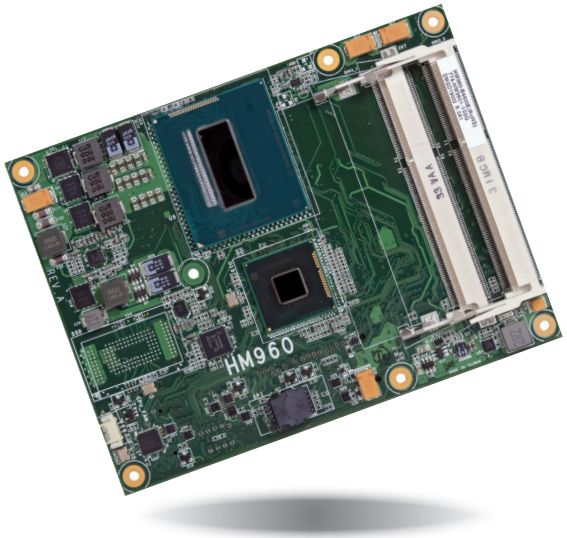
DFI®



HM960-QM87/HM86

COM Express Basic Module
User's Manual

A26830548

Copyright

Trademarks

COM Express Specification Reference

PICMG® COM Express Module™ Base Specification.

http://www.picmg.org/

FCC and DOC Statement on Class B

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio TV technician for help.

Notice:

1. The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
2. Shielded interface cables must be used in order to comply with the emission limits.

Table of Contents

About this Manual

An electronic file of this manual is included in the CD. To view the user's manual in the CD, insert the CD into a CD-ROM drive. The autorun screen (Main Board Utility CD) will appear. Click "User's Manual" on the main menu.

Warranty

1. Warranty does not cover damages or failures that arised from misuse of the product, inability to use the product, unauthorized replacement or alteration of components and product specifications.

2. The warranty is void if the product has been subjected to physical abuse, improper installation, modification, accidents or unauthorized repair of the product.

3. Unless otherwise instructed in this user's manual, the user may not, under any circumstances, attempt to perform service, adjustments or repairs on the product, whether in or out of warranty. It must be returned to the purchase point, factory or authorized service agency for all such work.

4. We will not be liable for any indirect, special, incidental or consequencial damages to the product that has been modified or altered.

Static Electricity Precautions

It is quite easy to inadvertently damage your PC, system board, components or devices even before installing them in your system unit. Static electrical discharge can damage computer components without causing any signs of physical damage. You must take extra care in handling them to ensure against electrostatic build-up.

1. To prevent electrostatic build-up, leave the system board in its anti-static bag until you are ready to install it.

2. Wear an antistatic wrist strap.

3. Do all preparation work on a static-free surface.

4. Hold the device only by its edges. Be careful not to touch any of the components, contacts or connections.

5. Avoid touching the pins or contacts on all modules and connectors. Hold modules or connectors by their ends.

Important:
Electrostatic discharge (ESD) can damage your processor, disk drive and other components. Perform the upgrade instruction procedures described at an ESD workstation only. If such a station is not available, you can provide some ESD protection by wearing an antistatic wrist strap and attaching it to a metal part of the system chassis. If a wrist strap is unavailable, establish and maintain contact with the system chassis throughout any procedures requiring ESD protection.

Safety Measures

To avoid damage to the system:
- Use the correct AC input voltage range.

To reduce the risk of electric shock:
- Unplug the power cord before removing the system chassis cover for installation or servicing. After installation or servicing, cover the system chassis before plugging the power cord.

About the Package

The package contains the following items. If any of these items are missing or damaged, please contact your dealer or sales representative for assistance.

- One HM960 board
- One DVD
- One QR (Quick Reference)
- Heat spreader with heat sink and fan

Optional Items

- COM331-B carrier board kit
- Heat spreader

The board and accessories in the package may not come similar to the information listed above. This may differ in accordance with the sales region or models in which it was sold. For more information about the standard package in your region, please contact your dealer or sales representative.

Before Using the System Board

Before using the system board, prepare basic system components.

If you are installing the system board in a new system, you will need at least the following internal components.

- Memory module
- Storage devices such as hard disk drive, CD-ROM, etc.

You will also need external system peripherals you intend to use which will normally include at least a keyboard, a mouse and a video display monitor.

Chapter 1 - Introduction

Specifications

Processor	HM960-QM87: • 4th generation Intel® Core™ processors 4700EQ: Intel® Core™ i7-4700EQ, 6M Cache, up to 3.4 GHz, 47W 4400E: Intel® Core™ i5-4400E, 3M Cache, up to 3.3 GHz, 37W • BGA 1364 packaging technology • 22nm process technology
	HM960-HM86: • 4th generation Intel® Core™ processors 4400E: Intel® Core™ i5-4400E, 3M Cache, up to 3.3 GHz, 37W 4402E: Intel® Core™ i5-4402E, 3M Cache, up to 2.7 GHz, 25W 4102E: Intel® Core™ i3-4102E, 3M Cache, 1.6 GHz, 25W • BGA 1364 packaging technology • 22nm process technology
Chipset	• Intel® QM87 Express Chipset (HM960-QM87) • Intel® HM86 Express Chipset (HM960-HM86)
System Memory	• Two 204-pin DDR3L SODIMM sockets • Supports DDR3L 1333/1600MHz SODIMM • Supports up to 16GB system memory • DRAM device technologies: 1Gb, 2Gb and 4Gb DDR3L DRAM technologies are supported for x8 and x16 devices, unbuffered, non-ECC
Graphics	• Intel® HD Graphics 4600 • Supports 1 VGA, 1 LVDS and 3 DDI • VGA: resolution up to 2048x1536 @75Hz • LVDS: NXP PTN3460, 24-bit, dual channel, resolution up to 1920x1200 @60Hz • Digital Display Interface: HDMI, DVI and DP • HDMI: resolution up to 4096x2304 @24Hz or 2560x1600 @60Hz • DVI: resolution up to 1920x1200 @60Hz • DP: resolution up to 3840x2160 @60Hz • Intel® Clear Video Technology • Intel® Advanced Vector Extensions (Intel® AVX) Instructions • Supports DirectX 11.1, OpenGL 3.2, OpenCL 1.2
Audio	• Supports High Definition Audio interface
LAN	• Intel® I217LM with iAMT9.0 Gigabit Ethernet Phy (HM960-QM87) • Intel® I217LM Gigabit Ethernet Phy (HM960-HM86) • Integrated 10/100/1000 transceiver • Fully compliant with IEEE 802.3, IEEE 802.3u, IEEE 802.3ab
Serial ATA	HM960-QM87: • Supports 4 SATA 3.0 with data transfer rate up to 6Gb/s • Integrated Advanced Host Controller Interface (AHCI) controller • Supports RAID 0/1/5/10 • Supports Intel® Smart Response Technology
	HM960-HM86: • Supports 2 SATA 3.0, and 2 SATA 2.0 • Supports 2 SATA 3.0, 1 SATA 2.0, and 1 SSD* (optional) • Integrated Advanced Host Controller Interface (AHCI) controller
USB Interface	HM960-QM87: • XHCI Host Controller supports up to 4 super speed USB 3.0 ports
	HM960-HM86: • XHCI Host Controller supports up to 2 super speed USB 3.0 ports
SSD* (optional)	• 2GB/4GB/8GB/16GB/32GB/64GB • Write: 30MB/sec (max), Read: 70MB/sec (max) • SATA to SSD onboard
Expansion Interfaces	HM960-QM87: • Supports 4 USB 3.0 interfaces • Supports 8 USB 2.0 interfaces • Supports 1 PCIe x16 Gen 3 interface • Supports 7 PCIe x1 interfaces • Supports LPC interface • Supports SMBus interface • Supports I^2C interface • Supports 2 serial interfaces (TX/RX) • Supports 4-bit input and 4-bit output GPIO
	HM960-HM86: • Supports 2 USB 3.0 interfaces • Supports 8 USB 2.0 interfaces • Supports 1 PCIe x16 Gen 3 interface • Supports 7 PCIe x1 interfaces • Supports LPC interface • Supports SMBus interface • Supports I^2C interface • Supports 2 serial interfaces (TX/RX) • Supports 4-bit input and 4-bit output GPIO
Trusted Platform Module - TPM* (optional)	• Provides a Trusted PC for secure transactions • Provides software license protection, enforcement and password protection
Intel® Active Management Technology - AMT (HM960-QM87)	• Supports iAMT9.0 • Out-of-band system access • Remote troubleshooting and recovery • Hardware-based agent presence checking • Proactive alerting • Remote hardware and software asset tracking
Damage Free Intelligence	• Monitors CPU temperature and overheat alarm • Monitors CPU fan speed and failure alarm • Monitors Vcore/1.05V/DDR voltages and failure alarm
BIOS	• AMI BIOS - 64Mbit SPI BIOS
WatchDog Timer	• Software programmable from 1 to 255 seconds
Temperature	• Operating: 0°C to 60°C • Storage: -20°C to 85°C
Humidity	• 5% to 90%
Power	• Input: 12V, VCC_RTC, 5VSB* (optional)
Power Consumption	• TBD

OS Support	• Windows XP Professional x86 & SP3 (32-bit) (limited function) • Windows 7 Ultimate x86 & SP1 (32-bit) • Windows 7 Ultimate x64 & SP1 (64-bit) • Windows 8 Enterprise x86 (32-bit) • Windows 8 Enterprise x64 (64-bit)
PCB	• Dimensions - COM Express® Basic - 95mm (3.74") x 125mm (4.9") • Compliance - PICMG COM Express® R2.1, Type 6
Certification	• CE, FCC Class B, RoHS

Note:
*Optional and is not supported in standard model. Please contact your sales representative for more information.

Features

• Watchdog Timer

The Watchdog Timer function allows your application to regularly "clear" the system at the set time interval. If the system hangs or fails to function, it will reset at the set time interval so that your system will continue to operate.

• DDR3L

DDR3L is a higher performance DDR3 SDRAM interface providing less voltage and higher speed successor. DDR3L SDRAM modules support 1333/1600MHz for DDR modules. DDR3L delivers increased system bandwidth and improved performance to provide its higher bandwidth and its increase in performance at a lower power.

• Graphics

The integrated Intel® HD graphics engine delivers an excellent blend of graphics performance and features to meet business needs. It provides excellent video and 3D graphics with outstanding graphics responsiveness. These enhancements deliver the performance and compatibility needed for today's and tomorrow's business applications. Supports VGA, LVDS and DDI interfaces for display outputs.

• Serial ATA

Serial ATA is a storage interface that is compliant with SATA 1.0a specification. With speed of up to 3Gb/s (SATA 2.0) and 6Gb/s (SATA 3.0), it improves hard drive performance faster than the standard parallel ATA whose data transfer rate is 100MB/s. The bandwidth of the SATA 3.0 will be limited by carrier board design.

• Gigabit LAN

The Intel® I217LM Gigabit LAN controller supports up to 1Gbps data transmission.

• USB

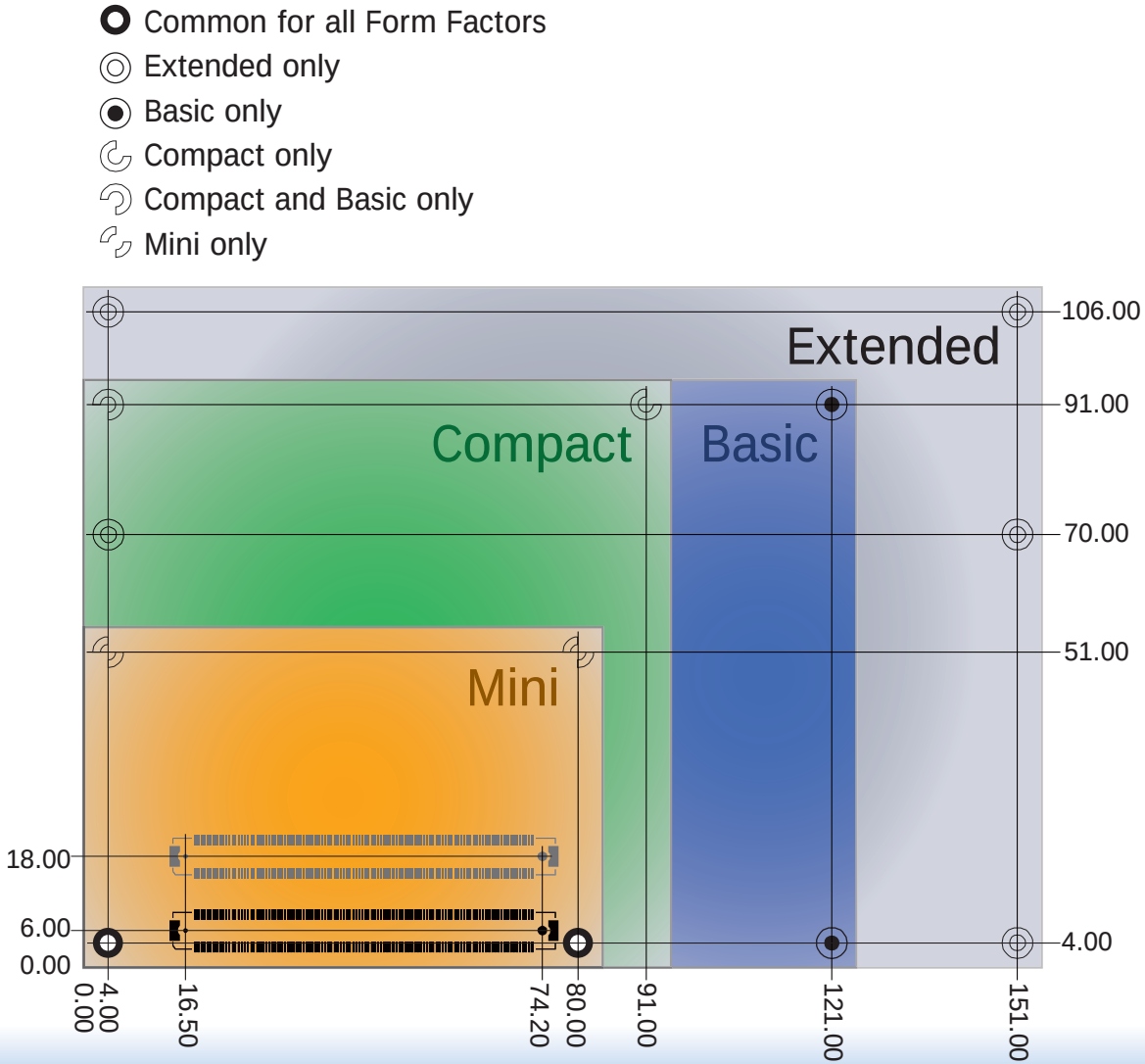
The system board supports the new USB 3.0. It is capable of running at a maximum transmission speed of up to 5 Gbit/s (625 MB/s) and is faster than USB 2.0 (480 Mbit/s, or 60 MB/s) and USB 1.1 (12Mb/s). USB 3.0 reduces the time required for data transmission, reduces power consumption, and is backward compatible with USB 2.0. It is a marked improvement in device transfer speeds between your computer and a wide range of simultaneously accessible external Plug and Play peripherals.

Chapter 2 - Concept

COM Express Module Standards

The figure below shows the dimensions of the different types of COM Express modules.

HM960-QM87/HM86 is a COM Express Basic module. The dimension is 95mm x 125mm.



Specification Comparison Table

The table below shows the COM Express standard specifications and the corresponding specifications supported on the HM960-QM87/HM86 module.

Connector	Feature	COM Express Module Base Specification Type 6 (No IDE or PCI, add DDI+ USB3) Min / Max	DFI HM960-QM87/HM86 Type 6
A-B	**System I/O**		
A-B	PCI Express Lanes 0 - 5	1 / 6	6
A-B	LVDS Channel A	0 / 1	1
A-B	LVDS Channel B	0 / 1	1
A-B	eDP on LVDS CH A pins	0 / 1	0
A-B	VGA Port	0 / 1	1
A-B	TV-Out	NA	NA
A-B	DDI 0	NA	NA
A-B[5]	Serial Ports 1 - 2	0 / 2	2
A-B	CAN interface on SER1	0 / 1	0
A-B	SATA / SAS Ports	1 / 4	4
A-B	AC'97 / HDA Digital Interface	0 / 1	1
A-B	USB 2.0 Ports	4 / 8	8
A-B	USB Client	0 / 1	0
A-B	USB 3.0 Ports	NA	NA
A-B	LAN Port 0	1 / 1	1
A-B	Express Card Support	1 / 2	2
A-B	LPC Bus	1 / 1	1
A-B	SPI	1 / 2	1
A-B	**System Management**		
A-B[6]	SDIO (muxed on GPIO)	0 / 1	0
	General Purpose I/O	8 / 8	8
A-B	SMBus	1 / 1	1
A-B	I2C	1 / 1	1
A-B	Watchdog Timer	0 / 1	1
A-B	Speaker Out	1 / 1	1
A-B	External BIOS ROM Support	0 / 2	1
A-B	Reset Functions	1 / 1	1

Connector	Feature	COM Express Module Base Specification Type 6 (No IDE or PCI, add DDI+ USB3) Min / Max	DFI HM960-QM87/HM86 Type 6
A-B	**Power Management**		
A-B	Thermal Protection	0 / 1	1
A-B	Battery Low Alarm	0 / 1	1
A-B	Suspend/Wake Signals	0 / 3	2
A-B	Power Button Support	1 / 1	1
A-B	Power Good	1 / 1	1
A-B	VCC_5V_SBY Contacts	4 / 4	4
A-B[5]	Sleep Input	0 / 1	1
A-B[5]	Lid Input	0 / 1	1
A-B[5]	Fan Control Signals	0 / 2	2
A-B	Trusted Platform Modules	0 / 1	1
A-B	**Power**		
A-B	VCC_12V Contacts	12 / 12	12

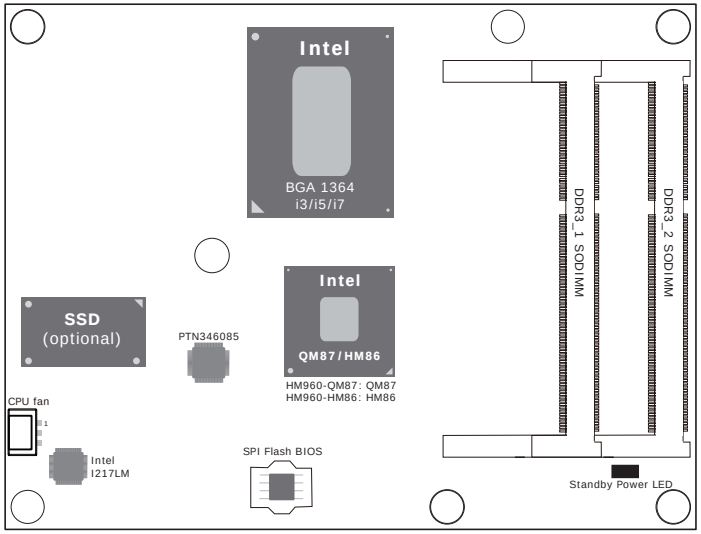
Module Pin-out - Required and Optional Features C-D Connector. PICMG® COM.0Revision 2.1

Connector	Feature	COM Express Module Base Specification Type 6 (No IDE or PCI, add DDI+ USB3) Min / Max	DFI HM960-QM87/HM86 Type 6
C-D	**System I/O**		
	PCI Express Lanes 16 - 31	0 / 16	16
	PCI Express Graphics (PEG)	0 / 1	1
C-D[6]	Muxed SDVO Channels 1 - 2	NA	NA
	PCI Express Lanes 6 - 15	0 / 2	1
	PCI Bus - 32 Bit	NA	NA
	PATA Port	NA	NA
	LAN Ports 1 - 2	NA	NA
	DDIs 1 - 3	0 / 3	3
C-D[6]	USB 3.0 Ports	0 / 4	4
C-D	**Power**		
C-D	VCC_12V Contacts	12 / 12	12

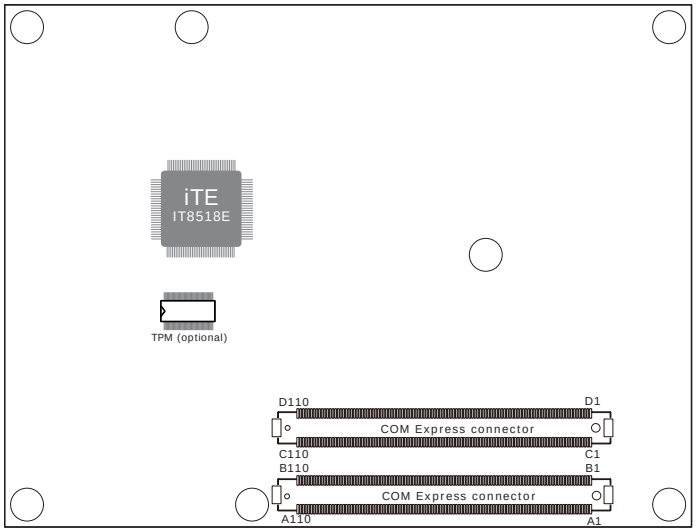
- 5 Indicates 12V-tolerant features on former VCC_12V signals.
- 6 Cells in the connected columns spanning rows provide a rough approximation of features sharing connector pins.

