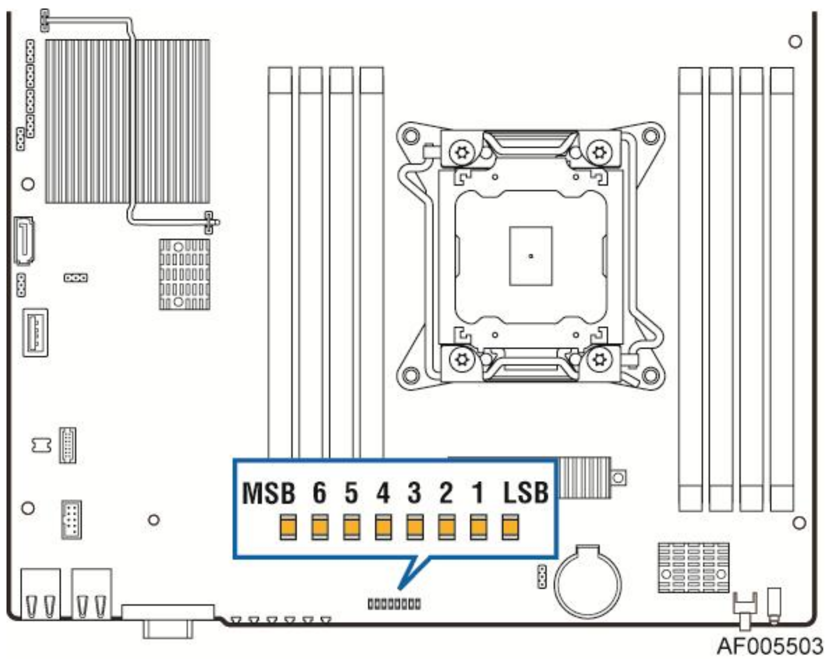


Figure 10. POST Code Diagnostic LED Decoder

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

Table 26. POST Progress Code LED Example

LEDs	Upper Nibble AMBER LEDs				Lower Nibble GREEN LEDs			
	MSB							LSB
	LED #7	LED #6	LED #5	LED #4	LED #3	LED #2	LED #1	LED #0
	8h	4h	2h	1h	8h	4h	2h	1h
Status	ON	OFF	ON	OFF	ON	ON	OFF	OFF
Results	1	0	1	0	1	1	0	0
	Ah				Ch			

Upper nibble bits = 1010b = Ah; Lower nibble bits = 1100b = Ch; the two are concatenated as ACh

The following table provides a list of all POST progress codes.

Table 27. POST Progress Codes

Checkpoint	Diagnostic LED Decoder 1 = LED On, 0 = LED Off								Description
	Upper Nibble				Lower Nibble				
	MSB							LSB	
	8h	4h	2h	1h	8h	4h	2h	1h	
LED #	#7	#6	#5	#4	#3	#2	#1	#0	
SEC Phase									
01h	0	0	0	0	0	0	0	1	First POST code after CPU reset
02h	0	0	0	0	0	0	1	0	Microcode load begin
03h	0	0	0	0	0	0	1	1	CRAM initialization begin
04h	0	0	0	0	0	1	0	0	Pei Cache When Disabled
05h	0	0	0	0	0	1	0	1	SEC Core At Power On Begin.
06h	0	0	0	0	0	1	1	0	Early CPU initialization during Sec Phase.
07h	0	0	0	0	0	1	1	1	Early SB initialization during Sec Phase.
08h	0	0	0	0	1	0	0	0	Early NB initialization during Sec Phase.
09h	0	0	0	0	1	0	0	1	End Of Sec Phase.
0Eh	0	0	0	0	1	1	1	0	Microcode Not Found.
0Fh	0	0	0	0	1	1	1	1	Microcode Not Loaded.
PEI Phase									
10h	0	0	0	1	0	0	0	0	PEI Core
11h	0	0	0	1	0	0	0	1	CPU PEIM
15h	0	0	0	1	0	1	0	1	NB PEIM
19h	0	0	0	1	1	0	0	1	SB PEIM
MRC Process Codes – MRC Progress Code Sequence is executed - See Table 28									
PEI Phase continued…									
31h	0	0	1	1	0	0	0	1	Memory Installed
32h	0	0	1	1	0	0	1	0	CPU PEIM (Cpu Init)
33h	0	0	1	1	0	0	1	1	CPU PEIM (Cache Init)
34h	0	0	1	1	0	1	0	0	CPU PEIM (BSP Select)
35h	0	0	1	1	0	1	0	1	CPU PEIM (AP Init)
36h	0	0	1	1	0	1	1	0	CPU PEIM (CPU SMM Init)
4Fh	0	1	0	0	1	1	1	1	Dxe IPL started
DXE Phase									
60h	0	1	1	0	0	0	0	0	DXE Core started
61h	0	1	1	0	0	0	0	1	DXE NVRAM Init
62h	0	1	1	0	0	0	1	0	SB RUN Init
63h	0	1	1	0	0	0	1	1	Dxe CPU Init
68h	0	1	1	0	1	0	0	0	DXE PCI Host Bridge Init
69h	0	1	1	0	1	0	0	1	DXE NB Init
6Ah	0	1	1	0	1	0	1	0	DXE NB SMM Init
70h	0	1	1	1	0	0	0	0	DXE SB Init
71h	0	1	1	1	0	0	0	1	DXE SB SMM Init
72h	0	1	1	1	0	0	1	0	DXE SB devices Init
78h	0	1	1	1	1	0	0	0	DXE ACPI Init
79h	0	1	1	1	1	0	0	1	DXE CSM Init
90h	1	0	0	1	0	0	0	0	DXE BDS Started
91h	1	0	0	1	0	0	0	1	DXE BDS connect drivers
92h	1	0	0	1	0	0	1	0	DXE PCI Bus begin
93h	1	0	0	1	0	0	1	1	DXE PCI Bus HPC Init
94h	1	0	0	1	0	1	0	0	DXE PCI Bus enumeration