Chapter 3 - Hardware Installation

Board Layout

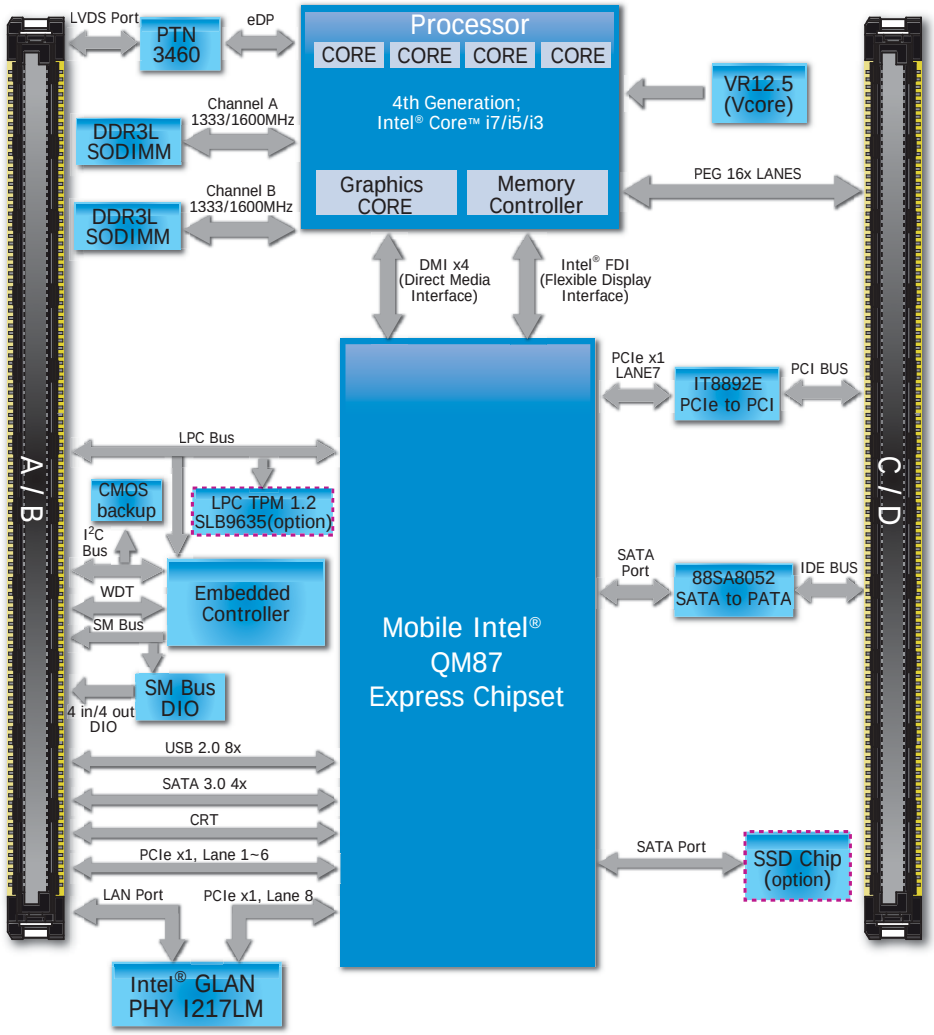


Top View

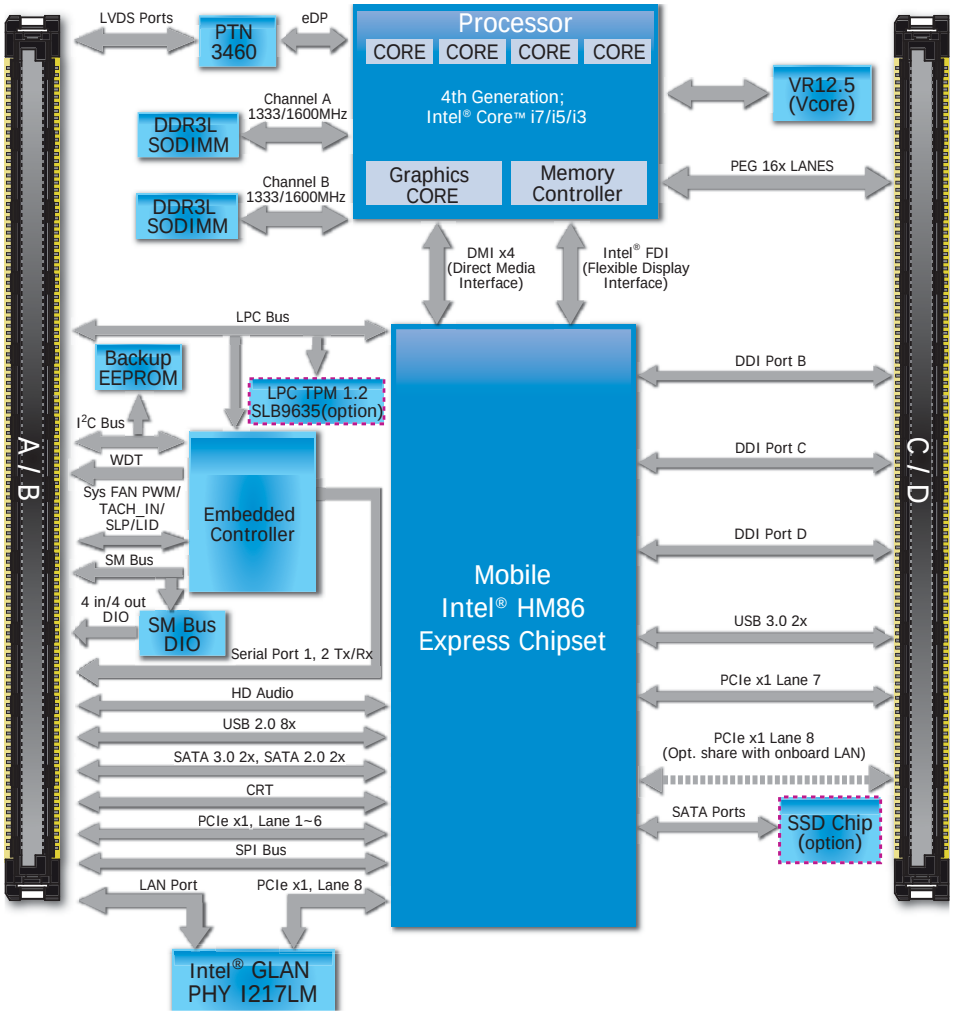


Bottom View

Block Diagram For HM960-QM87

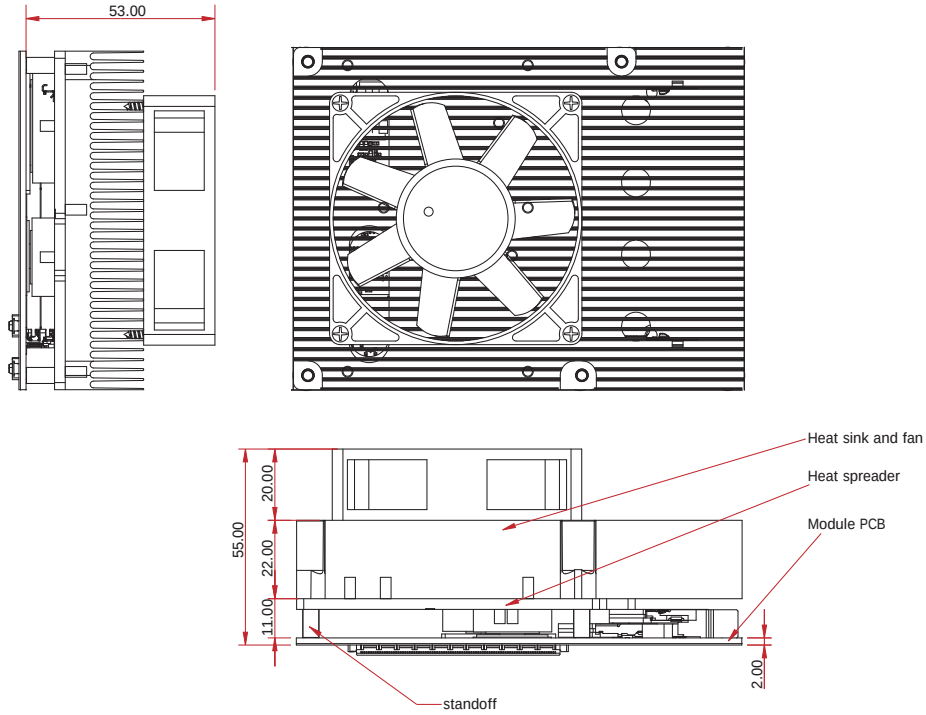


For HM960-HM86



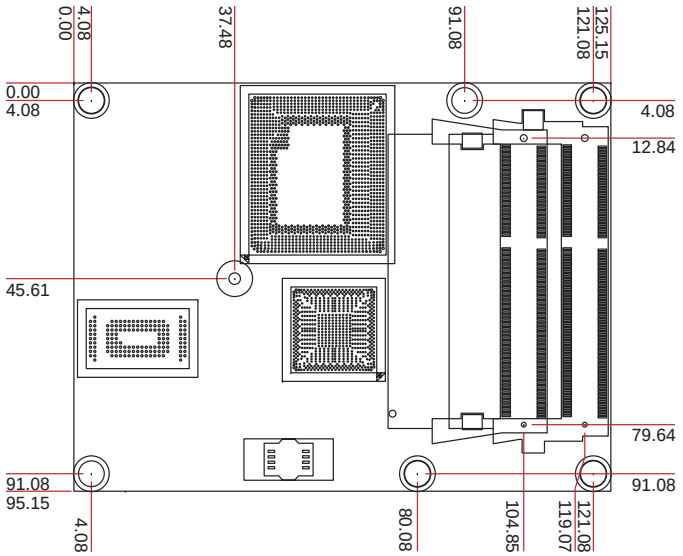
Mechanical Diagram

HM960-QM87/HM86 Module with Heat Sink

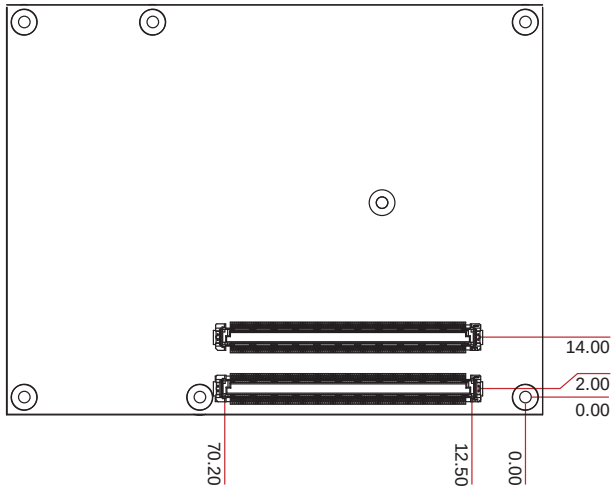


Side View of the Module with Heat Sink and Carrier Board

HM960-QM87/HM86 Module



Top View



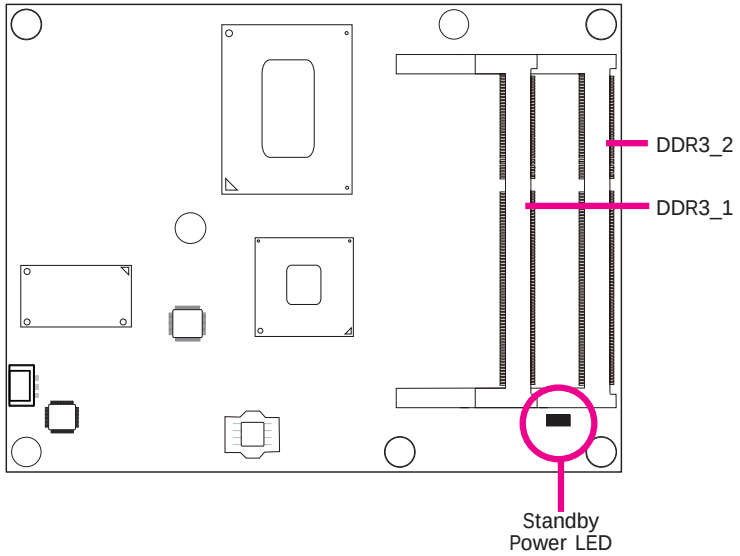
Bottom View

Important:
Electrostatic discharge (ESD) can damage your board, processor, disk drives, add-in boards, and other components. Perform installation procedures at an ESD workstation only. If such a station is not available, you can provide some ESD protection by wearing an antistatic wrist strap and attaching it to a metal part of the system chassis. If a wrist strap is unavailable, establish and maintain contact with the system chassis throughout any procedures requiring ESD protection.

System Memory

The system board is equipped with two 204-pin SODIMM sockets that support DDR3L(1.35V) memory modules; depends on CPU supported. However, DDR3L memory module can run at 1.5V.

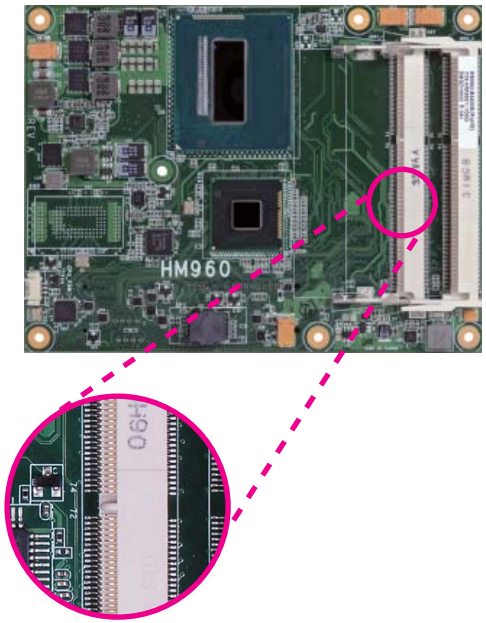
Important:
When the Standby Power LED lit red, it indicates that there is power on the board. Power-off the PC then unplug the power cord prior to installing any devices. Failure to do so will cause severe damage to the board and components.



Installing the DIMM Module

Note:
The system board used in the following illustrations may not resemble the actual one. These illustrations are for reference only.

1. Make sure the PC and all other peripheral devices connected to it has been powered down.
2. Disconnect all power cords and cables.
3. Locate the SODIMM socket on the system board.
4. Note the key on the socket. The key ensures the module can be plugged into the socket in only one direction.

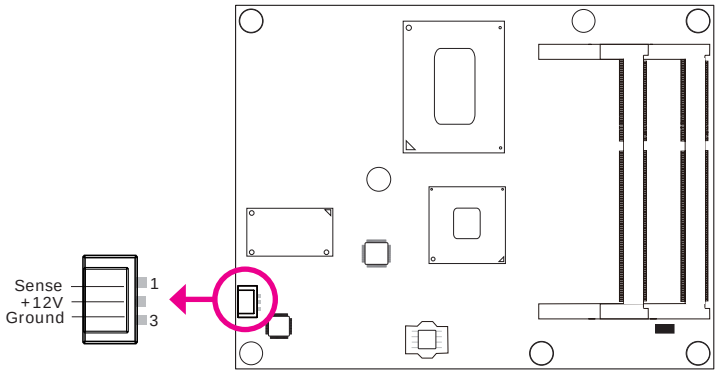


5. Grasping the module by its edges, align the module into the socket at an approximately 30 degrees angle. Apply firm even pressure to each end of the module until it slips down into the socket. The contact fingers on the edge of the module will almost completely disappear inside the socket.

6. Push down the module until the clips at each end of the socket lock into position. You will hear a distinctive “click”, indicating the module is correctly locked into position.

Connectors

CPU Fan Connector



Connect the CPU fan’s cable connector to the CPU fan connector on the board. The cooling fan will provide adequate airflow throughout the chassis to prevent overheating the CPU and board components.

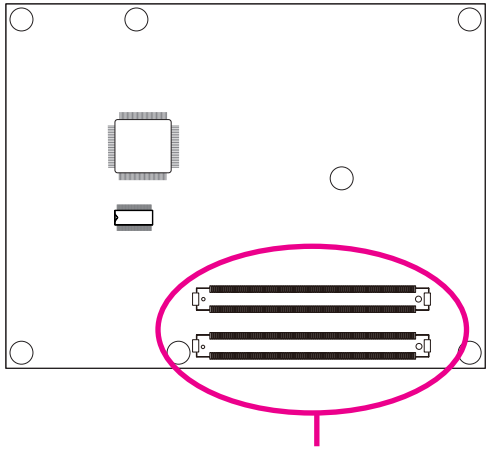
BIOS Setting

“Module Board H/W Monitor” submenu in the Advanced menu of the BIOS will display the current speed of the cooling fan. Refer to chapter 4 of the manual for more information.

COM Express Connectors

The COM Express connectors are used to interface the HM960-QM87/HM86 COM Express board to a carrier board. Connect the COM Express connectors (located on the solder side of the board) to the COM Express connectors on the carrier board.

Refer to the “Installing HM960-QM87/HM86 onto a Carrier Board” section for more information.



COM Express Connectors

Refer to the following pages for the pin functions of these connectors.

COM Express Connectors

Row A		Row B	
A1	GND (FIXED)	B1	GND (FIXED)
A2	GBE0_MDI3-	B2	GBE0_ACT#
A3	GBE0_MDI3+	B3	LPC_FRAME#
A4	GBE0_LINK100#	B4	LPC_AD0
A5	GBE0_LINK1000#	B5	LPC_AD1
A6	GBE0_MDI2-	B6	LPC_AD2
A7	GBE0_MDI2+	B7	LPC_AD3
A8	GBE0_LINK#	B8	LPC_DRQ0#
A9	GBE0_MDI1-	B9	LPC_DRQ1#
A10	GBE0_MDI1+	B10	LPC_CLK
A11	GND (FIXED)	B11	GND (FIXED)
A12	GBE0_MDI0-	B12	PWRBTN#
A13	GBE0_MDI0+	B13	SMB_CK
A14	GBE0_CTREF	B14	SMB_DAT
A15	SLP_S3#	B15	SMB_ALERT#
A16	SATA0_TX+	B16	SATA1_TX+
A17	SATA0_TX-	B17	SATA1_TX-
A18	SLP_S4#	B18	SUS_STAT#
A19	SATA0_RX+	B19	SATA1_RX+
A20	SATA0_RX-	B20	SATA1_RX-
A21	GND (FIXED)	B21	GND (FIXED)
A22	SATA2_TX+	B22	SATA3_TX+
A23	SATA2_TX-	B23	SATA3_TX-
A24	SUS_S5#	B24	PWR_OK
A25	SATA2_RX+	B25	SATA3_RX+
A26	SATA2_RX-	B26	SATA3_RX-
A27	BATLOW#	B27	WDT
A28	(S)ATA_ACT#	B28	AC/HDA _SDIN2
A29	AC/HDA_SYNC	B29	AC/HDA _SDIN1
A30	AC/HDA _RST#	B30	AC/HDA _SDIN0
A31	GND (FIXED)	B31	GND (FIXED)
A32	AC/HDA _BITCLK	B32	SPKR
A33	AC/HDA _SDOUT	B33	I2C_CK
A34	BIOS_DIS0#	B34	I2C_DAT
A35	THRMTRIP#	B35	THRM#
A36	USB6-	B36	USB7-
A37	USB6+	B37	USB7+
A38	USB_6_7_OC#	B38	USB_4_5_OC#
A39	USB4-	B39	USB5-
A40	USB4+	B40	USB5+
A41	GND (FIXED)	B41	GND (FIXED)
A42	USB2-	B42	USB3-
A43	USB2+	B43	USB3+
A44	USB_2_3_OC#	B44	USB_0_1_OC#
A45	USB0-	B45	USB1-
A46	USB0+	B46	USB1+
A47	VCC_RTC	B47	EXCD1_PERST#
A48	EXCD0_PERST#	B48	EXCD1_CPPE#
A49	EXCD0_CPPE#	B49	SYS_RESET#
A50	LPC_SERIRQ	B50	CB_RESET#

Row A		Row B	
A51	GND (FIXED)	B51	GND (FIXED)
A52	PCIE_TX5+	B52	PCIE_RX5+
A53	PCIE_TX5-	B53	PCIE_RX5-
A54	GPI0	B54	GPO1
A55	PCIE_TX4+	B55	PCIE_RX4+
A56	PCIE_TX4-	B56	PCIE_RX4-
A57	GND	B57	GPO2
A58	PCIE_TX3+	B58	PCIE_RX3+
A59	PCIE_TX3-	B59	PCIE_RX3-
A60	GND (FIXED)	B60	GND (FIXED)
A61	PCIE_TX2+	B61	PCIE_RX2+
A62	PCIE_TX2-	B62	PCIE_RX2-
A63	GPI1	B63	GPO3
A64	PCIE_TX1+	B64	PCIE_RX1+
A65	PCIE_TX1-	B65	PCIE_RX1-
A66	GND	B66	WAKE0#
A67	GPI2	B67	WAKE1#
A68	PCIE_TX0+	B68	PCIE_RX0+
A69	PCIE_TX0-	B69	PCIE_RX0-
A70	GND (FIXED)	B70	GND (FIXED)
A71	LVDS_A0+	B71	LVDS_B0+
A72	LVDS_A0-	B72	LVDS_B0-
A73	LVDS_A1+	B73	LVDS_B1+
A74	LVDS_A1-	B74	LVDS_B1-
A75	LVDS_A2+	B75	LVDS_B2+
A76	LVDS_A2-	B76	LVDS_B2-
A77	LVDS_VDD_EN	B77	LVDS_B3+
A78	LVDS_A3+	B78	LVDS_B3-
A79	LVDS_A3-	B79	LVDS_BKLT_EN
A80	GND (FIXED)	B80	GND (FIXED)
A81	LVDS_A_CK+	B81	LVDS_B_CK+
A82	LVDS_A_CK-	B82	LVDS_B_CK-
A83	LVDS_I2C_CK	B83	LVDS_BKLT_CTRL
A84	LVDS_I2C_DAT	B84	VCC_5V_SBY
A85	GPI3	B85	VCC_5V_SBY
A86	RSVD	B86	VCC_5V_SBY
A87	RSVD	B87	VCC_5V_SBY
A88	PCIE0_CK_REF+	B88	BIOS_DIS1#
A89	PCIE0_CK_REF-	B89	VGA_RED
A90	GND (FIXED)	B90	GND (FIXED)
A91	SPI_POWER	B91	VGA_GRN
A92	SPI_MISO	B92	VGA_BLU
A93	GPO0	B93	VGA_HSYNC
A94	SPI_CLK	B94	VGA_VSYNC
A95	SPI_MOSI	B95	VGA_I2C_CK
A96	TPM_PP	B96	VGA_I2C_DAT
A97	TYPE10#	B97	SPI_CS#
A98	SER0_TX	B98	RSVD
A99	SER0_RX	B99	RSVD
A100	GND (FIXED)	B100	GND (FIXED)
A101	SER1_TX	B101	FAN_PWMOUT
A102	SER1_RX	B102	FAN_TACHIN
A103	LID#	B103	SLEEP#
A104	VCC_12V	B104	VCC_12V
A105	VCC_12V	B105	VCC_12V
A106	VCC_12V	B106	VCC_12V
A107	VCC_12V	B107	VCC_12V
A108	VCC_12V	B108	VCC_12V
A109	VCC_12V	B109	VCC_12V
A110	GND (FIXED)	B110	GND (FIXED)

Row C		Row D	
C1	GND (FIXED)	D1	GND (FIXED)
C2	GND	D2	GND
C3	USB_SSRX0-	D3	USB_SSTX0-
C4	USB_SSRX0+	D4	USB_SSTX0+
C5	GND	D5	GND
C6	USB_SSRX1-	D6	USB_SSTX1-
C7	USB_SSRX1+	D7	USB_SSTX1+
C8	GND	D8	GND
C9	USB_SSRX2-	D9	USB_SSTX2-
C10	USB_SSRX2+	D10	USB_SSTX2+
C11	GND (FIXED)	D11	GND (FIXED)
C12	USB_SSRX3-	D12	USB_SSTX3-
C13	USB_SSRX3+	D13	USB_SSTX3+
C14	GND	D14	GND
C15	DDI1_PAIR6+	D15	DDI1_CTRLCLK_AUX+
C16	DDI1_PAIR6-	D16	DDI1_CTRLDATA_AUX-
C17	RSVD	D17	RSVD
C18	RSVD	D18	RSVD
C19	PCIE_RX6+	D19	PCIE_TX6+
C20	PCIE_RX6-	D20	PCIE_TX6-
C21	GND (FIXED)	D21	GND (FIXED)
C22	PCIE_RX7+	D22	PCIE_TX7+
C23	PCIE_RX7-	D23	PCIE_TX7-
C24	DDI1_HPD	D24	RSVD
C25	DDI1_PAIR4+	D25	RSVD
C26	DDI1_PAIR4-	D26	DDI1_PAIR0+
C27	RSVD	D27	DDI1_PAIR0-
C28	RSVD	D28	RSVD
C29	DDI1_PAIR5+	D29	DDI1_PAIR1+
C30	DDI1_PAIR5-	D30	DDI1_PAIR1-
C31	GND (FIXED)	D31	GND (FIXED)
C32	DDI2_CTRLCLK_AUX+	D32	DDI1_PAIR2+
C33	DDI2_CTRLDATA_AUX-	D33	DDI1_PAIR2-
C34	DDI2_DDC_AUX_SEL	D34	DDI1_DDC_AUX_SEL
C35	RSVD	D35	RSVD
C36	DDI2_CTRLCLK_AUX+	D36	DDI1_PAIR3+
C37	DDI2_CTRLDATA_AUX-	D37	DDI1_PAIR3-
C38	DDI2_DDC_AUX_SEL	D38	RSVD
C39	DDI3_PAIR0+	D39	DDI2_PAIR0+
C40	DDI3_PAIR0-	D40	DDI2_PAIR0-
C41	GND (FIXED)	D41	GND (FIXED)
C42	DDI3_PAIR1+	D42	DDI2_PAIR1+
C43	DDI3_PAIR1-	D43	DDI2_PAIR1-
C44	DDI3_HPD	D44	DDI2_HPD
C45	RSVD	D45	RSVD
C46	DDI3_PAIR2+	D46	DDI2_PAIR2+
C47	DDI3_PAIR2-	D47	DDI2_PAIR2-
C48	RSVD	D48	RSVD
C49	DDI3_PAIR3+	D49	DDI2_PAIR3+
C50	DDI3_PAIR3-	D50	DDI2_PAIR3-