Checkpoint	Diagnostic LED Decoder 1 = LED On, 0 = LED Off								Description
	Upper Nibble				Lower Nibble				
	MSB							LSB	
	8h	4h	2h	1h	8h	4h	2h	1h	
LED #	#7	#6	#5	#4	#3	#2	#1	#0	
95h	1	0	0	1	0	1	0	1	DXE PCI Bus resource requested
96h	1	0	0	1	0	1	1	0	DXE PCI Bus assign resource
97h	1	0	0	1	0	1	1	1	DXE CON_OUT connect
98h	1	0	0	1	1	0	0	0	DXE CON_IN connect
99h	1	0	0	1	1	0	0	1	DXE SIO Init
9Ah	1	0	0	1	1	0	1	0	DXE USB start
9Bh	1	0	0	1	1	0	1	1	DXE USB reset
9Ch	1	0	0	1	1	1	0	0	DXE USB detect
9Dh	1	0	0	1	1	1	0	1	DXE USB enable
A1h	1	0	1	0	0	0	0	1	DXE IDE begin
A2h	1	0	1	0	0	0	1	0	DXE IDE reset
A3h	1	0	1	0	0	0	1	1	DXE IDE detect
A4h	1	0	1	0	0	1	0	0	DXE IDE enable
A5h	1	0	1	0	0	1	0	1	DXE SCSI begin
A6h	1	0	1	0	0	1	1	0	DXE SCSI reset
A7h	1	0	1	0	0	1	1	1	DXE SCSI detect
A8h	1	0	1	0	1	0	0	0	DXE SCSI enable
A9h	1	0	1	0	1	0	0	1	DXE verifying SETUP password
ABh	1	0	1	0	1	0	1	1	DXE SETUP start
ACh	1	0	1	0	1	1	0	0	DXE SETUP input wait
ADh	1	0	1	0	1	1	0	1	DXE Ready to Boot
AEh	1	0	1	0	1	1	1	0	DXE Legacy Boot
AFh	1	0	1	0	1	1	1	1	DXE Exit Boot Services
B0h	1	0	1	1	0	0	0	0	RT Set Virtual Address Map Begin
B1h	1	0	1	1	0	0	0	1	RT Set Virtual Address Map End
B2h	1	0	1	1	0	0	1	0	DXE Legacy Option ROM init
B3h	1	0	1	1	0	0	1	1	DXE Reset system
B4h	1	0	1	1	0	1	0	0	DXE USB Hot plug
B5h	1	0	1	1	0	1	0	1	DXE PCI BUS Hot plug
B6h	1	0	1	1	0	1	1	0	DXE NVRAM cleanup
B7h	1	0	1	1	0	1	1	1	DXE Configuration Reset
00h	0	0	0	0	0	0	0	0	INT19
S3 Resume									
E0h	1	1	0	1	0	0	0	0	S3 Resume PEIM (S3 started)
E1h	1	1	0	1	0	0	0	1	S3 Resume PEIM (S3 boot script)
E2h	1	1	0	1	0	0	1	0	S3 Resume PEIM (S3 Video Repost)
E3h	1	1	0	1	0	0	1	1	S3 Resume PEIM (S3 OS wake)
BIOS Recovery									
F0h	1	1	1	1	0	0	0	0	PEIM which detected forced Recovery condition
F1h	1	1	1	1	0	0	0	1	PEIM which detected User Recovery condition
F2h	1	1	1	1	0	0	1	0	Recovery PEIM (Recovery started)
F3h	1	1	1	1	0	0	1	1	Recovery PEIM (Capsule found)
F4h	1	1	1	1	0	1	0	0	Recovery PEIM (Capsule loaded)

POST Memory Initialization MRC Diagnostic Codes

There are two types of POST Diagnostic Codes displayed by the MRC during memory initialization; Progress Codes and Fatal Error Codes.

The MRC Progress Codes are displays to the Diagnostic LEDs that show the execution point in the MRC operational path at each step.

Table 28. MRC Progress Codes

Checkpoint	Diagnostic LED Decoder 1 = LED On, 0 = LED Off								Description
	Upper Nibble				Lower Nibble				
	MSB							LSB	
	8h	4h	2h	1h	8h	4h	2h	1h	
LED	#7	#6	#5	#4	#3	#2	#1	#0	
MRC Progress Codes									
B0h	1	0	1	1	0	0	0	0	Detect DIMM population
B1h	1	0	1	1	0	0	0	1	Set DDR3 frequency
B2h	1	0	1	1	0	0	1	0	Gather remaining SPD data
B3h	1	0	1	1	0	0	1	1	Program registers on the memory controller level
B4h	1	0	1	1	0	1	0	0	Evaluate RAS modes and save rank information
B5h	1	0	1	1	0	1	0	1	Program registers on the channel level
B6h	1	0	1	1	0	1	1	0	Perform the JEDEC defined initialization sequence
B7h	1	0	1	1	0	1	1	1	Train DDR3 ranks
B8h	1	0	1	1	1	0	0	0	Initialize CLTT/OLTT
B9h	1	0	1	1	1	0	0	1	Hardware memory test and init
BAh	1	0	1	1	1	0	1	0	Execute software memory init
BBh	1	0	1	1	1	0	1	1	Program memory map and interleaving
BCh	1	0	1	1	1	1	0	0	Program RAS configuration
BFh	1	0	1	1	1	1	1	1	MRC is done

Memory Initialization at the beginning of POST includes multiple functions, including: discovery, channel training, validation that the DIMM population is acceptable and functional, initialization of the IMC and other hardware settings, and initialization of applicable RAS configurations.

When a major memory initialization error occurs and prevents the system from booting with data integrity, a beep code is generated, the MRC will display a fatal error code on the diagnostic LEDs, and a system halt command is executed. Fatal MRC error halts do NOT change the state of the System Status LED, and they do NOT get logged as SEL events. The following table lists all MRC fatal errors that are displayed to the Diagnostic LEDs.

Table 29. MRC Fatal Error Codes

Checkpoint	Diagnostic LED Decoder 1 = LED On, 0 = LED Off								Description
	Upper Nibble				Lower Nibble				
	MSB							LSB	
	8h	4h	2h	1h	8h	4h	2h	1h	
LED	#7	#6	#5	#4	#3	#2	#1	#0	
MRC Fatal Error Codes									
E8h	1	1	1	0	1	0	0	0	No usable memory error
E9h	1	1	1	0	1	0	0	1	Memory is locked by Intel® Trusted Executiton Technology and is inaccessible
EAh	1	1	1	0	1	0	1	0	DDR3 channel training error

Checkpoint	Diagnostic LED Decoder 1 = LED On, 0 = LED Off								Description
	Upper Nibble				Lower Nibble				
	MSB							LSB	
	8h	4h	2h	1h	8h	4h	2h	1h	
LED	#7	#6	#5	#4	#3	#2	#1	#0	
EBh	1	1	1	0	1	0	1	1	Memory test failure
EDh	1	1	1	0	1	1	0	1	DIMM configuration population error
EFh	1	1	1	0	1	1	1	1	Indicates a CLTT table structure error