Row C		Row D	
C51	GND (FIXED)	D51	GND (FIXED)
C52	PEG_RX0+	D52	PEG_TX0+
C53	PEG_RX0-	D53	PEG_TX0-
C54	TYPE0#	D54	PEG_LANE_RV#
C55	PEG_RX1+	D55	PEG_TX1+
C56	PEG_RX1-	D56	PEG_TX1-
C57	TYPE1#	D57	TYPE2#
C58	PEG_RX2+	D58	PEG_TX2+
C59	PEG_RX2-	D59	PEG_TX2-
C60	GND (FIXED)	D60	GND (FIXED)
C61	PEG_RX3+	D61	PEG_TX3+
C62	PEG_RX3-	D62	PEG_TX3-
C63	RSVD	D63	RSVD
C64	RSVD	D64	RSVD
C65	PEG_RX4+	D65	PEG_TX4+
C66	PEG_RX4-	D66	PEG_TX4-
C67	NC	D67	GND
C68	PEG_RX5+	D68	PEG_TX5+
C69	PEG_RX5-	D69	PEG_TX5-
C70	GND (FIXED)	D70	GND (FIXED)
C71	PEG_RX6+	D71	PEG_TX6+
C72	PEG_RX6-	D72	PEG_TX6-
C73	GND	D73	GND
C74	PEG_RX7+	D74	PEG_TX7+
C75	PEG_RX7-	D75	PEG_TX7-
C76	GND	D76	GND
C77	RSVD	D77	RSVD
C78	PEG_RX8+	D78	PEG_TX8+
C79	PEG_RX8-	D79	PEG_TX8-
C80	GND (FIXED)	D80	GND (FIXED)
C81	PEG_RX9+	D81	PEG_TX9+
C82	PEG_RX9-	D82	PEG_TX9-
C83	RSVD	D83	RSVD
C84	GND	D84	GND
C85	PEG_RX10+	D85	PEG_TX10+
C86	PEG_RX10-	D86	PEG_TX10-
C87	GND	D87	GND
C88	PEG_RX11+	D88	PEG_TX11+
C89	PEG_RX11-	D89	PEG_TX11-
C90	GND (FIXED)	D90	GND (FIXED)
C91	PEG_RX12+	D91	PEG_TX12+
C92	PEG_RX12-	D92	PEG_TX12-
C93	GND	D93	GND
C94	PEG_RX13+	D94	PEG_TX13+
C95	PEG_RX13-	D95	PEG_TX13-
C96	GND	D96	GND
C97	RSVD	D97	RSVD
C98	PEG_RX14+	D98	PEG_TX14+
C99	PEG_RX14-	D99	PEG_TX14-
C100	GND (FIXED)	D100	GND (FIXED)
C101	PEG_RX15+	D101	PEG_TX15+
C102	PEG_RX15-	D102	PEG_TX15-
C103	GND	D103	GND
C104	VCC_12V	D104	VCC_12V
C105	VCC_12V	D105	VCC_12V
C106	VCC_12V	D106	VCC_12V
C107	VCC_12V	D107	VCC_12V
C108	VCC_12V	D108	VCC_12V
C109	VCC_12V	D109	VCC_12V
C110	GND (FIXED)	D110	GND (FIXED)

COM Express Connectors Signal Description

Pin Types
I Input to the Module
O Output from the Module
I/O Bi-directional input / output signal
OD Open drain output

AC97/HDA Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
AC/HAD_RST#	A30	O CMOS	3.3V Suspend/3.3V		Connect to CODEC pin 11 RESET#	Reset output to CODEC, active low.
AC/HDA_SYNC	A29	O CMOS	3.3V/3.3V	PU 1K TO 3V3_DU	Connect to CODEC pin 10 SYNC	Sample-synchronization signal to the CODEC(s).
AC/HDA_BITCLK	A32	I/O CMOS	3.3V/3.3V		Connect to CODEC pin 6 BIT_CLK	Serial data clock generated by the external CODEC(s).
AC/HDA_SDOUT	A33	O CMOS	3.3V/3.3V		Connect to CODEC pin 5 SDATA_OUT	Serial TDM data output to the CODEC.
AC/HDA_SDIN2	B28	I/O CMOS	3.3V Suspend/3.3V		Connect 33 Ω in series to CODEC2 pin 8 SDATA_IN	Serial TDM data inputs from up to 3 CODECs.
AC/HDA_SDIN1	B29	I/O CMOS	3.3V Suspend/3.3V		Connect 33 Ω in series to CODEC1 pin 8 SDATA_IN	
AC/HDA_SDIN0	B30	I/O CMOS	3.3V Suspend/3.3V		Connect 33 Ω in series to CODEC0 pin 8 SDATA_IN	

Gigabit Ethernet Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
GBE0_MDI0+	A13	I/O Analog	3.3V max Suspend		Connect to Magnetics Module MDI0+/-	Gigabit Ethernet Controller 0: Media Dependent Interface Differential Pairs 0,1,2,3. The MDI can operate in 1000, 100 and 10 Mbit / sec modes. Some pairs are unused in some modes, per the following:
GBE0_MDI0-	A12	I/O Analog	3.3V max Suspend			
GBE0_MDI1+	A10	I/O Analog	3.3V max Suspend		Connect to Magnetics Module MDI1+/-	
GBE0_MDI1-	A9	I/O Analog	3.3V max Suspend			
GBE0_MDI2+	A7	I/O Analog	3.3V max Suspend		Connect to Magnetics Module MDI2+/-	
GBE0_MDI2-	A6	I/O Analog	3.3V max Suspend			
GBE0_MDI3+	A3	I/O Analog	3.3V max Suspend		Connect to Magnetics Module MDI3+/-	
GBE0_MDI3-	A2	I/O Analog	3.3V max Suspend			
GBE0_ACT#	B2	OD CMOS	3.3V Suspend/3.3V		Connect to LED and **recommend** current limit resistor 150Ω to 3.3VSB	Gigabit Ethernet Controller 0 activity indicator, active low.
GBE0_LINK#	A8	OD CMOS	3.3V Suspend/3.3V		NC	Gigabit Ethernet Controller 0 link indicator, active low.
GBE0_LINK100#	A4	OD CMOS	3.3V Suspend/3.3V			Gigabit Ethernet Controller 0 100 Mbit / sec link indicator, active low.
GBE0_LINK1000#	A5	OD CMOS	3.3V Suspend/3.3V		Connect to LED and **recommend** current limit resistor 150Ω to 3.3VSB	Gigabit Ethernet Controller 0 1000 Mbit / sec link indicator, active low.

	1000BASE-T	100BASE-TX	10BASE-T
MDI[0]+/-	B1_DA+/-	TX+/-	TX+/-
MDI[1]+/-	B1_DB+/-	RX+/-	RX+/-
MDI[2]+/-	B1_DC+/-		
MDI[3]+/-	B1_DD+/-		

SATA Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
SATA4_TX+	A16	O SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA0 Conn TX pin	Serial ATA or SAS Channel 0 transmit differential pair.
SATA4_TX-	A17	O SATA	AC coupled on Module	AC Coupling capacitor		
SATA4_RX+	A19	I SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA0 Conn RX pin	Serial ATA or SAS Channel 0 receive differential pair.
SATA4_RX-	A20	I SATA	AC coupled on Module	AC Coupling capacitor		
SATA5_TX+	B16	O SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA1 Conn TX pin	Serial ATA or SAS Channel 1 transmit differential pair.
SATA5_TX-	B17	O SATA	AC coupled on Module	AC Coupling capacitor		
SATA5_RX+	B19	I SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA1 Conn RX pin	Serial ATA or SAS Channel 1 receive differential pair.
SATA5_RX-	B20	I SATA	AC coupled on Module	AC Coupling capacitor		
SATA0_TX+	A22	O SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA2 Conn TX pin	Serial ATA or SAS Channel 2 transmit differential pair.
SATA0_TX-	A23	O SATA	AC coupled on Module	AC Coupling capacitor		
SATA0_RX+	A25	I SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA2 Conn RX pin	Serial ATA or SAS Channel 2 receive differential pair.
SATA0_RX-	A26	I SATA	AC coupled on Module	AC Coupling capacitor		
SATA2_TX+	B22	O SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA3 Conn TX pin	Serial ATA or SAS Channel 3 transmit differential pair.
SATA2_TX-	B23	O SATA	AC coupled on Module	AC Coupling capacitor		
SATA2_RX+	B25	I SATA	AC coupled on Module	AC Coupling capacitor	Connect to SATA3 Conn RX pin	Serial ATA or SAS Channel 3 receive differential pair.
SATA2_RX-	B26	I SATA	AC coupled on Module	AC Coupling capacitor		
ATA_ACT#	A28	I/O CMOS	3.3V / 3.3V	PU 10K to 3.3V	Connect to LED and **recommend** current limit resistor 220Ω to 3.3V	ATA (parallel and serial) or SAS activity indicator, active low.

PCI Express Lanes Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
PCIE_TX0+	A68	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Differential Transmit Pairs 0
PCIE_TX0-	A69			AC Coupling capacitor		
PCIE_RX0+	B68	I PCIE	AC coupled off Module		**Device** - Connect AC Coupling cap 0.1uF **Slot** - Connect to PCIE Conn pin	PCI Express Differential Receive Pairs 0
PCIE_RX0-	B69					
PCIE_TX1+	A64	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Differential Transmit Pairs 1
PCIE_TX1-	A65			AC Coupling capacitor		
PCIE_RX1+	B64	I PCIE	AC coupled off Module		**Device** - Connect AC Coupling cap 0.1uF **Slot** - Connect to PCIE Conn pin	PCI Express Differential Receive Pairs 1
PCIE_RX1-	B65					
PCIE_TX2+	A61	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Differential Transmit Pairs 2
PCIE_TX2-	A62			AC Coupling capacitor		
PCIE_RX2+	B61	I PCIE	AC coupled off Module		**Device** - Connect AC Coupling cap 0.1uF **Slot** - Connect to PCIE Conn pin	PCI Express Differential Receive Pairs 2
PCIE_RX2-	B62					
PCIE_TX3+	A58	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Differential Transmit Pairs 3
PCIE_TX3-	A59			AC Coupling capacitor		
PCIE_RX3+	B58	I PCIE	AC coupled off Module		**Device** - Connect AC Coupling cap 0.1uF **Slot** - Connect to PCIE Conn pin	PCI Express Differential Receive Pairs 3
PCIE_RX3-	B59					
PCIE_TX4+	A55	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Differential Transmit Pairs 4
PCIE_TX4-	A56			AC Coupling capacitor		
PCIE_RX4+	B55	I PCIE	AC coupled off Module		**Device** - Connect AC Coupling cap 0.1uF **Slot** - Connect to PCIE Conn pin	PCI Express Differential Receive Pairs 4
PCIE_RX4-	B56					
PCIE_TX5+	A52	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Differential Transmit Pairs 5
PCIE_TX5-	A53			AC Coupling capacitor		
PCIE_RX5+	B52	I PCIE	AC coupled off Module		**Device** - Connect AC Coupling cap 0.1uF **Slot** - Connect to PCIE Conn pin	PCI Express Differential Receive Pairs 5
PCIE_RX5-	B53					
PCIE_TX6+	D19	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Differential Transmit Pairs 6
PCIE_TX6-	D20			AC Coupling capacitor		
PCIE_RX6+	C19	I PCIE	AC coupled off Module		**Device** - Connect AC Coupling cap 0.1uF **Slot** - Connect to PCIE Conn pin	PCI Express Differential Receive Pairs 6
PCIE_RX6-	C20					
PCIE_TX7+	D22	O PCIE	AC coupled on Module	NA	NA	PCI Express Differential Transmit Pairs 7 (Optional with on board LAN, Default setting as NC)
PCIE_TX7-	D23			NA		
PCIE_RX7+	C22	I PCIE	AC coupled off Module	NA	NA	PCI Express Differential Receive Pairs 7 (Optional with on board LAN, Default setting as NC)
PCIE_RX7-	C23			NA		
PCIE0_CK_REF+	A88	O PCIE	PCIE		Connect to PCIE device, **PCIe CLK Buffer** or slot	Reference clock output for all PCI Express and PCI Express Graphics lanes.
PCIE0_CK_REF-	A89					

PEG Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
PEG_TX0+	D52	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 0
PEG_TX0-	D53			AC Coupling capacitor		
PEG_RX0+	C52	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 0
PEG_RX0-	C53					
PEG_TX1+	D55	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 1
PEG_TX1-	D56			AC Coupling capacitor		
PEG_RX1+	C55	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 1
PEG_RX1-	C56					
PEG_TX2+	D58	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 2
PEG_TX2-	D59			AC Coupling capacitor		
PEG_RX2+	C58	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 2
PEG_RX2-	C59					
PEG_TX3+	D61	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 3
PEG_TX3-	D62			AC Coupling capacitor		
PEG_RX3+	C61	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 3
PEG_RX3-	C62					
PEG_TX4+	D65	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 4
PEG_TX4-	D66			AC Coupling capacitor		
PEG_RX4+	C65	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 4
PEG_RX4-	C66					
PEG_TX5+	D68	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 5
PEG_TX5-	D69			AC Coupling capacitor		
PEG_RX5+	C68	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 5
PEG_RX5-	C69					

PEG Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
PEG_TX6+	D71	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 6
PEG_TX6-	D72			AC Coupling capacitor		
PEG_RX6+	C71	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 6
PEG_RX6-	C72					
PEG_TX7+	D74	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 7
PEG_TX7-	D75			AC Coupling capacitor		
PEG_RX7+	C74	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 7
PEG_RX7-	C75					
PEG_TX8+	D78	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 8
PEG_TX8-	D79			AC Coupling capacitor		
PEG_RX8+	C78	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 8
PEG_RX8-	C79					
PEG_TX9+	D81	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 9
PEG_TX9-	D82			AC Coupling capacitor		
PEG_RX9+	C81	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 9
PEG_RX9-	C82					
PEG_TX10+	D85	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 10
PEG_TX10-	D86			AC Coupling capacitor		
PEG_RX10+	C85	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 10
PEG_RX10-	C86					
PEG_TX11+	D88	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 11
PEG_TX11-	D89			AC Coupling capacitor		
PEG_RX11+	C88	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 11
PEG_RX11-	C89					
PEG_TX12+	D91	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 12
PEG_TX12-	D92			AC Coupling capacitor		
PEG_RX12+	C91	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 12
PEG_RX12-	C92					
PEG_TX13+	D94	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 13
PEG_TX13-	D95			AC Coupling capacitor		
PEG_RX13+	C94	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 13
PEG_RX13-	C95					
PEG_TX14+	D98	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 14
PEG_TX14-	D99			AC Coupling capacitor		
PEG_RX14+	C98	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 14
PEG_RX14-	C99					
PEG_TX15+	D101	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect to PCIE device or slot	PCI Express Graphics transmit differential pairs 15
PEG_TX15-	D102			AC Coupling capacitor		
PEG_RX15+	C101	I PCIE	AC coupled off Module		Connect AC Coupling cap 0.22uF	PCI Express Graphics receive differential pairs 15
PEG_RX15-	C102					
PEG_LANE_RV#	D54	I CMOS	3.3V / 3.3V			PCI Express Graphics lane reversal input strap. Pull low on the Carrier board to reverse lane order.

ExpressCard Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
EXCD0_CPPE#	A49	I CMOS	3.3V /3.3V			PCI ExpressCard: PCI Express capable card request, active low, one per card
EXCD1_CPPE#	B48					
EXCD0_PERST#	A48	O CMOS	3.3V /3.3V			PCI ExpressCard: reset, active low, one per card
EXCD1_PERST#	B47					

DDI Signals Descriptions						
Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
DDI1_PAIR0+/SDVO1_RED+	D26	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 1 Pair 0 differential pairs/Serial Digital Video B red output differential pair
DDI1_PAIR0-/SDVO1_RED-	D27				Connect AC Coupling Capacitors 0.1uF to Device	
DDI1_PAIR1+/SDVO1_GRN+	D29	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 1 Pair 1 differential pairs/Serial Digital Video B green output differential pair
DDI1_PAIR1-/SDVO1_GRN-	D30				Connect AC Coupling Capacitors 0.1uF to Device	
DDI1_PAIR2+/SDVO1_BLU+	D32	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 1 Pair 2 differential pairs/Serial Digital Video B blue output differential pair
DDI1_PAIR2-/SDVO1_BLU-	D33				Connect AC Coupling Capacitors 0.1uF to Device	
DDI1_PAIR3+/SDVO1_CK+	D36	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 1 Pair 3 differential pairs/Serial Digital Video B clock output differential pair.
DDI1_PAIR3-/SDVO1_CK-	D37				Connect AC Coupling Capacitors 0.1uF to Device	
DDI1_PAIR4+/SDVO1_INT+	C25	I PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	Serial Digital Video B interrupt input differential pair.
DDI1_PAIR4-/SDVO1_INT-	C26				Connect AC Coupling Capacitors 0.1uF to Device	
DDI1_PAIR5+/SDVO1_TVCLKIN+	C29	I PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	Serial Digital Video TVOUT synchronization clock input differential pair.
DDI1_PAIR5-/SDVO1_TVCLKIN-	C30				Connect AC Coupling Capacitors 0.1uF to Device	
DDI1_PAIR6+/SDVO1_FLDSTALL+	C15	I PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	Serial Digital Video Field Stall input differential pair.
DDI1_PAIR6-/SDVO1_FLDSTALL-	C16				Connect AC Coupling Capacitors 0.1uF to Device	
DDI1_CTRLCLK_AUX+/SDVO1_CTRLCLK	D15	I/O PCIE	AC coupled on Module	PD 49.9K to GND **(S/W IC between Rpu/PCH)**	Connect to DP AUX+	DP AUX+ function if DDI1_DDC_AUX_SEL is no connect
		I/O OD CMOS	3.3V / 3.3V	PU 2.2K to 3.3V, PD 49.9K to GND **(S/W IC between Rpu/Rpd resistor)**	Connect to HDMI/DVI I2C CTRLCLK	HDMI/DVI I2C CTRLCLK if DDI1_DDC_AUX_SEL is pulled high
DDI1_CTRLCLK_AUX-/SDVO1_CTRLDATA	D16	I/O PCIE	AC coupled on Module	PU 100K to 3.3V **(S/W IC between Rpu/PCH)**	Connect to DP AUX-	DP AUX- function if DDI1_DDC_AUX_SEL is no connect
		I/O OD CMOS	3.3V / 3.3V	PU 2.2K to 3.3V/PU 100K to 3.3V **(S/W IC between 2.2K/100K resistor)**	Connect to HDMI/DVI I2C CTRLDATA	HDMI/DVI I2C CTRLDATA if DDI1_DDC_AUX_SEL is pulled high
DDI1_HPD	C24	I CMOS	3.3V / 3.3V		PD 1M and Connect to device Hot Plug Detect	DDI Hot-Plug Detect
DDI1_DDC_AUX_SEL	D34	I CMOS	3.3V / 3.3V	PD 1M TO GND	PU 100K to 3.3V for DDC(HDMI/DVI)	Selects the function of DDI1_CTRLCLK_AUX+ and DDI1_CTRLDATA_AUX-.
DDI2_PAIR0+	D39	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 2 Pair 0 differential pairs
DDI2_PAIR0-	D40				Connect AC Coupling Capacitors 0.1uF to Device	
DDI2_PAIR1+	D42	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 2 Pair 1 differential pairs
DDI2_PAIR1-	D43				Connect AC Coupling Capacitors 0.1uF to Device	
DDI2_PAIR2+	D46	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 2 Pair 2 differential pairs
DDI2_PAIR2-	D47				Connect AC Coupling Capacitors 0.1uF to Device	
DDI2_PAIR3+	D49	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 2 Pair 3 differential pairs
DDI2_PAIR3-	D50				Connect AC Coupling Capacitors 0.1uF to Device	
DDI2_CTRLCLK_AUX+	C32	I/O PCIE	AC coupled on Module	PD 49.9K to GND **(S/W IC between Rpu/PCH)**	Connect to DP AUX+	DP AUX+ function if DDI2_DDC_AUX_SEL is no connect
		I/O OD CMOS	3.3V / 3.3V	PU 2.2K to 3.3V, PD 49.9K to GND **(S/W IC between Rpu/Rpd**	Connect to HDMI/DVI I2C CTRLCLK	HDMI/DVI I2C CTRLCLK if DDI2_DDC_AUX_SEL is pulled high
DDI2_CTRLCLK_AUX-	C33	I/O PCIE	AC coupled on Module	PU 100K to 3.3V **(S/W IC between Rpu/PCH)**	Connect to DP AUX-	DP AUX- function if DDI2_DDC_AUX_SEL is no connect
		I/O OD CMOS	3.3V / 3.3V	PU 2.2K to 3.3V/PU 100K to 3.3V **(S/W IC between 2.2K/100K resistor)**	Connect to HDMI/DVI I2C CTRLDATA	HDMI/DVI I2C CTRLDATA if DDI2_DDC_AUX_SEL is pulled high
DDI3_HPD	D44	I CMOS	3.3V / 3.3V		PD 1M and Connect to device Hot Plug Detect	DDI Hot-Plug Detect
DDI3_DDC_AUX_SEL	C34	I CMOS	3.3V / 3.3V	PD 1M TO GND	PU 100K to 3.3V for DDC(HDMI/DVI)	Selects the function of DDI2_CTRLCLK_AUX+ and DDI2_CTRLDATA_AUX-.
DDI3_PAIR0+	C39	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 3 Pair 0 differential pairs
DDI3_PAIR0-	C40				Connect AC Coupling Capacitors 0.1uF to Device	
DDI3_PAIR1+	C42	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 3 Pair 1 differential pairs
DDI3_PAIR1-	C43				Connect AC Coupling Capacitors 0.1uF to Device	
DDI3_PAIR2+	C46	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 3 Pair 2 differential pairs
DDI3_PAIR2-	C47				Connect AC Coupling Capacitors 0.1uF to Device	
DDI3_PAIR3+	C49	O PCIE	AC coupled off Module		Connect AC Coupling Capacitors 0.1uF to Device	DDI 3 Pair 3 differential pairs
DDI3_PAIR3-	C50				Connect AC Coupling Capacitors 0.1uF to Device	

DDI Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
DDI3_CTRLCLK_AUX+	C36	I/O PCIE	AC coupled on Module	PD 49.9K to GND **(S/W IC between Rpu/PCH)**	Connect to DP AUX+	DP AUX+ function if DDI3_DDC_AUX_SEL is no connect
		I/O OD CMOS	3.3V / 3.3V	PU 2.2K to 3.3V, PD 49.9K to GND **(S/W IC between Rpu/Rpd**	Connect to HDMI/DVI I2C CTRLCLK	HDMI/DVI I2C CTRLCLK if DDI3_DDC_AUX_SEL is pulled high
DDI3_CTRLCLK_AUX-	C37	I/O PCIE	AC coupled on Module	PU 100K to 3.3V **(S/W IC between Rpu/PCH)**	Connect to DP AUX-	DP AUX- function if DDI3_DDC_AUX_SEL is no connect
		I/O OD CMOS	3.3V / 3.3V	PU 2.2K to 3.3V/PU 100K to 3.3V **(S/W IC between 2.2K/100K resistor)**	Connect to HDMI/DVI I2C CTRLDATA	HDMI/DVI I2C CTRLDATA if DDI3_DDC_AUX_SEL is pulled high
DDI3_HPD	C44	I CMOS	3.3V / 3.3V	NC	PD 1M and Connect to device Hot Plug Detect	DDI Hot-Plug Detect
DDI3_DDC_AUX_SEL	C38	I CMOS	3.3V / 3.3V	PD 1M TO GND	PU 100K to 3.3V for DDC(HDMI/DVI)	Selects the function of DDI3_CTRLCLK_AUX+ and DDI3_CTRLDATA_AUX-.

USB Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
USB0+	A46	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 0
USB0-	A45					
USB1+	B46	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 1
USB1-	B45					
USB2+	A43	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 2
USB2-	A42					
USB3+	B43	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 3
USB3-	B42					
USB4+	A40	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 4
USB4-	A39					
USB5+	B40	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 5
USB5-	B39					
USB6+	A37	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 6
USB6-	A36					
USB7+	B37	I/O USB	3.3V Suspend/3.3V		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	USB differential pairs 7, USB7 may be configured as a USB client or as a host, or both, at the Module designer's discretion.(HM960-QM87/HM86 default set as a host)
USB7-	B36					
USB_0_1_OC#	B44	I CMOS	3.3V Suspend/3.3V	PU 10K TO 3V3_DU	Connect to Overcurrent of USB Power Switch	USB over-current sense, USB channels 0 and 1. A pull-up for this line shall be present on the Module. An open drain driver from a USB current monitor on the Carrier Board may drive this line low. Do not pull this line high on the Carrier Board.
USB_2_3_OC#	A44	I CMOS	3.3V Suspend/3.3V	PU 10K TO 3V3_DU	Connect to Overcurrent of USB Power Switch	USB over-current sense, USB channels 2 and 3. A pull-up for this line shall be present on the Module. An open drain driver from a USB current monitor on the Carrier Board may drive this line low. Do not pull this line high on the Carrier Board.
USB_4_5_OC#	B38	I CMOS	3.3V Suspend/3.3V	PU 10K TO 3V3_DU	Connect to Overcurrent of USB Power Switch	USB over-current sense, USB channels 4 and 5. A pull-up for this line shall be present on the Module. An open drain driver from a USB current monitor on the Carrier Board may drive this line low. Do not pull this line high on the Carrier Board.
USB_6_7_OC#	A38	I CMOS	3.3V Suspend/3.3V	PU 10K TO 3V3_DU	Connect to Overcurrent of USB Power Switch	USB over-current sense, USB channels 6 and 7. A pull-up for this line shall be present on the Module. An open drain driver from a USB current monitor on the Carrier Board may drive this line low. Do not pull this line high on the Carrier Board.
USB_SSTX0+	D4	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional transmit signal differential pairs for the SuperSpeed USB data path.
USB_SSTX0-	D3			AC Coupling capacitor		
USB_SSRX0+	C4	I PCIE	AC coupled off Modul		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional receive signal differential pairs for the SuperSpeed USB data path.
USB_SSRX0-	C3					
USB_SSTX1+	D7	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional transmit signal differential pairs for the SuperSpeed USB data path.
USB_SSTX1-	D6			AC Coupling capacitor		
USB_SSRX1+	C7	I PCIE	AC coupled off Modul		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional receive signal differential pairs for the SuperSpeed USB data path.
USB_SSRX1-	C6					
USB_SSTX2+	D10	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional transmit signal differential pairs for the SuperSpeed USB data path.
USB_SSTX2-	D9			AC Coupling capacitor		
USB_SSRX2+	C10	I PCIE	AC coupled off Modul		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional receive signal differential pairs for the SuperSpeed USB data path.
USB_SSRX2-	C9					
USB_SSTX3+	D13	O PCIE	AC coupled on Module	AC Coupling capacitor	Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional transmit signal differential pairs for the SuperSpeed USB data path.
USB_SSTX3-	D12			AC Coupling capacitor		
USB_SSRX3+	C13	I PCIE	AC coupled off Modul		Connect 90Ω @100MHz Common Choke in series and ESD suppressors to GND to USB connector	Additional receive signal differential pairs for the SuperSpeed USB data path.
USB_SSRX3-	C12					

LVDS Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
LVDS_A0+	A71	O LVDS	LVDS		Connect to LVDS connector	LVDS Channel A differential pairs
LVDS_A0-	A72					
LVDS_A1+	A73	O LVDS	LVDS		Connect to LVDS connector	
LVDS_A1-	A74					
LVDS_A2+	A75	O LVDS	LVDS		Connect to LVDS connector	
LVDS_A2-	A76					
LVDS_A3+	A78	O LVDS	LVDS		Connect to LVDS connector	
LVDS_A3-	A79					
LVDS_A_CK+	A81	O LVDS	LVDS		Connect to LVDS connector	LVDS Channel A differential clock
LVDS_A_CK-	A82					
LVDS_B0+	B71	O LVDS	LVDS		Connect to LVDS connector	LVDS Channel B differential pairs
LVDS_B0-	B72					
LVDS_B1+	B73	O LVDS	LVDS		Connect to LVDS connector	
LVDS_B1-	B74					
LVDS_B2+	B75	O LVDS	LVDS		Connect to LVDS connector	
LVDS_B2-	B76					
LVDS_B3+	B77	O LVDS	LVDS		Connect to LVDS connector	
LVDS_B3-	B78					
LVDS_B_CK+	B81	O LVDS	LVDS		Connect to LVDS connector	LVDS Channel B differential clock
LVDS_B_CK-	B82					
LVDS_VDD_EN	A77	O CMOS	3.3V / 3.3V		Connect to enable control of LVDS panel power	LVDS panel power enable
LVDS_BKLT_EN	B79	O CMOS	3.3V / 3.3V		Connect to enable control of LVDS panel backlight	LVDS panel backlight enable
LVDS_BKLT_CTRL	B83	O CMOS	3.3V / 3.3V		Connect to brightness control of LVDS panel backlight	LVDS panel backlight brightness control
LVDS_I2C_CK	A83	I/O OD CMOS	3.3V / 3.3V	PU 4.7K TO 3V3	Connect to DDC clock of LVDS panel	I2C clock output for LVDS display use
LVDS_I2C_DAT	A84	I/O OD CMOS	3.3V / 3.3V	PU 4.7K TO 3V3	Connect to DDC data of LVDS panel	I2C data line for LVDS display use

LPC Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
LPC_AD0	B4	I/O CMOS	3.3V / 3.3V		Connect to LPC device	LPC multiplexed address, command and data bus
LPC_AD1	B5					
LPC_AD2	B6					
LPC_AD3	B7					
LPC_FRAME#	B3	O CMOS	3.3V / 3.3V			LPC frame indicates the start of an LPC cycle
LPC_DRQ0#	B8	I CMOS	3.3V / 3.3V			LPC serial DMA request
LPC_DRQ1#	B9					
LPC_SERIRQ	A50	I/O CMOS	3.3V / 3.3V	PU 8.2K TO 3V3		LPC serial interrupt
LPC_CLK	B10	O CMOS	3.3V / 3.3V			LPC clock output - 33MHz nominal

SPI Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
SPI_CS#	B97	O CMOS	3.3V Suspend/3.3V		**Connect a series resistor 33Ω to Carrier Board SPI Device CS# pin**	Chip select for Carrier Board SPI - may be sourced from chipset SPI0 or SPI1
SPI_MISO	A92	I CMOS	3.3V Suspend/3.3V		**Connect a series resistor 33Ω to Carrier Board**	Data in to Module from Carrier SPI
SPI_MOSI	A95	O CMOS	3.3V Suspend/3.3V		**Connect a series resistor 33Ω to Carrier Board**	Data out from Module to Carrier SPI
SPI_CLK	A94	O CMOS	3.3V Suspend/3.3V		**Connect a series resistor 33Ω to Carrier Board**	Clock from Module to Carrier SPI
SPI_POWER	A91	O	3.3V Suspend/3.3V			Power supply for Carrier Board SPI – sourced from Module – nominally 3.3V. The Module shall provide a minimum of 100mA on SPI_POWER. Carriers shall use less than 100mA of SPI_POWER. SPI_POWER shall only be used to power SPI devices on the Carrier
BIOS_DIS0#	A34	I CMOS	NA			Selection straps to determine the BIOS boot device. The Carrier should only float these or pull them low, please refer to COM Express Module Base Specification Revision 2.1 for strapping options of BIOS disable signals.
BIOS_DIS1#	B88					

VGA Signals Descriptions						
Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
VGA_RED	B89	O Analog	Analog	PD 150 TO GND	**PD 150R,connect to VGA connector with EMI**	Red for monitor. Analog output
VGA_GRN	B91	O Analog	Analog	PD 150 TO GND	**PD 150R,connect to VGA connector with EMI**	Green for monitor. Analog output
VGA_BLU	B92	O Analog	Analog	PD 150 TO GND	**PD 150R,connect to VGA connector with EMI**	Blue for monitor. Analog output
VGA_HSYNC	B93	O CMOS	3.3V / 3.3V		**Connect to VGA connector with a3.3V Buffer**	Horizontal sync output to VGA monitor
VGA_VSYNC	B94	O CMOS	3.3V / 3.3V		**Connect to VGA connector with a 33V Buffer**	Vertical sync output to VGA monitor
VGA_I2C_CK	B95	I/O OD CMOS	3.3V / 3.3V	PU 2.2K TO 3V3	**Connect to VGA connector with a 3.3V to 5V**	DDC clock line (I2C port dedicated to identify VGA monitor capabilities)
VGA_I2C_DAT	B96	I/O OD CMOS	3.3V / 3.3V	PU 2.2K TO 3V3	**Connect to VGA connector with a 3.3V to 5V**	DDC data line.

Serial Interface Signals Descriptions						
Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
SER0_TX	A98	O CMOS	3.3V/5V		PD 4.7K TO GND	General purpose serial port 0 transmitter
SER0_RX	A99	I CMOS	3.3V/5V	PU 47K TO 3V3		General purpose serial port 0 receiver
SER1_TX	A101	O CMOS	3.3V/5V		PD 4.7K TO GND	General purpose serial port 1 transmitter
SER1_RX	A102	I CMOS	3.3V/5V	PU 47K TO 3V3		General purpose serial port 1 receiver

Miscellaneous Signal Descriptions						
Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
I2C_CK	B33	I/O OD CMOS	3.3V Suspend/3.3V	PU 2.2K TO 3V3_DU_EC		General purpose I2C port clock output
I2C_DAT	B34	I/O OD CMOS	3.3V Suspend/3.3V	PU 2.2K TO 3V3_DU_EC		General purpose I2C port data I/O line
SPKR	B32	O CMOS	3.3V / 3.3V			Output for audio enunciator - the "speaker" in PC-AT systems. This port provides the PC beep signal and is mostly intended for debugging purposes.
WDT	B27	O CMOS	3.3V / 3.3V			Output indicating that a watchdog time-out event has occurred.
FAN_PWNOUT	B101	O OD CMOS	3.3V / 12V			Fan speed control. Uses the Pulse Width Modulation (PWM) technique to control the fan's RPM.
FAN_TACHIN	B102	I OD CMOS	3.3V / 12V	PU 10K TO 3V3		Fan tachometer input for a fan with a two pulse output.
TPM_PP	A96	I CMOS	3.3V / 3.3V	PU 0 TO 3V3_DU	NC PU 4.7K TO 3V3_SB	Trusted Platform Module (TPM) Physical Presence pin. Active high. TPM chip has an internal pull down. This signal is used to indicate Physical Presence to the TPM.

Power and System Management Signals Descriptions						
Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
PWRBTN#	B12	I CMOS	3.3V Suspend/3.3V	PU 10K TO 3V3_DU_EC	PU 4.7K TO 3V3_SB	A falling edge creates a power button event. Power button events can be used to bring a system out of S5 soft off and other suspend states, as well as powering the system down.
SYS_RESET#	B49	I CMOS	3.3V Suspend/3.3V	PU 10K TO 3V3_DU	NC PU 4.7K TO 3V3_SB	Reset button input. Active low request for Module to reset and reboot. May be falling edge sensitive. For situations when SYS_RESET# is not able to reestablish control of the system, PWR_OK or a power cycle may be used.
CB_RESET#	B50	O CMOS	3.3V Suspend/3.3V			Reset output from Module to Carrier Board. Active low. Issued by Module chipset and may result from a low SYS_RESET# input, a low PWR_OK input, a VCC_12V power input that falls below the minimum specification, a watchdog timeout, or may be initiated by the Module software.
PWR_OK	B24	I CMOS	3.3V / 3.3V	PU 10K TO 3V3		Power OK from main power supply. A high value indicates that the power is good. This signal can be used to hold off Module startup to allow Carrier based FPGAs or other configurable devices time to be programmed.

Power and System Management Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
SUS_STAT#	B18	O CMOS	3.3V Suspend/3.3V			Indicates imminent suspend operation; used to notify LPC devices.
SUS_S3#	A15	O CMOS	3.3V Suspend/3.3V			Indicates system is in Suspend to RAM state. Active low output. An inverted copy of SUS_S3# on the Carrier Board may be used to enable the non-standby power on a typical ATX supply.
SUS_S4#	A18	O CMOS	3.3V Suspend/3.3V			Indicates system is in Suspend to Disk state. Active low output.
SUS_S5#	A24	O CMOS	3.3V Suspend/3.3V			Indicates system is in Soft Off state.
WAKE0#	B66	I CMOS	3.3V Suspend/3.3V	PU 1K TO 3V3_DU		PCI Express wake up signal.
WAKE1#	B67	I CMOS	3.3V Suspend/3.3V	PU 10K TO 3V3_DU	NC PU 10 K TO 3V3_DU	General purpose wake up signal. May be used to implement wake-up on PS2 keyboard or mouse activity.
BATLOW#	A27	I CMOS	3.3V Suspend/ 3.3V	PU 8.2K TO 3V3_DU		Indicates that external battery is low. This port provides a battery-low signal to the Module for orderly transitioning to power saving or power cut-off ACPI modes.
LID#	A103	I OD CMOS	3.3V Suspend/12V			LID switch. Low active signal used by the ACPI operating system for a LID switch.
SLEEP#	B103	I OD CMOS	3.3V Suspend/12V	PU 10K TO 3V3_DU		Sleep button. Low active signal used by the ACPI operating system to bring the system to sleep state or to wake it up again.
THRM#	B35	I CMOS	3.3V / 3.3V	PU 10K TO 3V3		Input from off-Module temp sensor indicating an over-temp situation.
THRMTRIP#	A35	O CMOS	3.3V / 3.3V	PU 10K TO 3V3		Active low output indicating that the CPU has entered thermal shutdown.
SMB_CK	B13	I/O OD CMOS	3.3V Suspend/3.3V	PU 2.2K TO 3V3_DU_EC	NC PU 4.7K TO 3V3_DU	System Management Bus bidirectional clock line.
SMB_DAT	B14	I/O OD CMOS	3.3V Suspend/3.3V	PU 2.2K TO 3V3_DU_EC	NC PU 4.7K TO 3V3_DU	System Management Bus bidirectional data line.
SMB_ALERT#	B15	I CMOS	3.3V Suspend/3.3V			System Management Bus Alert – active low input can be used to generate an SMI# (System Management Interrupt) or to wake the system.

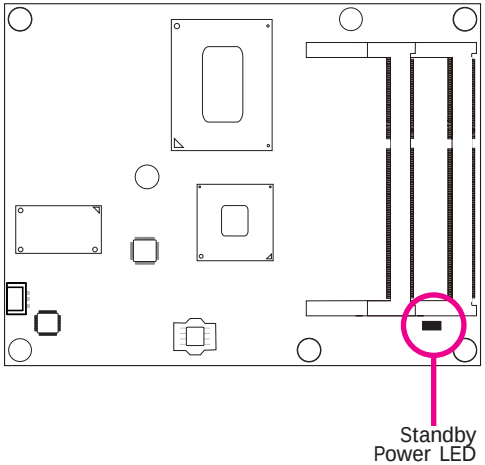
GPIO Signals Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
GPO0	A93	O CMOS	3.3V / 3.3V			General purpose output pins.
GPO1	B54					
GPO2	B57					
GPO3	B63					
GPI0	A54	I CMOS	3.3V / 3.3V	PU 100K TO 3V3		General purpose input pins.
GPI1	A63			PU 100K TO 3V3		
GPI2	A67			PU 100K TO 3V3		
GPI3	A85			PU 100K TO 3V3		

Power and GND Signal Descriptions

Signal	Pin#	Pin Type	Pwr Rail /Tolerance	HM960-QM87/HM86	Carrier Board	Description
VCC_12V	A104~A109 B104~B109 C104~C109 D104~D109	Power				Primary power input: +12V nominal. All available VCC_12V pins on the connector(s) shall be used.
VCC_5V_SBY	B84~B87	Power				Standby power input: +5.0V nominal. If VCC5_SBY is used, all available VCC_5V_SBY pins on the connector(s) shall be used. Only used for standby and suspend functions. May be left unconnected if these functions are not used in the system design.
VCC_RTC	A47	Power				Real-time clock circuit-power input. Nominally +3.0V.
GND	A1, A11, A21, A31, A41, A51, A57, A60, A66, A70, A80, A90, A100, A110, B1, B11, B21 ,B31, B41, B51, B60, B70, B80, B90, B100, B110, C1, C2, C5, C8, C11, C14, C21, C31, C41, C51, C60, C70, C73, C76, C80, C84, C87, C90, C93, C96, C100, C103, C110, D1, D2, D5, D8, D11, D14, D21, D31, D51, D60, D67, D70, D73, D76, D80, D84, D87, D90, D93, D96, D100, D103, D110	Power				Ground - DC power and signal and AC signal return path. All available GND connector pins shall be used and tied to Carrier Board GND plane.

Standby Power LED



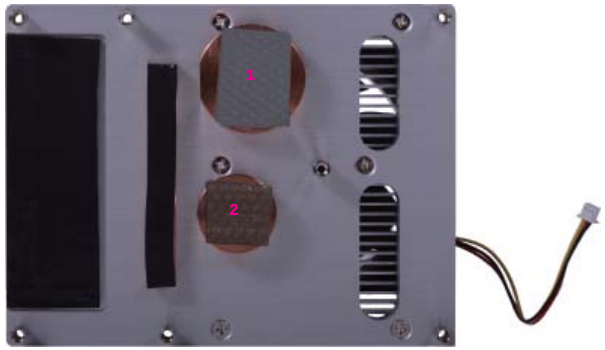
This LED will light when the system is in the standby mode.

Cooling Option

Heat Spreader with Heat Sink and Fan

Note:
The system board used in the following illustrations may not resemble the actual board. These illustrations are for reference only.

Top View of the Heat Sink



Bottom View of the Heat Sink

• “1” and “2” denote the locations of the thermal pads designed to contact the corresponding components that are on HM960-QM87/HM86.

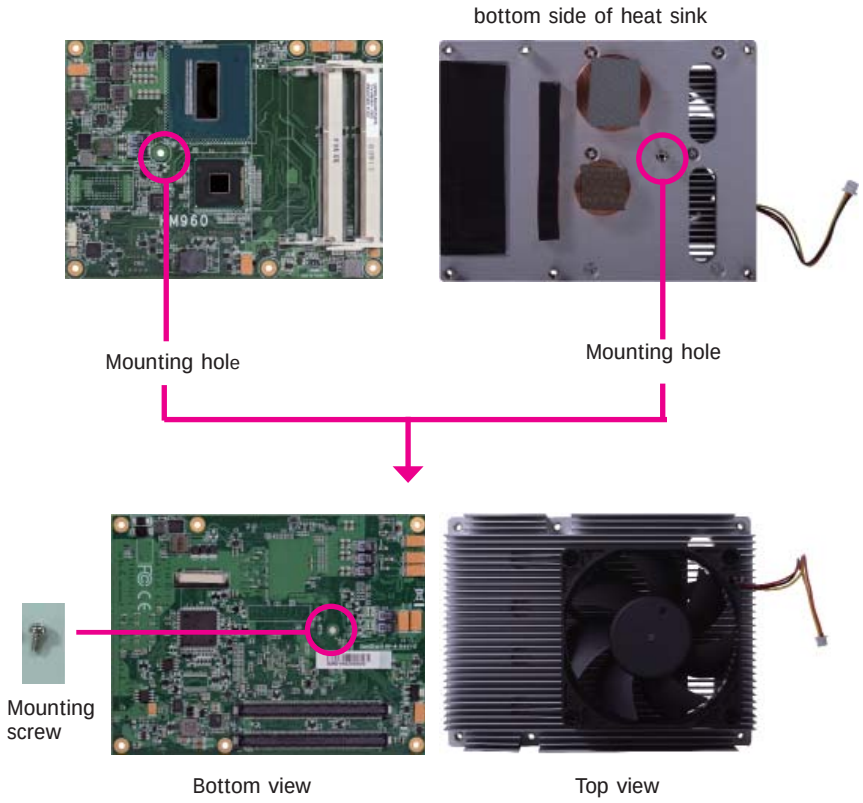
Important:
Remove the plastic covering from the thermal pads prior to mounting the heat sink onto HM960-QM87/HM86.

Installing HM960-QM87/HM86 onto a Carrier Board

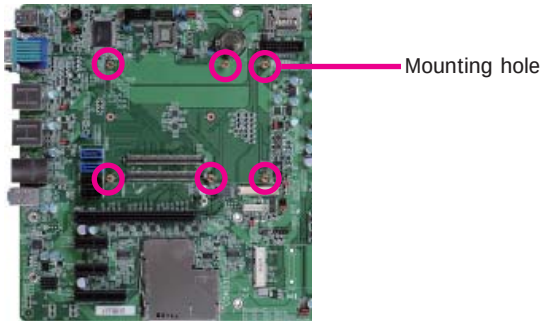
Important:
The carrier board (COM331-B) used in this section is for reference purpose only and may not resemble your carrier board. These illustrations are mainly to guide you on how to install HM960-QM87/HM86 onto the carrier board of your choice.