Appendix C: POST Error Code

Most error conditions encountered during POST are reported using POST Error Codes. These codes represent specific failures, warnings, or informational messages that are identified with particular hardware units. These POST Error Codes may be displayed in the Error Manager display screen, and are always automatically logged to the System Event Log (SEL). The table below lists the supported POST Error Codes, with a descriptive Error Message text. For each, There is also a Response listed, which classifies the error as Minor, Major, or Fatal depending on how serious the error is and what action the system should take. The Response section in the following table indicates one of these actions:

- **Minor:** The message is displayed on the screen or on the Error Manager screen, and an error is logged to the SEL. The system continues booting in a degraded state. The user may want to replace the erroneous unit. The POST Error Pause option setting in the BIOS setup does not have any effect on this error.
- **Major:** The message is displayed on the Error Manager screen, and an error is logged to the SEL. The POST Error Pause option setting in the BIOS setup determines whether the system pauses to the Error Manager for this type of error so the user can take immediate corrective action or the system continues booting.
- **Fatal:** The system halts during post at a blank screen with the text **"Unrecoverable fatal error found. System will not boot until the error is resolved"** and **"Press <F2> to enter setup"** The POST Error Pause option setting in the BIOS setup does not have any effect with this class of error.

Table 30. POST Error Codes and Messages

Error Code	Error Message	Response
0012	System RTC date/time not set	Major
0048	Password check failed	Major
0140	PCI component encountered a PERR error	Major
0141	PCI resource conflict	Major
0146	PCI out of resources error	Major
0191	Processor core/thread count mismatch detected	Fatal
0192	Processor cache size mismatch detected	Fatal
0194	Processor family mismatch detected	Fatal
0195	Processor Intel® QPI link frequencies unable to synchronize	Fatal
0196	Processor model mismatch detected	Fatal
0197	Processor frequencies unable to synchronize	Fatal
5220	BIOS Settings reset to default settings	Major
5221	Passwords cleared by jumper	Major
5224	Password clear jumper is Set	Major
8130	Processor 01 disabled	Major
8131	Processor 02 disabled	Major
8132	Processor 03 disabled	Major
8133	Processor 04 disabled	Major
8160	Processor 01 unable to apply microcode update	Major
8161	Processor 02 unable to apply microcode update	Major
8162	Processor 03 unable to apply microcode update	Major

Error Code	Error Message	Response
8163	Processor 04 unable to apply microcode update	Major
8170	Processor 01 failed Self Test (BIST)	Major
8171	Processor 02 failed Self Test (BIST)	Major
8172	Processor 03 failed Self Test (BIST)	Major
8173	Processor 04 failed Self Test (BIST)	Major
8180	Processor 01 microcode update not found	Minor
8181	Processor 02 microcode update not found	Minor
8182	Processor 03 microcode update not found	Minor
8183	Processor 04 microcode update not found	Minor
8190	Watchdog timer failed on last boot	Major
8198	OS boot watchdog timer failure	Major
8300	Baseboard management controller failed self-test	Major
8305	Hot Swap Controller failure	Major
83A0	Management Engine (ME) failed Selftest	Major
83A1	Management Engine (ME) Failed to respond.	Major
84F2	Baseboard management controller failed to respond	Major
84F3	Baseboard management controller in update mode	Major
84F4	Sensor data record empty	Major
84FF	System event log full	Minor
8500	Memory component could not be configured in the selected RAS mode	Major
8501	DIMM Population Error	Major
8520	DIMM_A1 failed test/initialization	Major
8521	DIMM_A2 failed test/initialization	Major
8522	DIMM_A3 failed test/initialization	Major
8523	DIMM_B1 failed test/initialization	Major
8524	DIMM_B2 failed test/initialization	Major
8525	DIMM_B3 failed test/initialization	Major
8526	DIMM_C1 failed test/initialization	Major
8527	DIMM_C2 failed test/initialization	Major
8528	DIMM_C3 failed test/initialization	Major
8529	DIMM_D1 failed test/initialization	Major
852A	DIMM_D2 failed test/initialization	Major
852B	DIMM_D3 failed test/initialization	Major
852C	DIMM_E1 failed test/initialization	Major
852D	DIMM_E2 failed test/initialization	Major
852E	DIMM_E3 failed test/initialization	Major
852F	DIMM_F1 failed test/initialization	Major
8530	DIMM_F2 failed test/initialization	Major
8531	DIMM_F3 failed test/initialization	Major
8532	DIMM_G1 failed test/initialization	Major
8533	DIMM_G2 failed test/initialization	Major
8534	DIMM_G3 failed test/initialization	Major
8535	DIMM_H1 failed test/initialization	Major
8536	DIMM_H2 failed test/initialization	Major
8537	DIMM_H3 failed test/initialization	Major
8538	DIMM_I1 failed test/initialization	Major