• To download COM331-B datasheet and manual

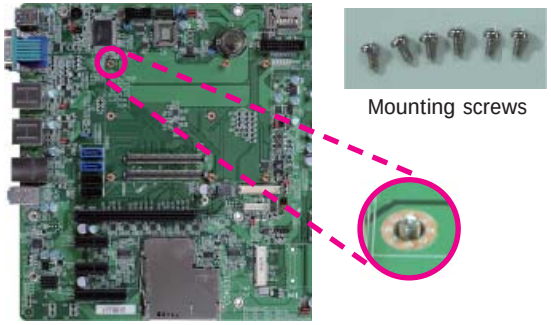
1. Use the provided screw to install the heatsink onto the module. First align the mounting hole of the heatsink with the mounting hole of the module and then from the bottom side of the module, secure them with the provided screw. The module and heatsink as sembly should look like the one shown below.



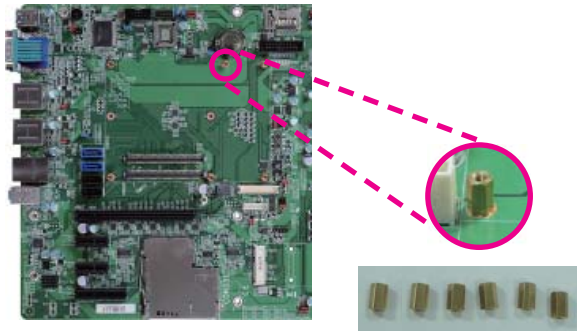
2. Now install the module and heatsink assembly onto the carrier board. The photo below shows the locations of the mounting holes on carrier board.



3. Insert the provided mounting screws into the mounting holes - from the bottom through the top of the carrier board.

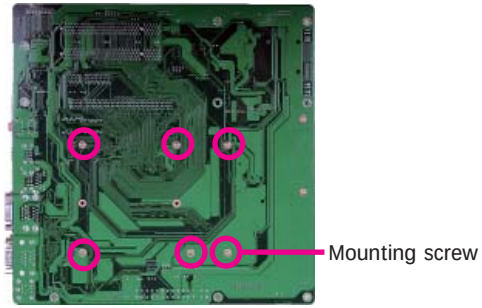


4. While supporting the mounting screw at the bottom, from the top side of the board, fasten a bolt into the screw.

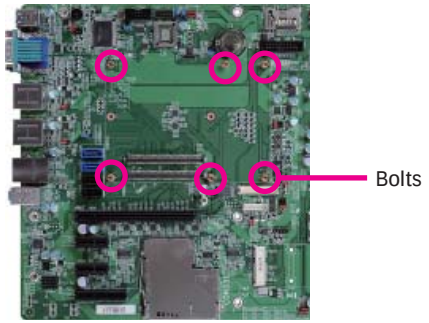


Bolts

5. The photo below shows the solder side of the board with the screws already fixed in place.



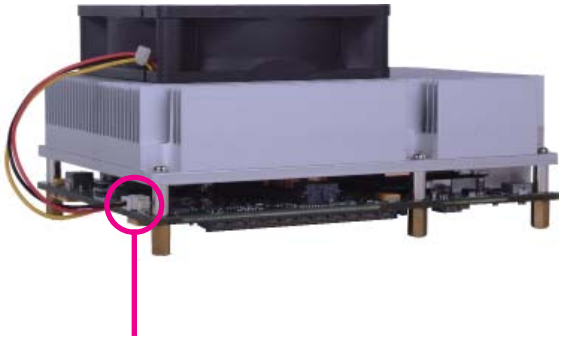
6. The photo below shows the component side of the board with the bolts already fixed in place.



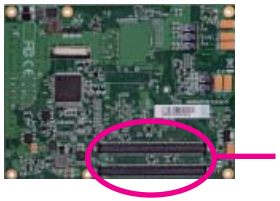
7. Position the heat sink on the top of HM960-QM87/HM86 with the heat sink's mounting holes aligned with HM960-QM87/HM86 mounting holes. Insert one of the provided long screws into the mounting hole shown in the photo below.

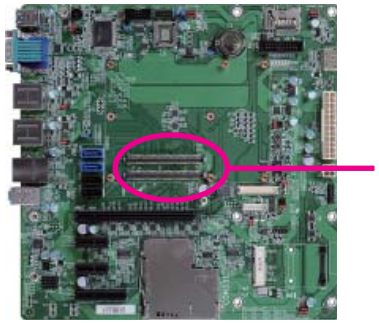
Long screw

8. From the bottom of the board, fasten the provided bolt into the screw and then connect the heat spreader/heat spreader with heat sink and fan's cable to the fan connector on HM960-QM87/HM86.

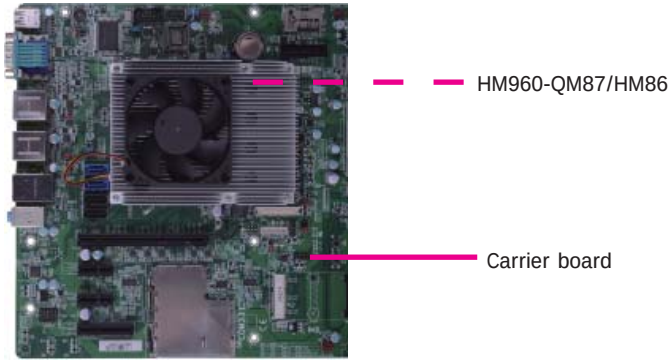


9. Grasping HM960-QM87/HM86 by its edges, position it on top of the carrier board with its mounting holes aligned with the bolts on the carrier board. This will also align the COM Express connectors of the two boards to each other.

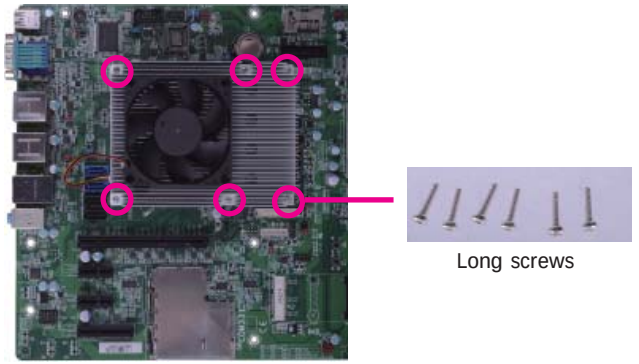




10. Press HM960-QM87/HM86 down firmly until it is completely seated on the COM Express connectors of the carrier board.



11. Use the provided mounting screws to secure HM960-QM87/HM86 with heat sink to the carrier board. The photo below shows the locations of the long/short mounting screws.

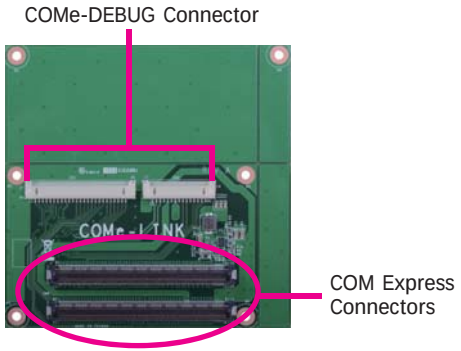


Installing the COM Express Debug Card

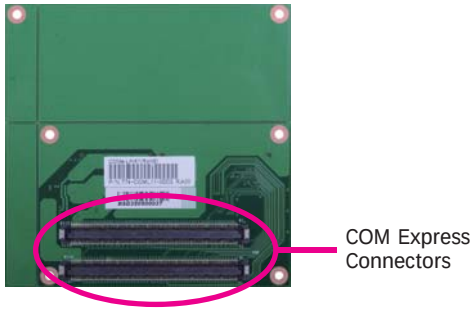
Note:
The system board used in the following illustrations may not resemble the actual board. These illustrations are for reference only.

1. COMe-LINK1 is the COM Express debug card designed for COM Express Basic modules to debug and display signals and codes of COM Express modules.

COMe-LINK1



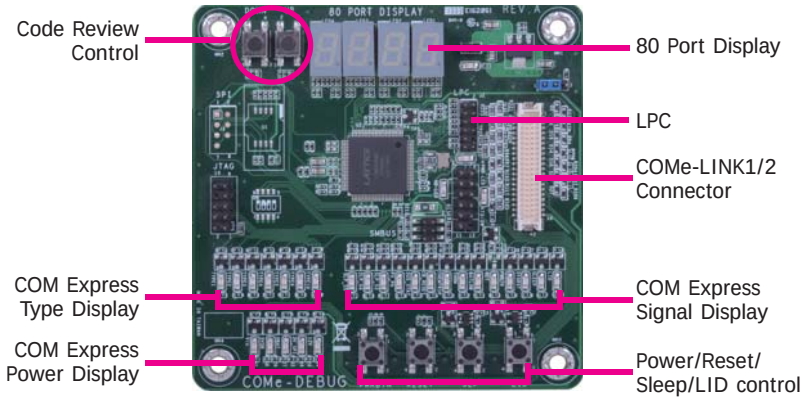
Top view

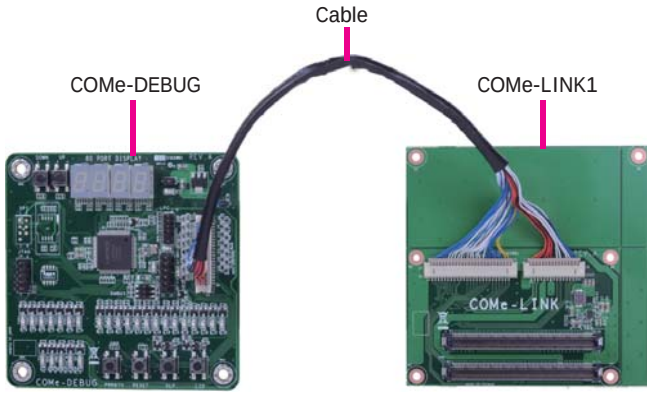


Bottom view

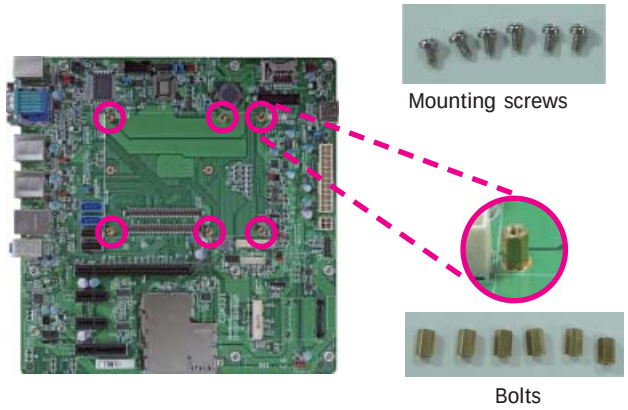
2. Connect the COMe-DEBUG card to COMe-LINK1 via a cable.

COMe-DEBUG

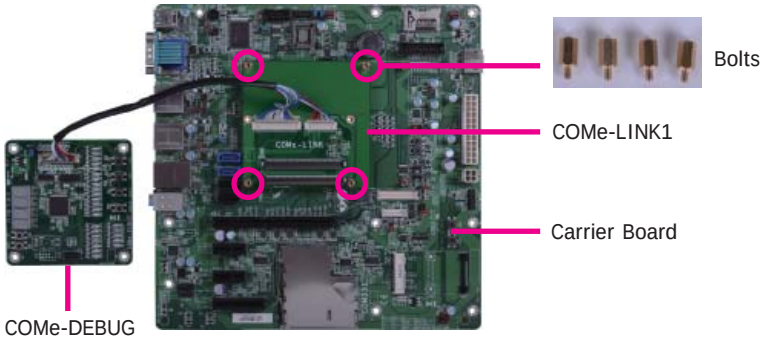




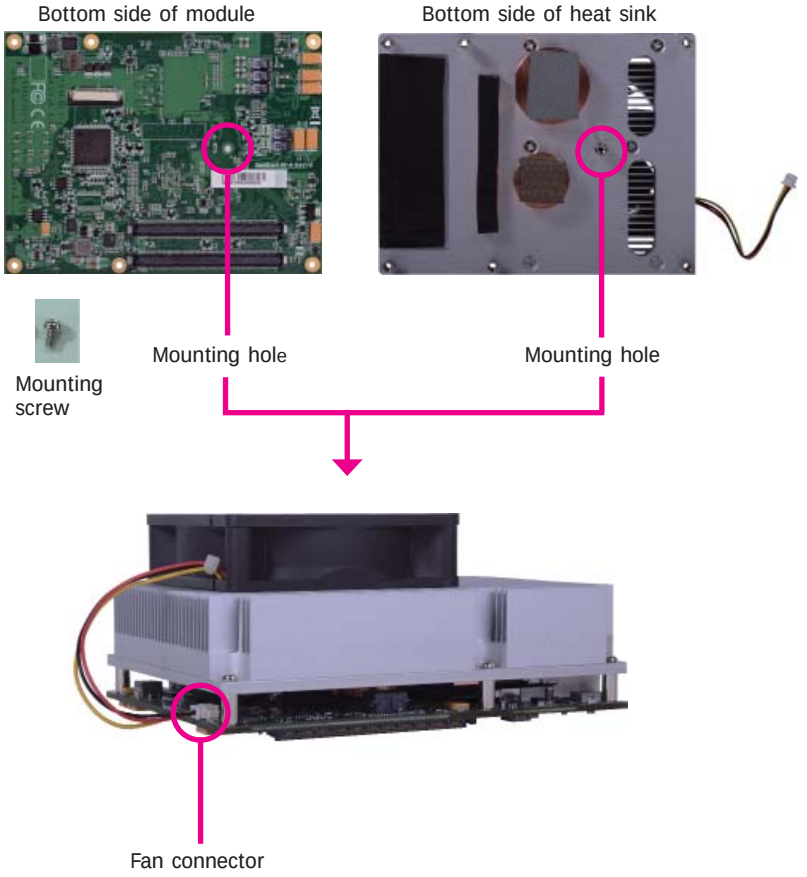
3. Fasten bolts with mounting screws through mounting holes to be fixed in place.



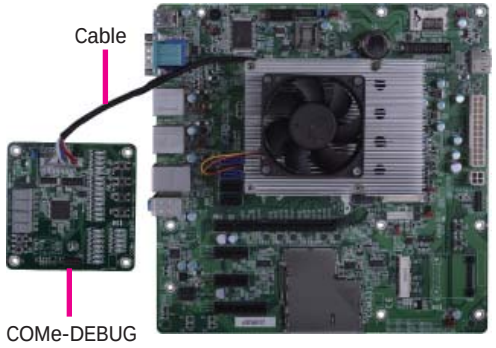
4. Use the provided bolts to fix the COMe-LINK1 debug card onto the carrier board.

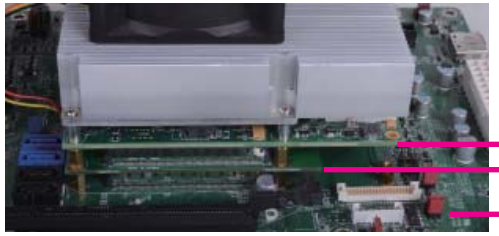


5. Align the mounting hole on the heat sink with the mounting hole on the module and secure the heat sink onto the module by a mounting screw from the bottom side of the module.



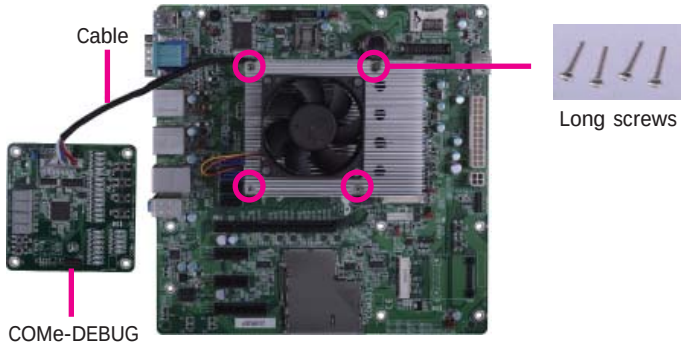
6. Grasp HM960-QM87/HM86 with the heat sink by its edges and position them down firmly on the top of the COMe-LINK1 debug card.





Side View of the Module, Debug Card and Carrier Board

7. Use the long mounting screws to secure them on the top of the COMe-LINK1 debug card and the carrier board. The photo below shows the locations of long mounting screws.



Chapter 4 - BIOS Setup

Overview

The BIOS is a program that takes care of the basic level of communication between the CPU and peripherals. It contains codes for various advanced features found in this system board. The BIOS allows you to configure the system and save the configuration in a battery-backed CMOS so that the data retains even when the power is off. In general, the information stored in the CMOS RAM of the EEPROM will stay unchanged unless a configuration change has been made such as a hard drive replaced or a device added.
It is possible that the CMOS battery will fail causing CMOS data loss. If this happens, you need to install a new CMOS battery and reconfigure the BIOS settings.

Note:
The BIOS is constantly updated to improve the performance of the system board; therefore the BIOS screens in this chapter may not appear the same as the actual one. These screens are for reference purpose only.

Default Configuration

Most of the configuration settings are either predefined according to the Load Optimal Defaults settings which are stored in the BIOS or are automatically detected and configured without requiring any actions. There are a few settings that you may need to change depending on your system configuration.

Entering the BIOS Setup Utility

The BIOS Setup Utility can only be operated from the keyboard and all commands are keyboard commands. The commands are available at the right side of each setup screen.

The BIOS Setup Utility does not require an operating system to run. After you power up the system, the BIOS message appears on the screen and the memory count begins. After the memory test, the message “Press DEL to run setup” will appear on the screen. If the message disappears before you respond, restart the system or press the “Reset” button. You may also restart the system by pressing the <Ctrl> <Alt> and <Del> keys simultaneously.

Legends

KEYs	Function
Right and Left Arrows	Moves the highlight left or right to select a menu.
Up and Down Arrows	Moves the highlight up or down between submenus or fields.
<Esc>	Exits to the BIOS setup utility
+ (plus key)	Scrolls forward through the values or options of the hightlighted field.
- (minus key)	Scolls backward through the values or options of the hightlighted field.
<F1>	Displays general help
<F2>	Displays previous values
<F3>	Optimized defaults
<F4>	Saves and reset the setup program.
<Enter>	Press <Enter> to enter the highlighted submenu

Scroll Bar

When a scroll bar appears to the right of the setup screen, it indicates that there are more available fields not shown on the screen. Use the up and down arrow keys to scroll through all the available fields.

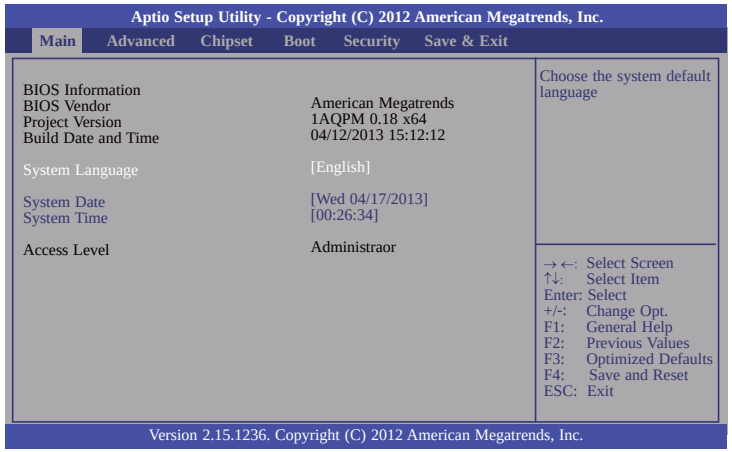
Submenu

When “▶“ appears on the left of a particular field, it indicates that a submenu which contains additional options are available for that field. To display the submenu, move the highlight to that field and press <Enter>.

AMI BIOS Setup Utility

Main

The Main menu is the first screen that you will see when you enter the BIOS Setup Utility.



System Date

The date format is <day>, <month>, <date>, <year>. Day displays a day, from Sunday to Saturday. Month displays the month, from January to December. Date displays the date, from 1 to 31. Year displays the year, from 1980 to 2099.

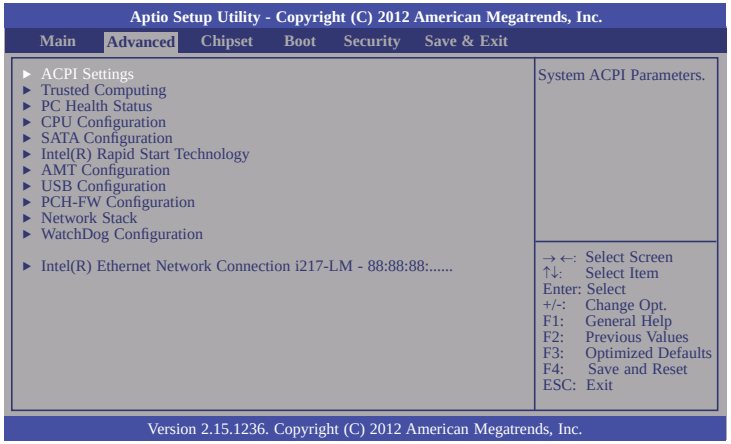
System Time

The time format is <hour>, <minute>, <second>. The time is based on the 24-hour military-time clock. For example, 1 p.m. is 13:00:00. Hour displays hours from 00 to 23. Minute displays minutes from 00 to 59. Second displays seconds from 00 to 59.

Advanced

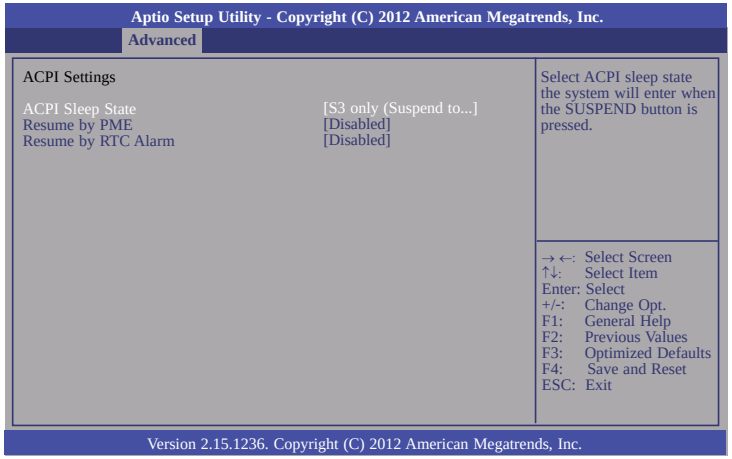
The Advanced menu allows you to configure your system for basic operation. Some entries are defaults required by the system board, while others, if enabled, will improve the performance of your system or let you set some features according to your preference.

Important:
Setting incorrect field values may cause the system to malfunction.



ACPI Settings

This section is used to configure the ACPI settings.



ACPI Sleep State

Select the highest ACPI sleep state that the system will enter when the Suspend button is pressed.

S3(STR) Enable the Suspend to RAM function.

Resume by PME

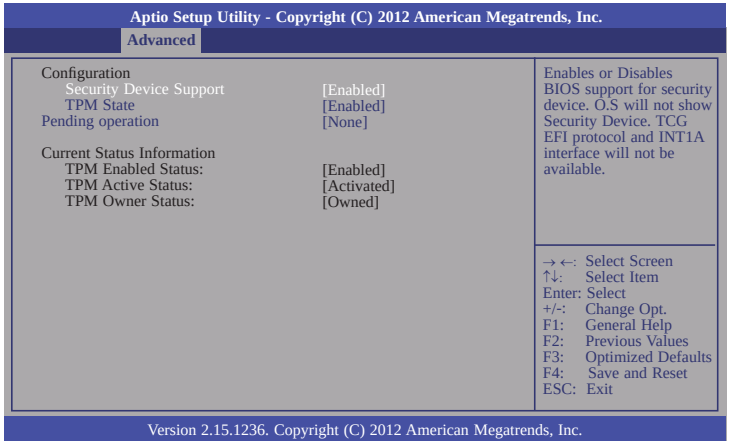
Enable this field to use the PME signal to wake up the system (via PCI, PCIE and onboard LAN).

Resume by RTC Alarm

When Enabled, the system uses the RTC to generate a wakeup event.

Trusted Computing

This section configures settings relevant to Trusted Computing innovations.



Security Device Support

This field is used to enable or disable BIOS supporting for the security device. O.S will not show the security device. TCG EFI protocol and INT1A interface will not be available.

TPM State

Enable or disable the security device.

Note:
Your computer will reboot during restart in order to change the state of the device.

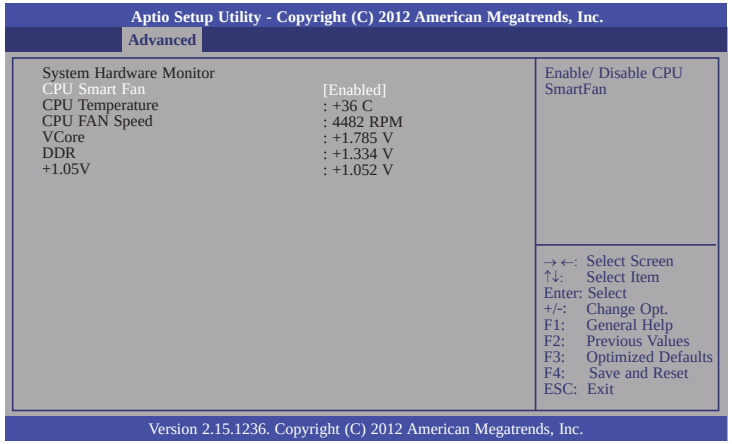
Pending operation

Arrange the schedule for an pending operation of the security device.

Note:
Your computer will reboot during restart in order to change the state of the device.

PC Health Status

This section displays hardware health monitor.

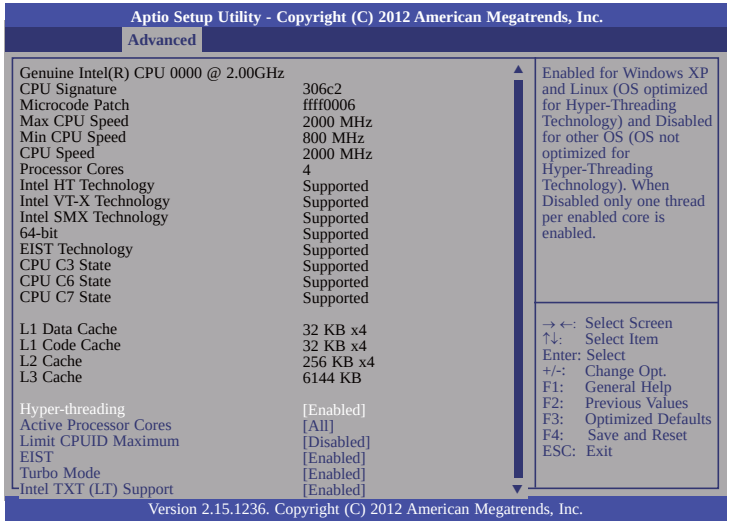


CPU Smart Fan

Enable or disable the CPU smart fan.

CPU Configuration

This section is used to configure the CPU. It will also display the detection of CPU information.



Hyper-threading

Enable this field for Windows XP and Linux which are optimized for Hyper-Threading technology. Select disabled for other OSes not optimized for Hyper-Threading technology. When disabled, only one thread per enabled core is enabled.

Active Processor Cores

Number of cores to enable in each processor package.

Limit CPUID Maximum

The CPUID instruction of some newer CPUs will return a value greater than 3. The default is Disabled because this problem does not exist in the Windows series operating systems. If you are using an operating system other than Windows, this problem may occur. To avoid this problem, enable this field to limit the return value to 3 or less than 3.

EIST

This field is used to enable or disable the Intel Enhanced SpeedStep Technology.

Turbo Mode

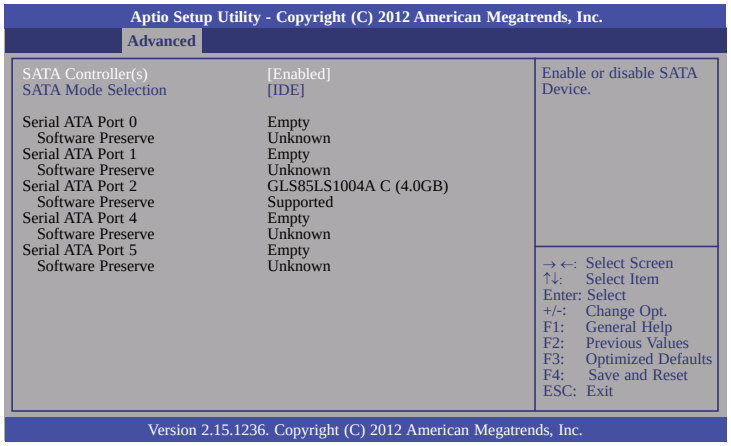
If you want the system to run at a faster speed, set this field to Enabled. However, compatibility problems may occur with some DRAMs if the system is running in Turbo mode. If you encounter this problem, set this field to Disabled.

Intel TXT (LT) Support

Enable or disable the support of Intel Trusted Execution technology.

SATA Configuration

This section is used to configure the settings of SATA device.



SATA Controller(s)

This field is used to enable or disable the Serial ATA channels.

SATA Mode Selection

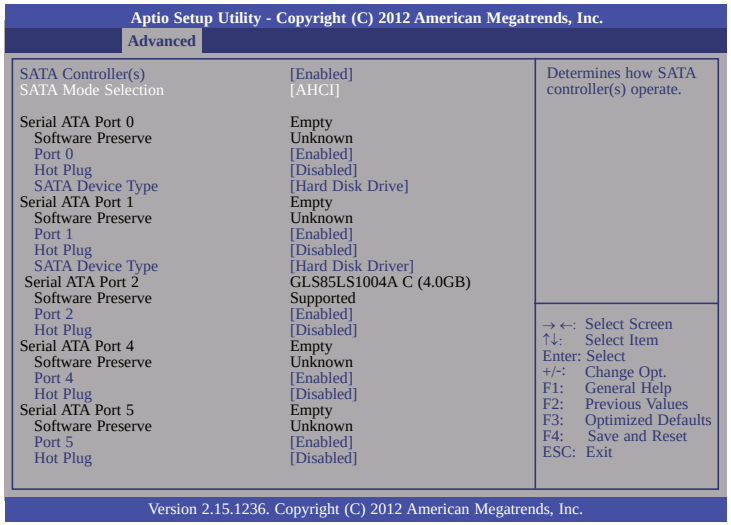
Determine how the Serial ATA controller(s) operates.

IDE Mode
This option configures the Serial ATA drives as Parallel ATA storage devices.

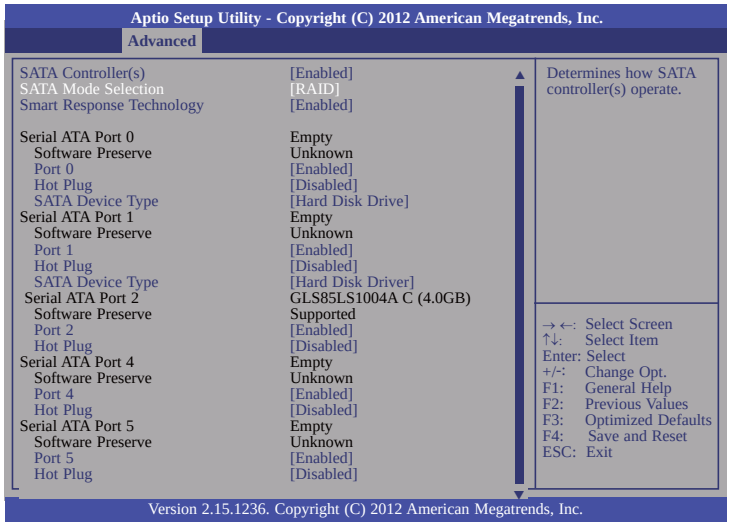
AHCI Mode
This option allows the Serial ATA devices to use AHCI (Advanced Host Controller Interface).

RAID Mode
This option allows the Serial ATA devices to use RAID 0/1/5/10/Recovery (Redundant Array of Independent Disks)

When AHCI mode is selected in the SATA Mode Selection, it will display the following information:



When RAID mode is selected in the SATA Mode Selection, it will display the following information:



Smart Response Technology

This field is used to enable or disable the Smart Response Technology.

Port 0/1/2/4/5

Enable or disable the Serial ATA port 0/1/2/4/5.

Hot Plug

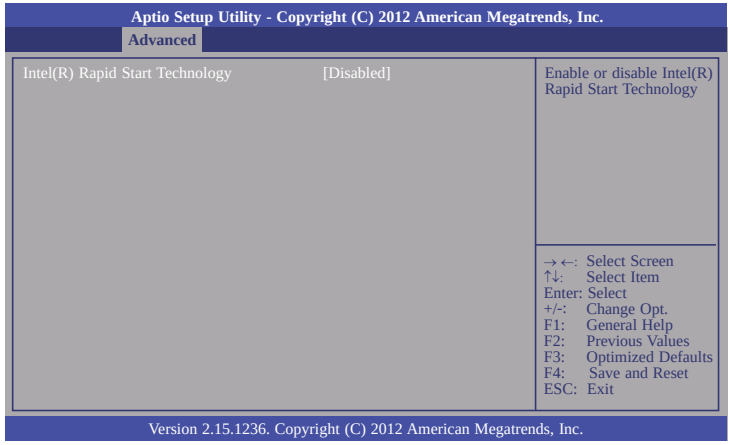
Designate the Serial ATA port 0/1/2/4/5 as Hot Pluggable.

SATA Device Type

Identify the Serial ATA port is connected to Solid State Drive or Hard Disk Drive.

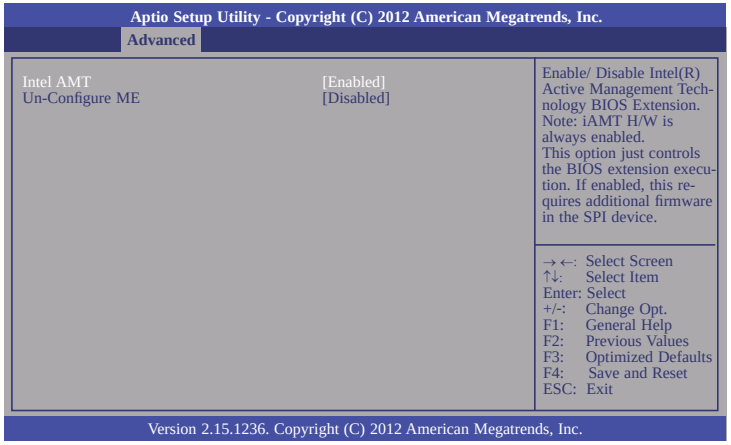
Intel(R) Rapid Start Technology

This section is used to enable or disable the Intel Rapid Start Technology.



AMT Configuration

This section configures the parameters of Active Management Technology.



Intel AMT

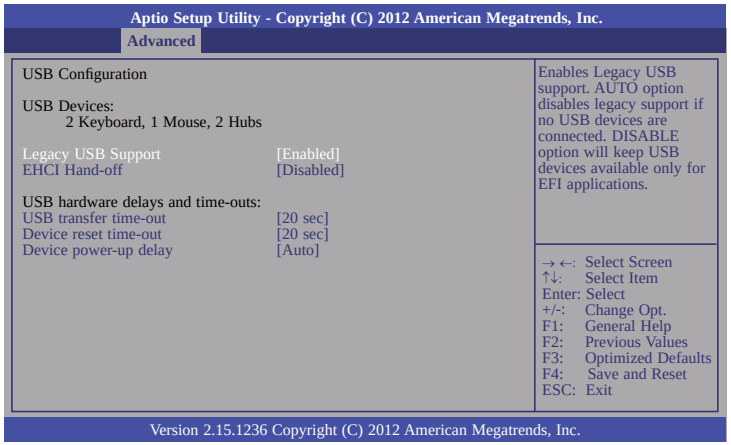
Enable or disable the AMT function.

Un-Configure ME

Select Enabled to unconfigure the ME function without the need for a password.

USB Configuration

This section is used to configure the parameters of USB.



Legacy USB Support

Enabled
Enable legacy USB.

Auto
Disable support for legacy when no USB devices are connected.

Disabled
Keep USB devices available only for EFI applications.

EHCI Hand-off

This is a workaround for OSes that does not support EHCI hand-off. The chane of EHCI ownership should be claimed by the EHCI driver.

USB transfer time-out

The time-out value for Bulk and Interrupt transfers.

Device reset time-out

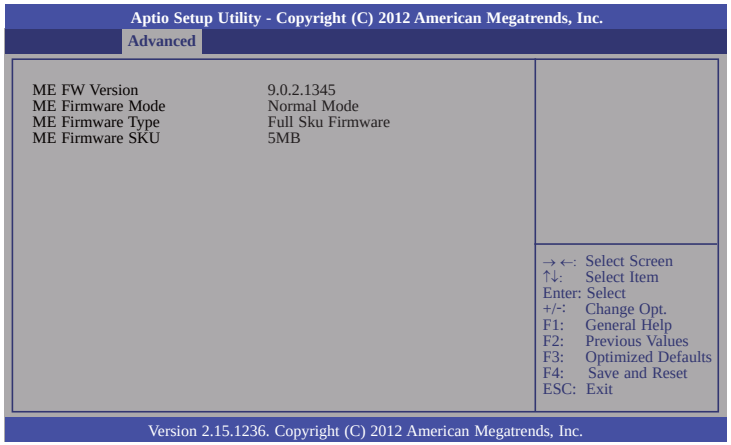
Select the USB mass storage device start unit command timeout.

Device power-up delay

Maximum time the device will take before it properly reports itself to the Host Controller. “Auto” uses default value: for a Root port it is 100 ms, for a Hub port the delay is taken from Hub descriptor.

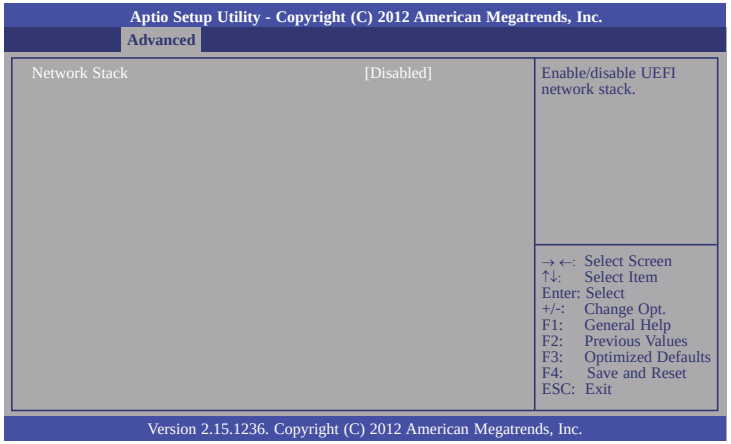
PCH-FW Configuration

This section is used to configure the parameters of Management Engine Technology.

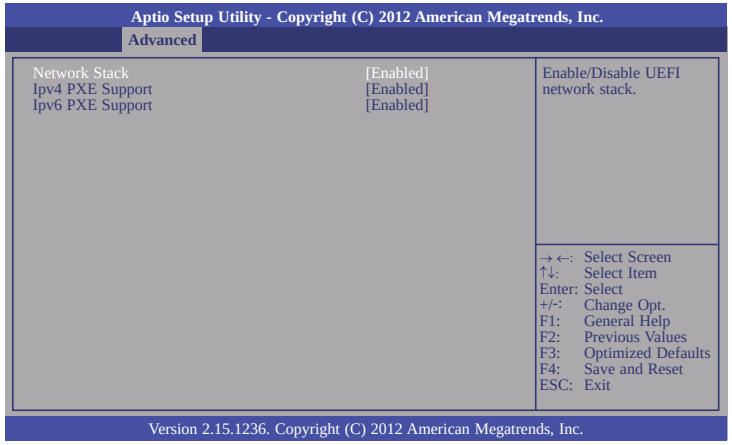


Network Stack

This section is used to enable or disable UEFI network stack.



When Network Stack is enabled, it will display the following information:



Ipv4 PXE Support

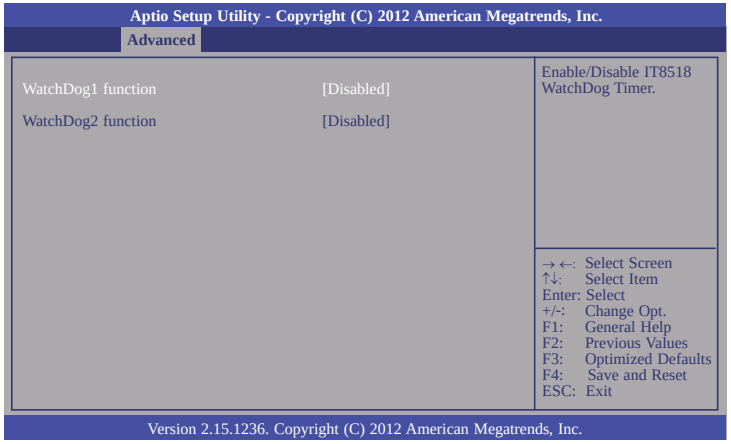
When enabled, Ipv4 PXE boot supports. When disabled, Ipv4 PXE boot option will not be created.

Ipv6 PXE Support

When enabled, Ipv6 PXE boot supports. When disabled, Ipv6 PXE boot option will not be created.

WatchDog Configuration

This field is used to enable or disable the Watchdog timer function.



WatchDog1 function

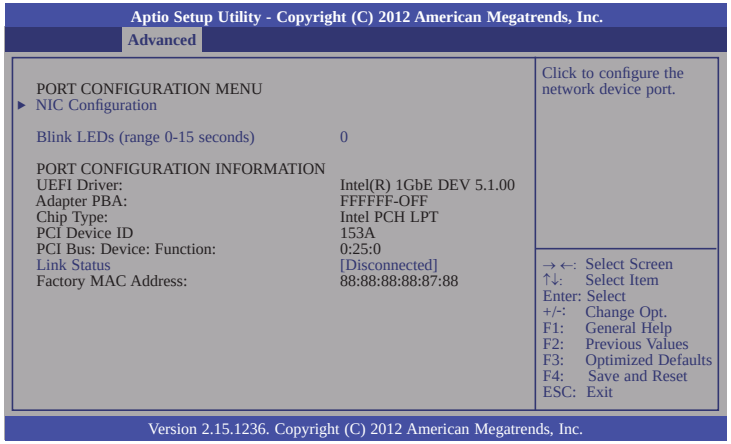
For HM960-QM87/HM86 module board (Reset HM960-QM87/HM86 by hardware).

WatchDog2 function

For carrier board usage.

Intel(R) Ethernet Network Connection i217-LM - 88:88:88:...

This section is used to configure the parameters of Gigabit Ethernet device.



NIC Configuration

This field is used to configure the network device.

Blink LEDs

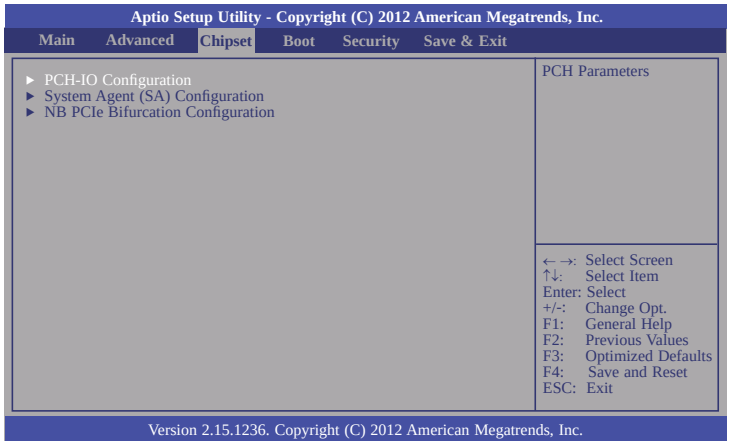
Blink LEDs for the specified duration (up to 15 seconds).

Link Status

This field indicates the link status of the network device.

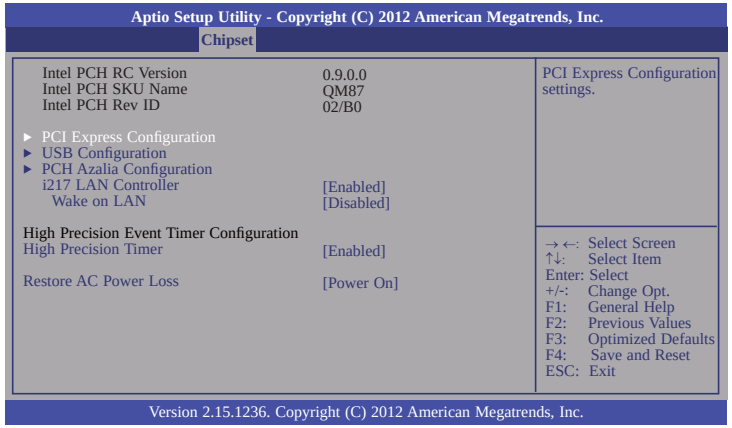
Chipset

The section configures the relevant functions of chipset.



PCH-IO Configuration

This section configures PCH parameters.



i217 LAN Controller

Enable or disable onboard NIC.

Wake on LAN

Set this field to enable to wake up the system via the onboard LAN or via a LAN card that supports the remote wake up function.

High Precision Timer

Enable or disable the High Precision Event Timer.

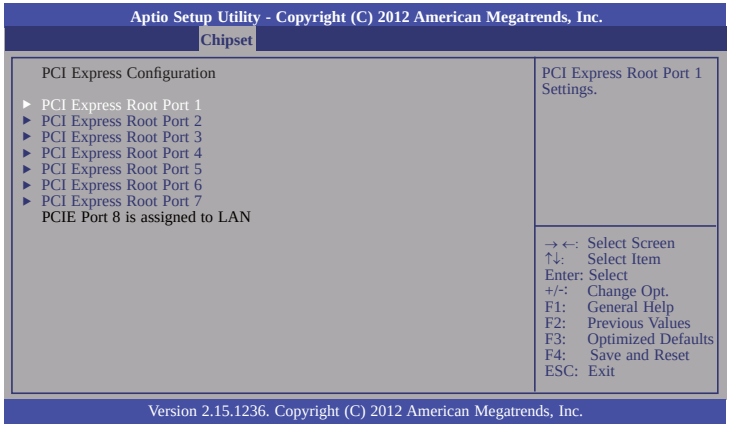
Restore AC Power Loss

Power-off
When power returns after an AC power failure, the system's power is off. You must press the Power button to power-on the system.