Error Code	Error Message	Response
8539	DIMM_I2 failed test/initialization	Major
853A	DIMM_I3 failed test/initialization	Major
853B	DIMM_J1 failed test/initialization	Major
853C	DIMM_J2 failed test/initialization	Major
853D	DIMM_J3 failed test/initialization	Major
853E	DIMM_K1 failed test/initialization	Major
853F (Go to 85C0)	DIMM_K2 failed test/initialization	Major
8540	DIMM_A1 disabled	Major
8541	DIMM_A2 disabled	Major
8542	DIMM_A3 disabled	Major
8543	DIMM_B1 disabled	Major
8544	DIMM_B2 disabled	Major
8545	DIMM_B3 disabled	Major
8546	DIMM_C1 disabled	Major
8547	DIMM_C2 disabled	Major
8548	DIMM_C3 disabled	Major
8549	DIMM_D1 disabled	Major
854A	DIMM_D2 disabled	Major
854B	DIMM_D3 disabled	Major
854C	DIMM_E1 disabled	Major
854D	DIMM_E2 disabled	Major
854E	DIMM_E3 disabled	Major
854F	DIMM_F1 disabled	Major
8550	DIMM_F2 disabled	Major
8551	DIMM_F3 disabled	Major
8552	DIMM_G1 disabled	Major
8553	DIMM_G2 disabled	Major
8554	DIMM_G3 disabled	Major
8555	DIMM_H1 disabled	Major
8556	DIMM_H2 disabled	Major
8557	DIMM_H3 disabled	Major
8558	DIMM_I1 disabled	Major
8559	DIMM_I2 disabled	Major
855A	DIMM_I3 disabled	Major
855B	DIMM_J1 disabled	Major
855C	DIMM_J2 disabled	Major
855D	DIMM_J3 disabled	Major
855E	DIMM_K1 disabled	Major
855F (Go to 85D0)	DIMM_K2 disabled	Major
8560	DIMM_A1 encountered a Serial Presence Detection (SPD) failure	Major
8561	DIMM_A2 encountered a Serial Presence Detection (SPD) failure	Major
8562	DIMM_A3 encountered a Serial Presence Detection (SPD) failure	Major
8563	DIMM_B1 encountered a Serial Presence Detection (SPD) failure	Major

Error Code	Error Message	Response
8564	DIMM_B2 encountered a Serial Presence Detection (SPD) failure	Major
8565	DIMM_B3 encountered a Serial Presence Detection (SPD) failure	Major
8566	DIMM_C1 encountered a Serial Presence Detection (SPD) failure	Major
8567	DIMM_C2 encountered a Serial Presence Detection (SPD) failure	Major
8568	DIMM_C3 encountered a Serial Presence Detection (SPD) failure	Major
8569	DIMM_D1 encountered a Serial Presence Detection (SPD) failure	Major
856A	DIMM_D2 encountered a Serial Presence Detection (SPD) failure	Major
856B	DIMM_D3 encountered a Serial Presence Detection (SPD) failure	Major
856C	DIMM_E1 encountered a Serial Presence Detection (SPD) failure	Major
856D	DIMM_E2 encountered a Serial Presence Detection (SPD) failure	Major
856E	DIMM_E3 encountered a Serial Presence Detection (SPD) failure	Major
856F	DIMM_F1 encountered a Serial Presence Detection (SPD) failure	Major
8570	DIMM_F2 encountered a Serial Presence Detection (SPD) failure	Major
8571	DIMM_F3 encountered a Serial Presence Detection (SPD) failure	Major
8572	DIMM_G1 encountered a Serial Presence Detection (SPD) failure	Major
8573	DIMM_G2 encountered a Serial Presence Detection (SPD) failure	Major
8574	DIMM_G3 encountered a Serial Presence Detection (SPD) failure	Major
8575	DIMM_H1 encountered a Serial Presence Detection (SPD) failure	Major
8576	DIMM_H2 encountered a Serial Presence Detection (SPD) failure	Major
8577	DIMM_H3 encountered a Serial Presence Detection (SPD) failure	Major
8578	DIMM_I1 encountered a Serial Presence Detection (SPD) failure	Major
8579	DIMM_I2 encountered a Serial Presence Detection (SPD) failure	Major
857A	DIMM_I3 encountered a Serial Presence Detection (SPD) failure	Major
857B	DIMM_J1 encountered a Serial Presence Detection (SPD) failure	Major
857C	DIMM_J2 encountered a Serial Presence Detection (SPD) failure	Major
857D	DIMM_J3 encountered a Serial Presence Detection (SPD) failure	Major
857E	DIMM_K1 encountered a Serial Presence Detection (SPD) failure	Major
857F (Go to 85E0)	DIMM_K2 encountered a Serial Presence Detection (SPD) failure	Major
85C0	DIMM_K3 failed test/initialization	Major
85C1	DIMM_L1 failed test/initialization	Major
85C2	DIMM_L2 failed test/initialization	Major
85C3	DIMM_L3 failed test/initialization	Major
85C4	DIMM_M1 failed test/initialization	Major
85C5	DIMM_M2 failed test/initialization	Major
85C6	DIMM_M3 failed test/initialization	Major
85C7	DIMM_N1 failed test/initialization	Major
85C8	DIMM_N2 failed test/initialization	Major
85C9	DIMM_N3 failed test/initialization	Major
85CA	DIMM_O1 failed test/initialization	Major
85CB	DIMM_O2 failed test/initialization	Major
85CC	DIMM_O3 failed test/initialization	Major
85CD	DIMM_P1 failed test/initialization	Major
85CE	DIMM_P2 failed test/initialization	Major
85CF	DIMM_P3 failed test/initialization	Major

Error Code	Error Message	Response
85D0	DIMM_K3 disabled	Major
85D1	DIMM_L1 disabled	Major
85D2	DIMM_L2 disabled	Major
85D3	DIMM_L3 disabled	Major
85D4	DIMM_M1 disabled	Major
85D5	DIMM_M2 disabled	Major
85D6	DIMM_M3 disabled	Major
85D7	DIMM_N1 disabled	Major
85D8	DIMM_N2 disabled	Major
85D9	DIMM_N3 disabled	Major
85DA	DIMM_O1 disabled	Major
85DB	DIMM_O2 disabled	Major
85DC	DIMM_O3 disabled	Major
85DD	DIMM_P1 disabled	Major
85DE	DIMM_P2 disabled	Major
85DF	DIMM_P3 disabled	Major
85E0	DIMM_K3 encountered a Serial Presence Detection (SPD) failure	Major
85E1	DIMM_L1 encountered a Serial Presence Detection (SPD) failure	Major
85E2	DIMM_L2 encountered a Serial Presence Detection (SPD) failure	Major
85E3	DIMM_L3 encountered a Serial Presence Detection (SPD) failure	Major
85E4	DIMM_M1 encountered a Serial Presence Detection (SPD) failure	Major
85E5	DIMM_M2 encountered a Serial Presence Detection (SPD) failure	Major
85E6	DIMM_M3 encountered a Serial Presence Detection (SPD) failure	Major
85E7	DIMM_N1 encountered a Serial Presence Detection (SPD) failure	Major
85E8	DIMM_N2 encountered a Serial Presence Detection (SPD) failure	Major
85E9	DIMM_N3 encountered a Serial Presence Detection (SPD) failure	Major
85EA	DIMM_O1 encountered a Serial Presence Detection (SPD) failure	Major
85EB	DIMM_O2 encountered a Serial Presence Detection (SPD) failure	Major
85EC	DIMM_O3 encountered a Serial Presence Detection (SPD) failure	Major
85ED	DIMM_P1 encountered a Serial Presence Detection (SPD) failure	Major
85EE	DIMM_P2 encountered a Serial Presence Detection (SPD) failure	Major
85EF	DIMM_P3 encountered a Serial Presence Detection (SPD) failure	Major
8604	POST Reclaim of non-critical NVRAM variables	Minor
8605	BIOS Settings are corrupted	Major
92A3	Serial port component was not detected	Major
92A9	Serial port component encountered a resource conflict error	Major
A000	TPM device not detected.	Minor
A001	TPM device missing or not responding.	Minor
A002	TPM device failure.	Minor
A003	TPM device failed self-test.	Minor
A100	BIOS ACM Error	Major
A421	PCI component encountered a SERR error	Fatal
A5A0	PCI Express component encountered a PERR error	Minor
A5A1	PCI Express component encountered an SERR error	Fatal

The following table lists the POST error beep codes. Prior to system video initialization, the BIOS uses these beep codes to inform users on error conditions. The beep code is followed by a user-visible code on the POST Progress LEDs

Table 31. POST Error Beep Codes

Beeps	Error Message	POST Progress Code	Description
3	Memory error	See Table 64	System halted because a fatal error related to the memory was detected.
1 long	Intel® TXT security violation	0xAE, 0xAF	System halted because Intel® Trusted Execution Technology detected a potential violation of system security.