Power-on
When power returns after an AC power failure, the system will automatically power-on.

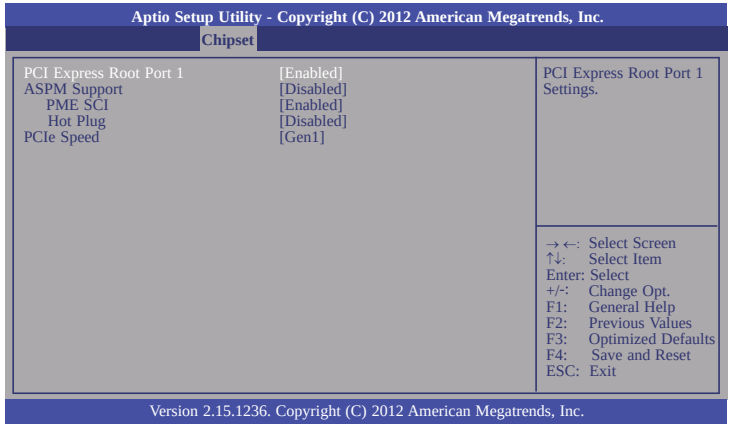
Last State
When power returns after an AC power failure, the system will return to the state where you left off before power failure occurs. If the system's power is off when AC power failure occurs, it will remain off when power returns. If the system's power is on when AC power failure occurs, the system will power-on when power returns.

PCI Express Configuration



PCI Express Root Port 1 to PCI Express Root Port 7

Control the PCI Express Root Port.



ASPM Support

Select the ASPM level. The options are listed as below:

Force L0s	Forces all links to L0s State.
Auto	The BIOS automatically select an ASPM level.
Disabled	Disables ASPM.

PME SCI

Enable or disable PCI Express PME SCI.

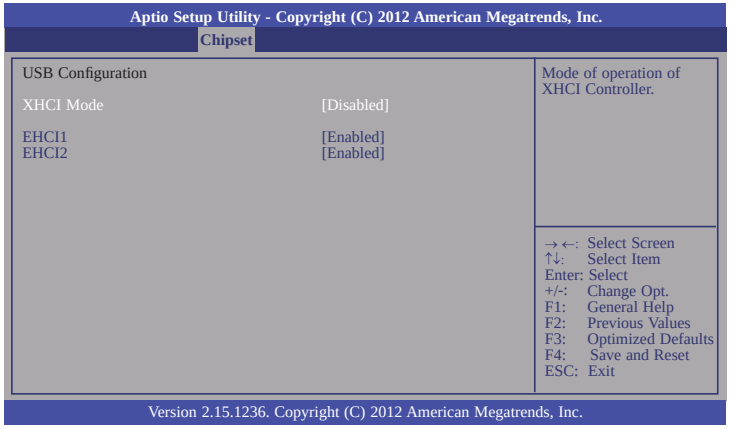
Hot Plug

Enable or disable PCI Express Hot Plug.

PCIe Speed

Select the PCIe Speed: Gen1 or Gen 2.

USB Configuration



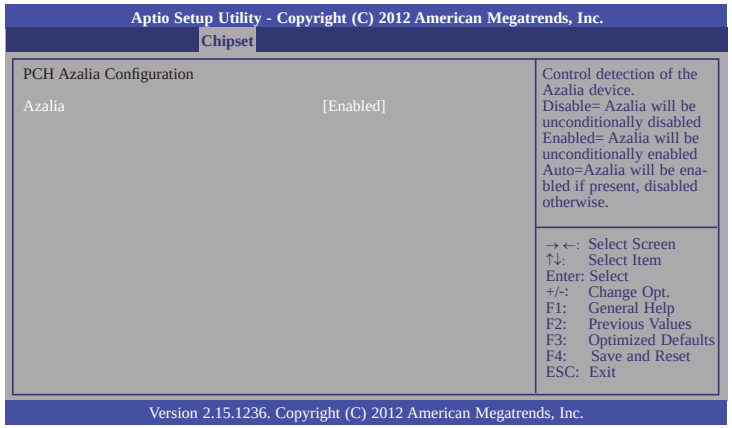
XHCI Mode

Select the operation mode of XHCI controller. These options are Smart Auto, Auto, Enabled, Disabled.

EHCI 1 and EHCI 2

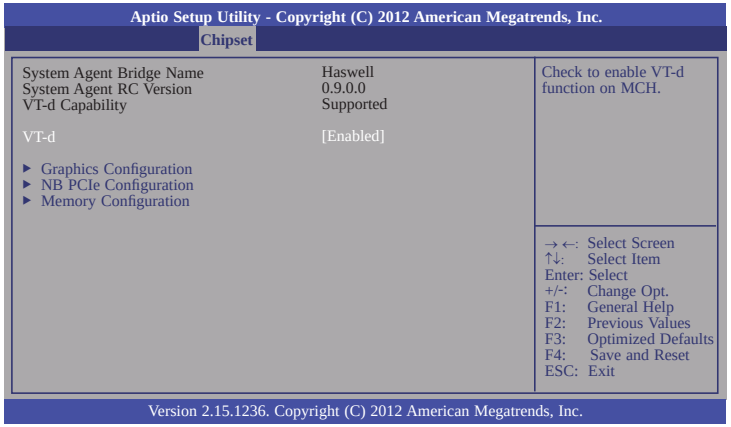
These fields are used to control the functions of USB EHCI (USB 2.0) controllers. One EHCI controller must always be enabled.

PCH Azalia Configuration

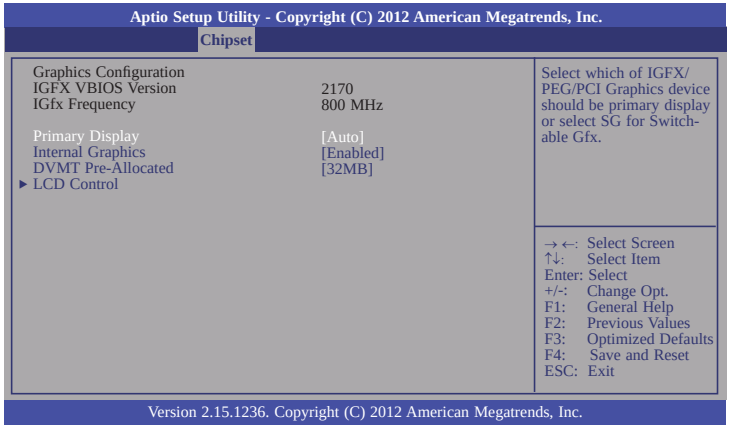


System Agent (SA) Configuration

This section configures System Agent (SA) parameters.



Graphics Configuration



Primary Display

Auto When the system boots, it will auto detects the display device.

IGFX When the system boots, it will first initialize the onboard VGA.

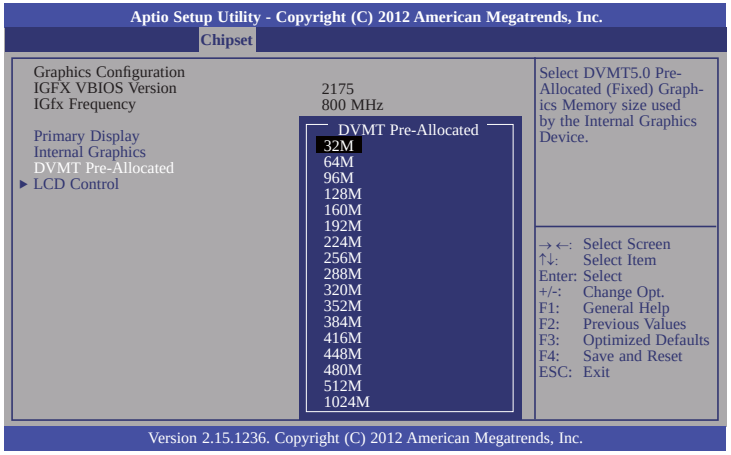
PEG When the system boots, it will first initialize the PCI Express x16 graphics card.

Internal Graphics

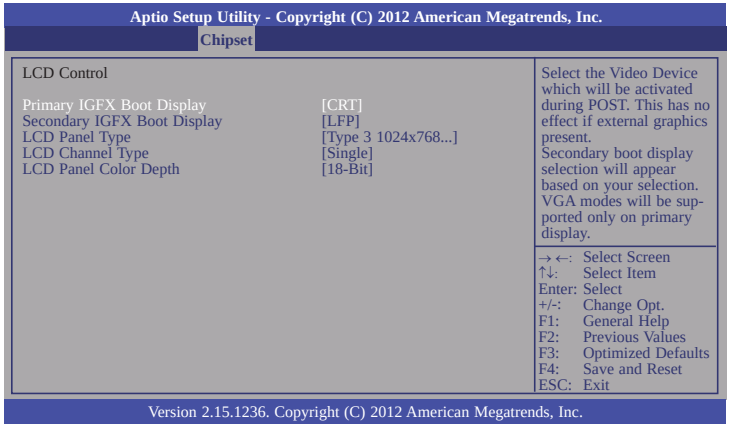
Keep IGD enabled based on setup options.

DVMT Pre-Allocated

Select DVMT 5.0 Pre-Allocated (Fixed) Graphics Memory size used by the Internal Graphics Device. Please refer to the screen shown below.



LCD Control



Primary IGFX Boot Display

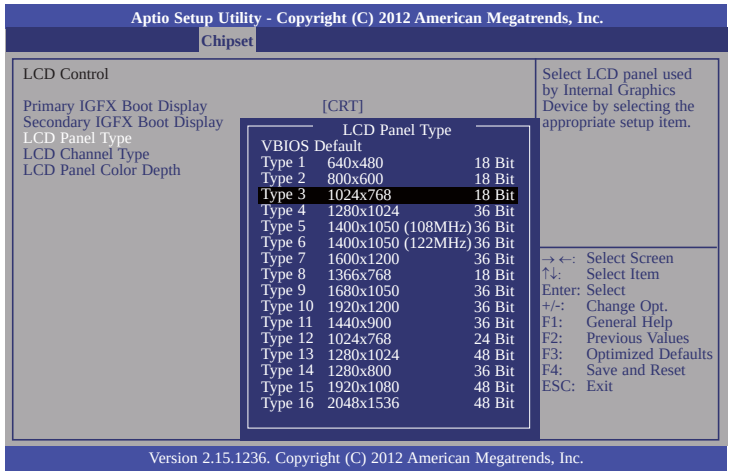
Select the Video Device which will be activated during POST. This has no effect if the external graphics presents. The selection of secondary boot display will appear based on your selection. VGA modes will be supported only on primary display.

Secondary IGFX Boot Display

Select secondary display device.

LCD Panel Type

Select LCD panel used by Internal Graphics Device by selecting the appropriate setup item. Please refer to the screen shown below.



LCD Channel Type

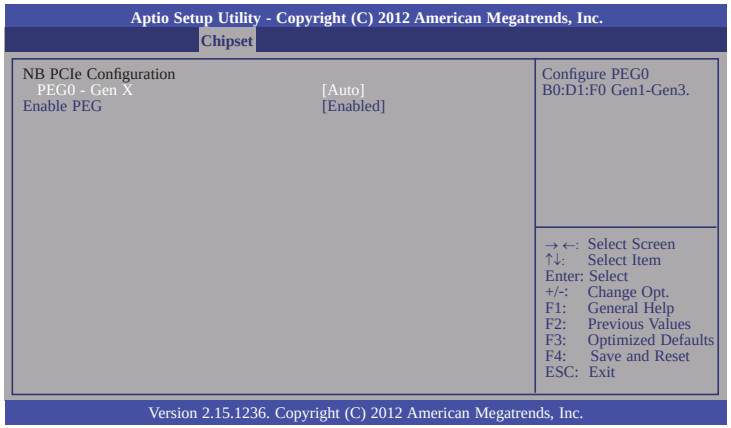
Select the LCD Channel Type. The option is dual or single.

LCD Panel Color Depth

Select the color mode of the LCD display. The option is 24-bit or 18-bit.

NB PCIe Configuration

This section is used to configure the settings of NB PCI Express.



PEG0-Gen X

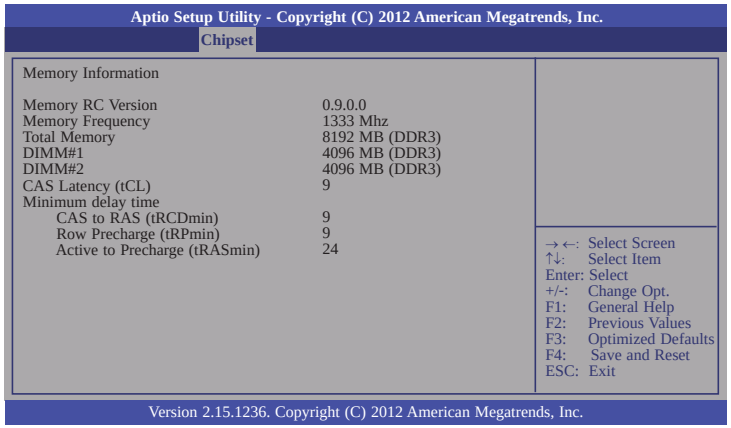
Configure PEG0 Gen1-Gen3.

Enable PEG

Enable or disable the PEG.

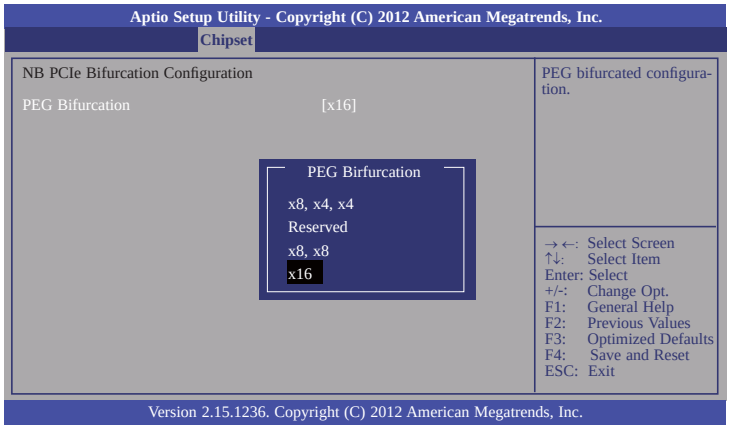
Memory Configuration

This section only display the parameters of memory configuration.

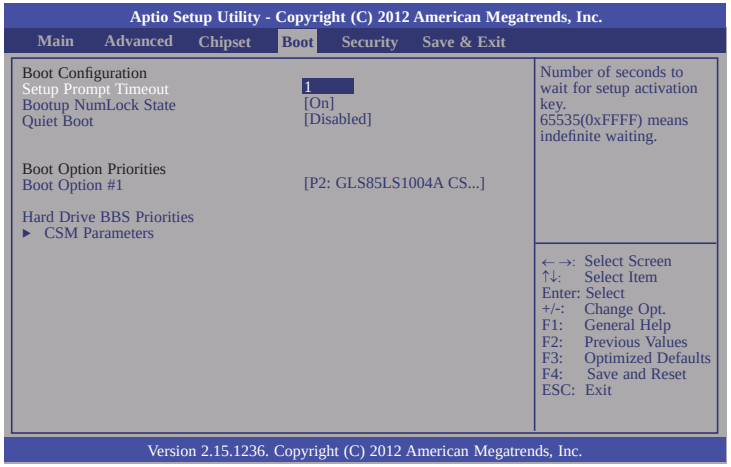


NB PCIe Bifurcation Configuration

This field is used to configure the parameters of CPU PEG Bifurcation.



Boot



Setup Prompt Timeout

Select the number of seconds to wait for the setup activation key. 65535(0xFFFF) denotes indefinite waiting.

Bootup NumLock State

This allows you to determine the default state of the numeric keypad. By default, the system boots up with NumLock on wherein the function of the numeric keypad is the number keys. When set to Off, the function of the numeric keypad is the arrow keys.

Quiet Boot

Enable or disable the quiet boot function.

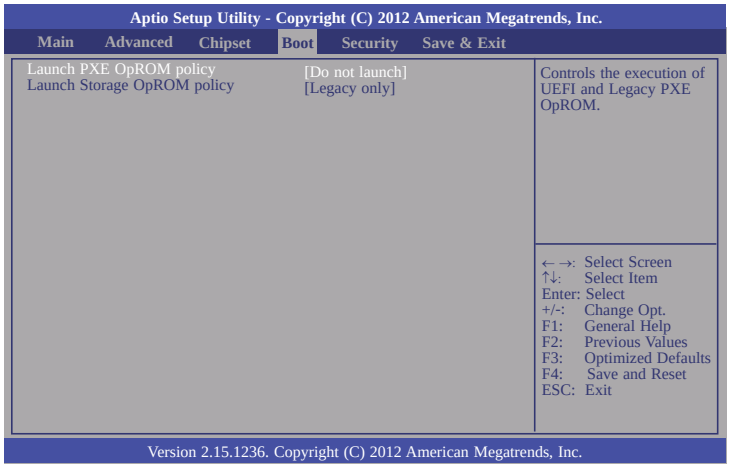
Boot Option

Sets the order of the system boot.

Hard Driver BBS Priorities

Set the order of the legacy devices in this group.

CSM Parameters



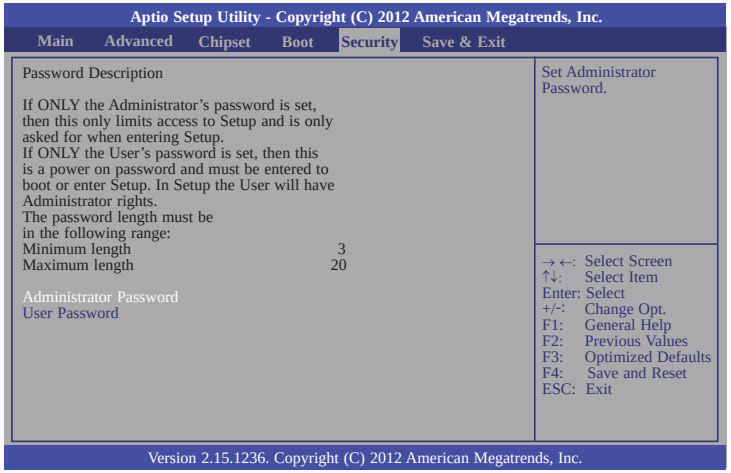
Launch PXE OpROM policy

Control the execution of UEFI and legacy PXE OpROM.

Launch Storage OpROM policy

Control the execution of UEFI and legacy storage OpROM.

Security



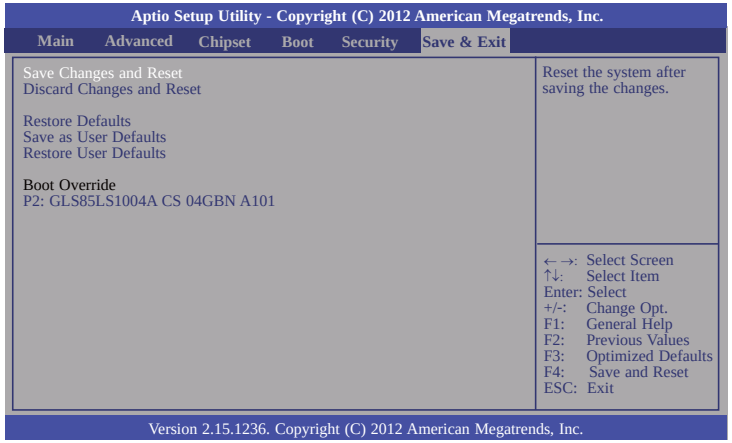
Administrator Password

Set the administrator password.

User Password

Set the user password.

Save & Exit



Save Changes and Reset

To save the changes, select this field and then press <Enter>. A dialog box will appear. Select Yes to reset the system after saving all changes made.

Discard Changes and Reset

To discard the changes, select this field and then press <Enter>. A dialog box will appear. Select Yes to reset the system setup without saving any changes.

Restore Defaults

To restore and load the optimized default values, select this field and then press <Enter>. A dialog box will appear. Select Yes to restore the default values of all the setup options.

Save as User Defaults

To save changes done so far as user default, select this field and then press <Enter>. A dialog box will appear. Select Yes to save values as user default.

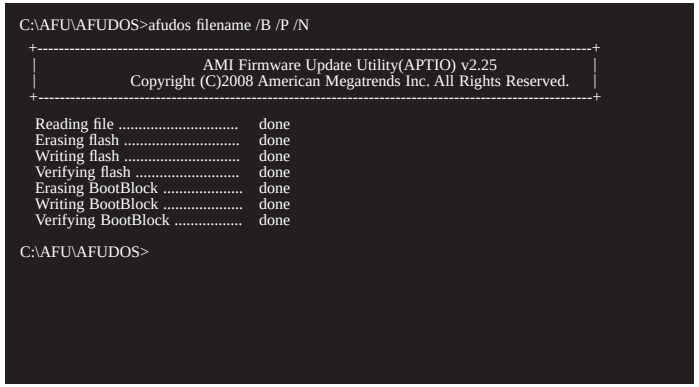
Restore User Defaults

To restore user default to all the setup options, select this field and then press <Enter>. A dialog box will appear. Select Yes to restore user default.

Updating the BIOS

To update the BIOS, you will need the new BIOS file and a flash utility, AFUDOS.EXE. Please contact technical support or your sales representative for the files.

To execute the utility, type:
A:> AFUDOS BIOS_File_Name /b /p /n
then press <Enter>.



After finishing BIOS update, please turn off the AC power. Wait about 10 seconds and then turn on the AC power again.

Notice: BIOS SPI ROM

1. The Intel® Management Engine has already been integrated into this system board. Due to the safety concerns, the BIOS (SPI ROM) chip cannot be removed from this system board and used on another system board of the same model.

2. The BIOS (SPI ROM) on this system board must be the original equipment from the factory and cannot be used to replace one which has been utilized on other system boards.

3. If you do not follow the methods above, the Intel® Management Engine will not be updated and will cease to be effective.

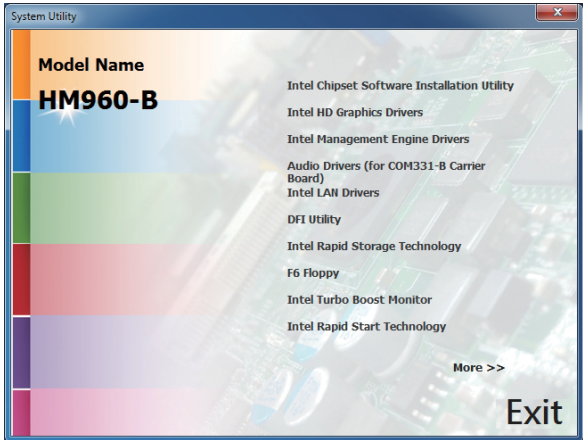
Note:
a. You can take advantage of flash tools to update the default configuration of the BIOS (SPI ROM) to the latest version anytime.
b. When the BIOS IC needs to be replaced, you have to populate it properly onto the system board after the EEPROM programmer has been burned and follow the technical person's instructions to confirm that the MAC address should be burned or not.