POST Error Beep Code

The Integrated BMC may generate beep codes upon detection of failure conditions. Beep codes are sounded each time the problem is discovered, such as on each power-up attempt, but are not sounded continuously. Codes that are common across all Intel® server boards and systems that use same generation chipset are listed in the following table. Each digit in the code is represented by a sequence of beeps whose count is equal to the digit.

Table 32. Integrated BMC Beep Codes

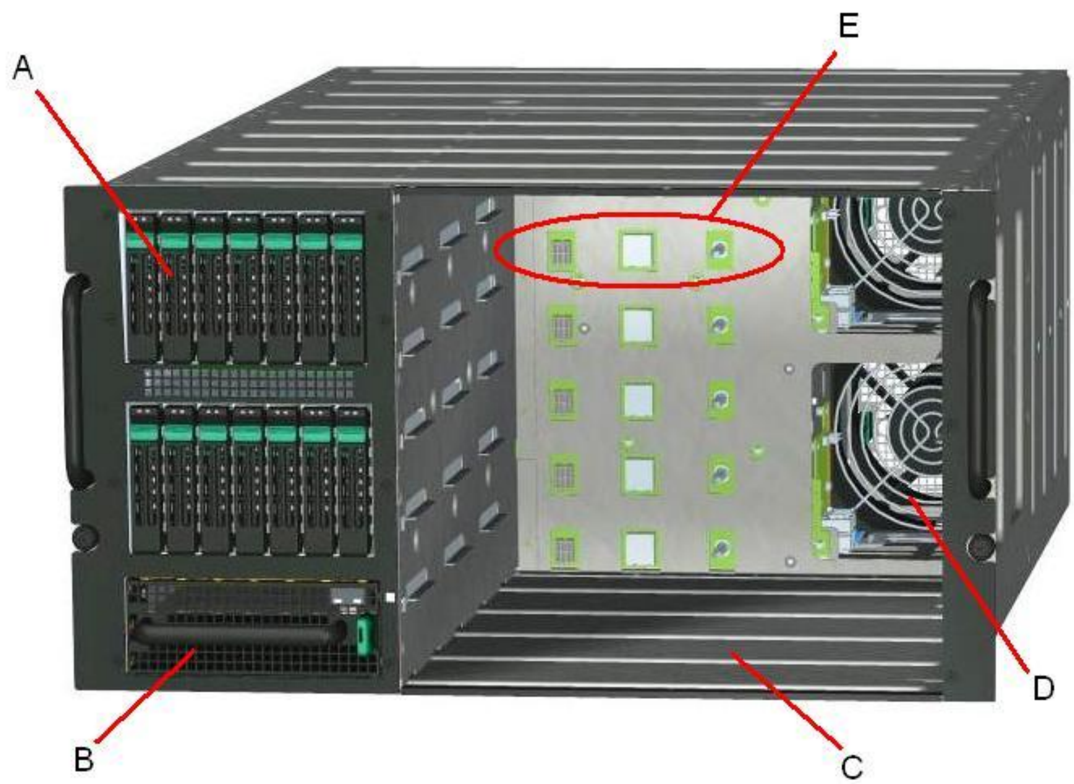
Code	Reason for Beep	Associated Sensors
1-5-2-1	No CPUs installed or first CPU socket is empty.	CPU Missing Sensor
1-5-2-4	MSID Mismatch.	MSID Mismatch Sensor.
1-5-4-2	Power fault: DC power is unexpectedly lost (power good dropout).	Power unit – power unit failure offset.
1-5-4-4	Power control fault (power good assertion timeout).	Power unit – soft power control failure offset.
1-5-1-2	VR Watchdog Timer sensor assertion	VR Watchdog Timer
1-5-1-4	The system does not power on or unexpectedly powers off and a power supply unit (PSU) is present that is an incompatible model with one or more other PSUs in the system	PS Status

Appendix D: Supported Intel® Modular Server System

The Intel® Compute Module MFS5520VI is supported in the following chassis:

- Intel® Modular Server System MFSYS25V2

This section provides a high-level pictorial overview of the *Intel® Modular Server System* MFSYS25V2. For more details, refer to the *Intel® Modular Server System Technical Product Specification (TPS)*.



A	Shared hard drive storage bay
B	I/O cooling fans
C	Empty compute module bay
D	Compute module cooling fans
E	Compute module midplane connectors

Figure 11. Intel® Modular Server System MFSYS25V2

Glossary

This appendix contains important terms used in the preceding chapters. For ease of use, numeric entries are listed first (for example, "82460GX") followed by alpha entries (for example, "AGP 4x"). Acronyms are followed by non-acronyms.

Term	Definition
ACPI	Advanced Configuration and Power Interface
AP	Application Processor
APIC	Advanced Programmable Interrupt Control
ASIC	Application Specific Integrated Circuit
ASMI	Advanced Server Management Interface
BIOS	Basic Input/Output System
BIST	Built-In Self Test
BMC	Baseboard Management Controller
Bridge	Circuitry connecting one computer bus to another, allowing an agent on one to access the other
BSP	Bootstrap Processor
byte	8-bit quantity.
CBC	Chassis Bridge Controller (A microcontroller connected to one or more other CBCs, together they bridge the IPMB buses of multiple chassis.
CEK	Common Enabling Kit
CHAP	Challenge Handshake Authentication Protocol
CMOS	In terms of this specification, this describes the PC-AT compatible region of battery-backed 128 bytes of memory, which normally resides on the server board.
DPC	Direct Platform Control
EEPROM	Electrically Erasable Programmable Read-Only Memory
EHCI	Enhanced Host Controller Interface
EMP	Emergency Management Port
EPS	External Product Specification
ESB2	Enterprise South Bridge 2
FBD	Fully Buffered DIMM
FMB	Flexible Mother Board
FRB	Fault Resilient Booting
FRU	Field Replaceable Unit
FSB	Front-Side Bus
GB	1024MB
GPIO	General Purpose I/O
GTL	Gunning Transceiver Logic
HSC	Hot-Swap Controller
Hz	Hertz (1 cycle/second)
I2C	Inter-Integrated Circuit Bus
IA	Intel® Architecture
IBF	Input Buffer
ICH	I/O Controller Hub
ICMB	Intelligent Chassis Management Bus
IERR	Internal Error

Term	Definition
IFB	I/O and Firmware Bridge
INTR	Interrupt
IP	Internet Protocol
IPMB	Intelligent Platform Management Bus
IPMI	Intelligent Platform Management Interface
IR	Infrared
ITP	In-Target Probe
KB	1024 bytes
KCS	Keyboard Controller Style
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LPC	Low Pin Count
LUN	Logical Unit Number
MAC	Media Access Control
MB	1024KB
MCH	Memory Controller Hub
MD2	Message Digest 2 – Hashing Algorithm
MD5	Message Digest 5 – Hashing Algorithm – Higher Security
ms	milliseconds
MTTR	Memory Type Range Register
Mux	Multiplexor
NIC	Network Interface Controller
NMI	Non-maskable Interrupt
OBF	Output Buffer
OEM	Original Equipment Manufacturer
Ohm	Unit of electrical resistance
PEF	Platform Event Filtering
PEP	Platform Event Paging
PIA	Platform Information Area (This feature configures the firmware for the platform hardware)
PLD	Programmable Logic Device
PMI	Platform Management Interrupt
POST	Power-On Self Test
PSMI	Power Supply Management Interface
PWM	Pulse-Width Modulation
RAM	Random Access Memory
RASUM	Reliability, Availability, Serviceability, Usability, and Manageability
RISC	Reduced Instruction Set Computing
ROM	Read Only Memory
RTC	Real-Time Clock (Component of ICH peripheral chip on the server board)
SDR	Sensor Data Record
SECC	Single Edge Connector Cartridge
SEEPROM	Serial Electrically Erasable Programmable Read-Only Memory
SEL	System Event Log
SIO	Server Input/Output

Term	Definition
SMBus*	System Management Bus
SMI	Server Management Interrupt (SMI is the highest priority non-maskable interrupt)
SMM	Server Management Mode
SMS	Server Management Software
SNMP	Simple Network Management Protocol
TBD	To Be Determined
TIM	Thermal Interface Material
UART	Universal Asynchronous Receiver/Transmitter
UDP	User Datagram Protocol
UHCI	Universal Host Controller Interface
UTC	Universal time coordinate
VID	Voltage Identification
VRD	Voltage Regulator Down
Word	16-bit quantity
ZIF	Zero Insertion Force

Reference Documents

For additional information, refer to the *Intel® Modular Server System Technical Product Specification*.