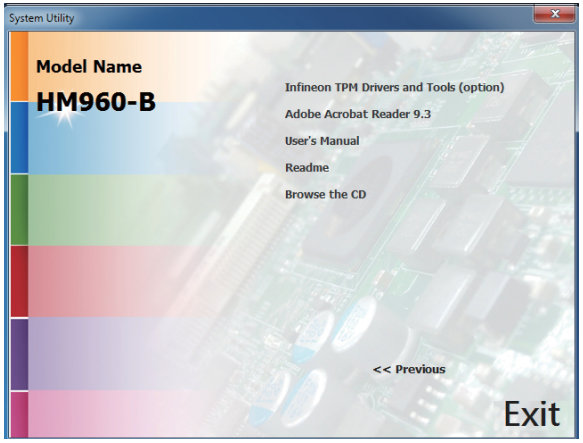
Chapter 5 - Supported Software

The CD that came with the system board contains drivers, utilities and software applications required to enhance the performance of the system board.

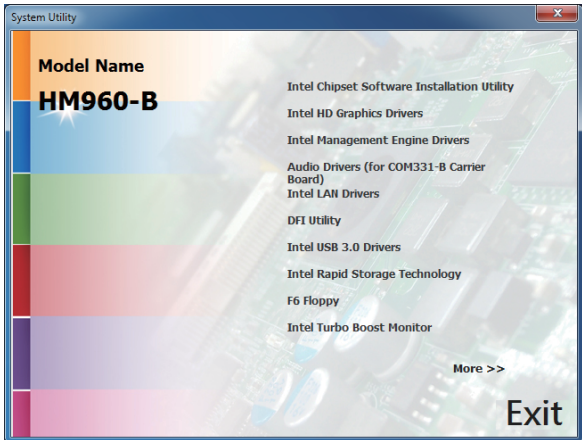
Insert the CD into a CD-ROM drive. The autorun screen (Mainboard Utility CD) will appear. If after inserting the CD, “Autorun” did not automatically start (which is, the Mainboard Utility CD screen did not appear), please go directly to the root directory of the CD and double-click “Setup”.

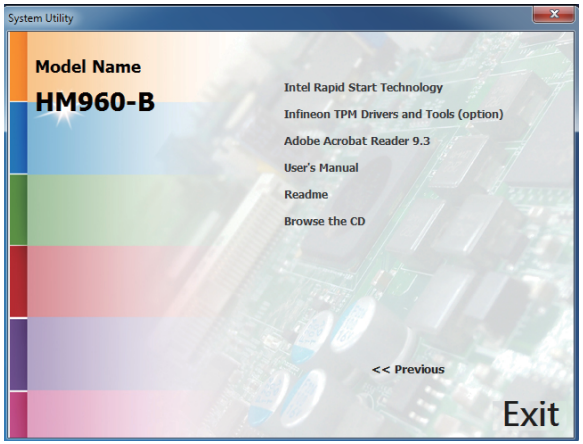
Auto Run Page (For Windows 8)



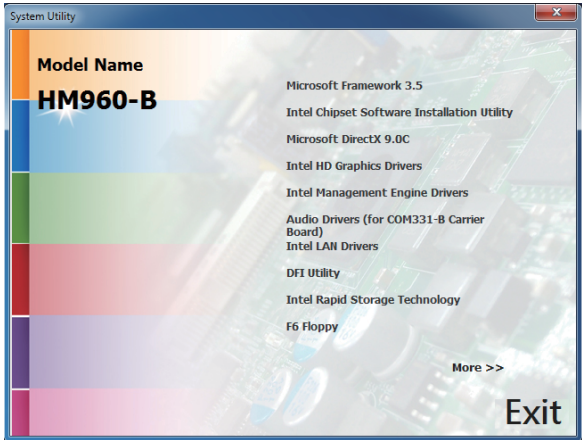


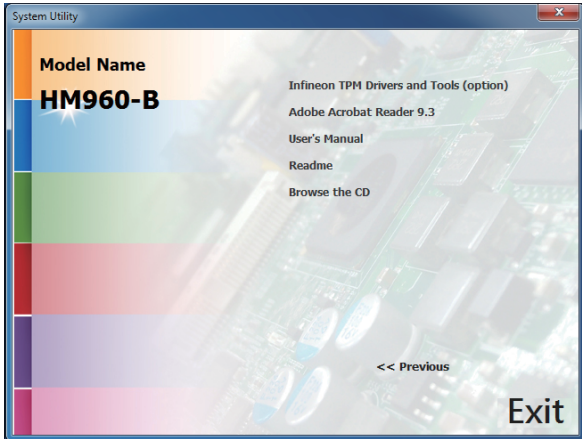
Auto Run Page (For Windows 7)





Auto Run Page (For Windows XP)





Microsoft Framework 3.5 (For Windows XP)

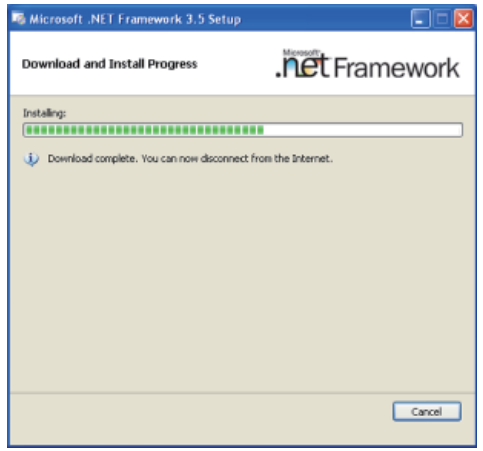
Note:
Before installing Microsoft .NET Framework 3.5, make sure you have updated your Windows XP operating system to Service Pack 3.

To install the driver, click "Microsoft .NET Framework 3.5" on the main menu.

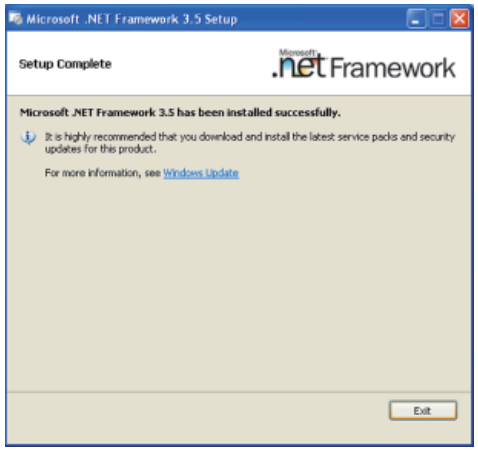
1. Read the license agreement carefully.

   Click "I have read and accept the terms of the License Agreement" then click Install.

2. Setup is now installing the driver.



3. Click Exit.



Intel Chipset Software Installation Utility

The Intel Chipset Software Installation Utility is used for updating Windows INF files so that the Intel chipset can be recognized and configured properly in the system.

To install the utility, click “Intel Chipset Software Installation Utility” on the main menu.

1. Setup is now ready to install the utility. Click Next.

2. Read the license agreement then click Yes.

3. Go through the readme document for system requirements and installation tips then click Next.

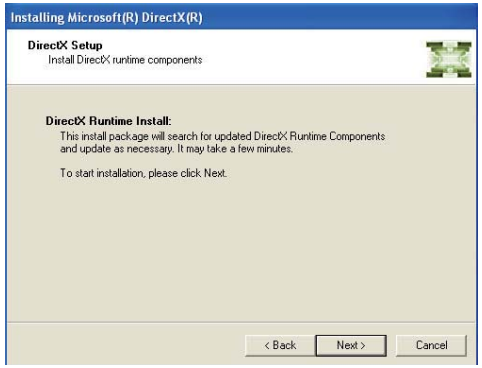
4. After completing installation, click Finish to exit setup.

Microsoft DirectX 9.0C (For Windows XP)

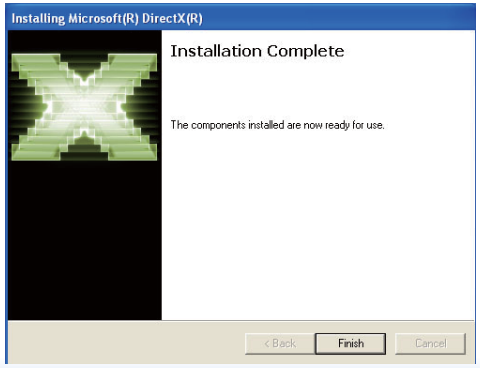
To install the utility, click “Microsoft DirectX 9.0C Driver” on the main menu.

1. Click “I accept the agreement” then click Next.

2. To start installation, click Next.



3. Click Finish. Reboot the system for DirectX to take effect.

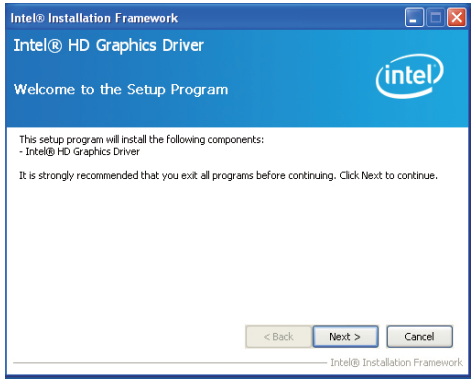


Intel HD Graphics Drivers (For Windows XP)

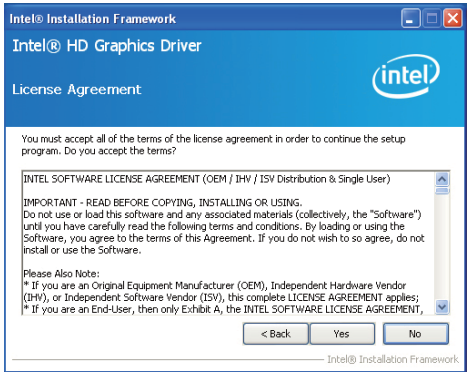
Note:
Before installing Intel HD Graphics Drivers, make sure you have installed Microsoft .NET Framework 3.5 SP1.

To install the driver, click “Intel HD Graphics Drivers” on the main menu.

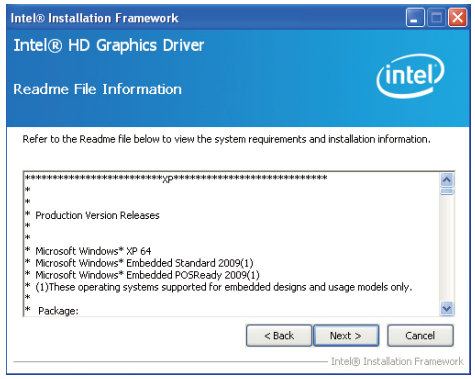
1. Setup is ready to install the graphics driver. Click Next.



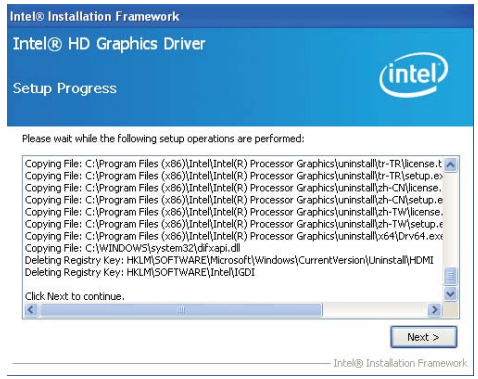
2. Read the license agreement then click Yes.



3. Go through the readme document for more installation tips then click Next.

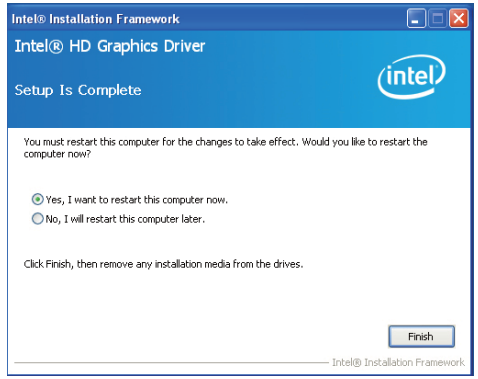


4. Setup is currently installing the driver. After installation has completed, click Next.



5. Click “Yes, I want to restart this computer now.” then click Finish.

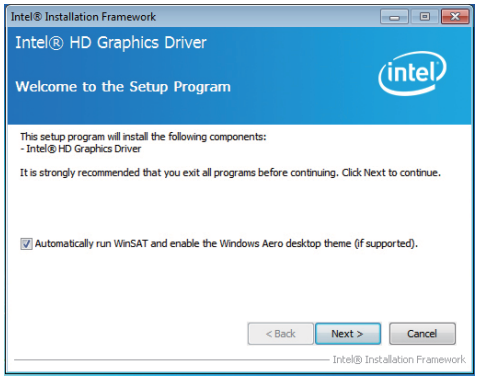
Restarting the system will allow the new software installlation to take effect.



Intel HD Graphics Drivers (For Windows 7/8)

To install the driver, click “Intel HD Graphics Drivers” on the main menu.

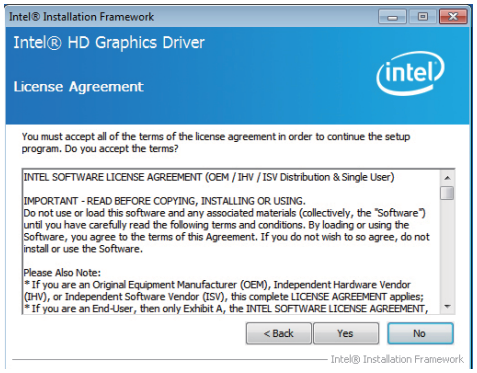
1. Setup is now ready to install the graphics driver. Click Next.



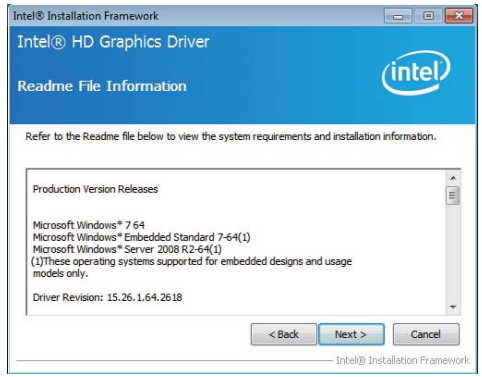
By default, the “Automatically run WinSAT and enable the Windows Aero desktop theme” is enabled. With this enabled, after installing the graphics driver and the system rebooted, the screen will turn blank for 1 to 2 minutes (while WinSAT is running) before the Windows 7/ Windows 8 desktop appears. The “blank screen” period is the time Windows is testing the graphics performance.

We recommend that you skip this process by disabling this function then click Next.

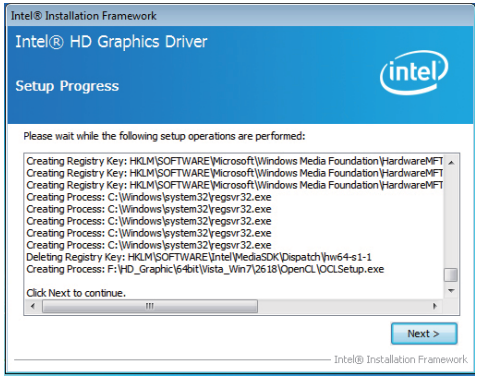
2. Read the license agreement then click Yes.



3. Go through the readme document for system requirements and installation tips then click Next.

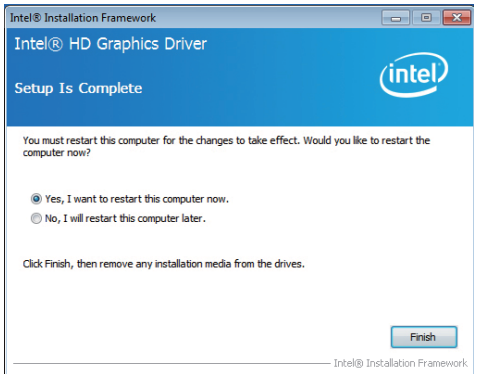


4. Setup is now installing the driver. Click Next to continue.



5. Click “Yes, I want to restart this computer now” then click Finish.

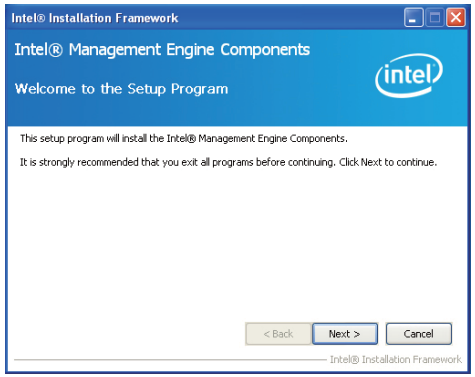
Restarting the system will allow the new software installation to take effect.



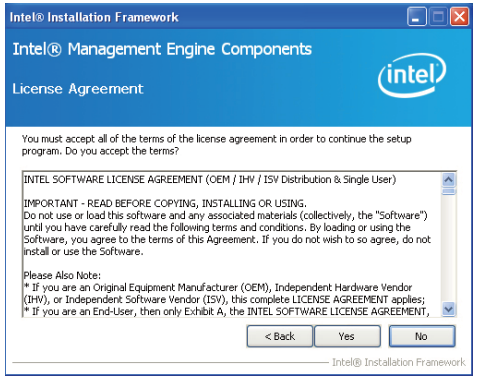
Intel Management Engine Drivers

To install the driver, click “Intel Management Engine Drivers” on the main menu.

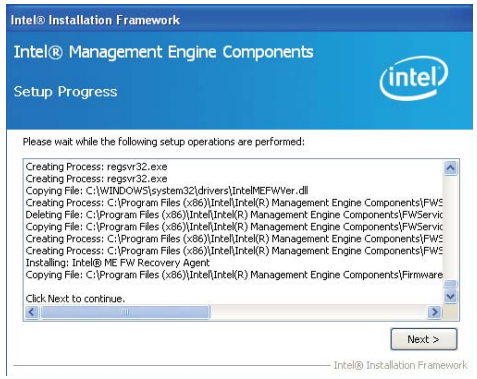
1. Setup is ready to install the driver. Click Next.



2. Read the license agreement then click Yes.



3. Setup is currently installing the driver. After installation has completed, click Next.



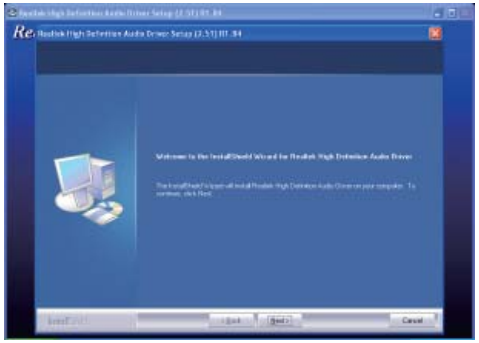
4. After completing installation, click Finish.

Audio Drivers (For COM331-B Carrier Board)

To install the driver, click “Audio Drivers (for COM331-B Carrier Board” on the main menu.

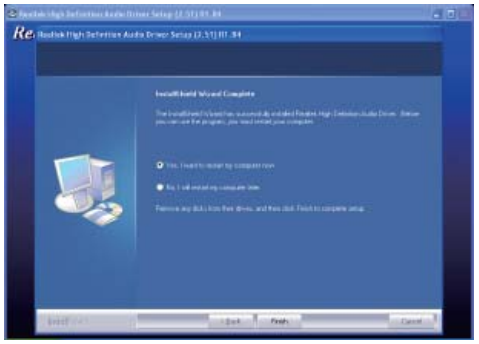
1. Setup is now ready to install the audio driver. Click Next.

2. Follow the remainder of the steps on the screen; clicking “Next” each time you finish a step.



3. Click “Yes, I want to restart my computer now” then click Finish.

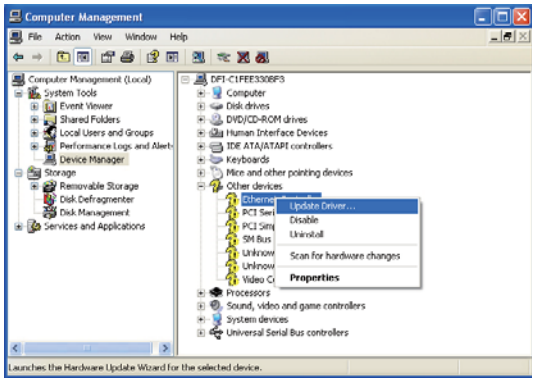
Restarting the system will allow the new software installation to take effect.



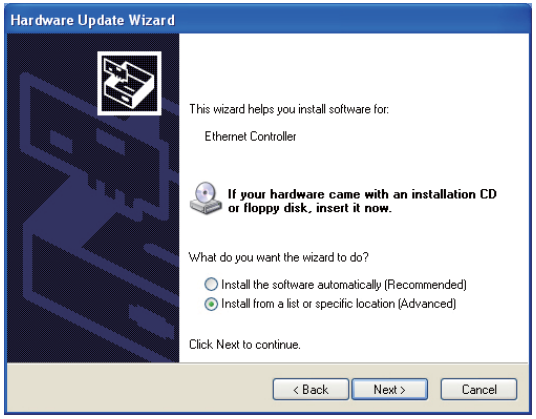
Intel LAN Drivers (For Windows XP)

The LAN drivers for Windows XP supporting on the HM960-QM87/HM86 system board has to be installed manually. When you want to install the LAN driver for Windows XP, please follow the steps below to accomplish the installation.

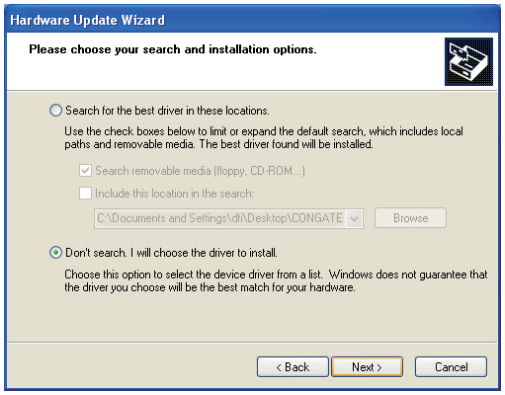
1. Launch the Hardware Update Wizard for the selected device. Select "Update Driver."



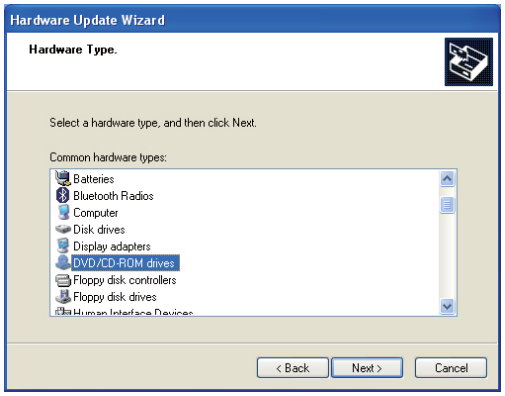
2. Choose "Install from a list or specific location (Advanced)" and click "Next" to continue the installation.



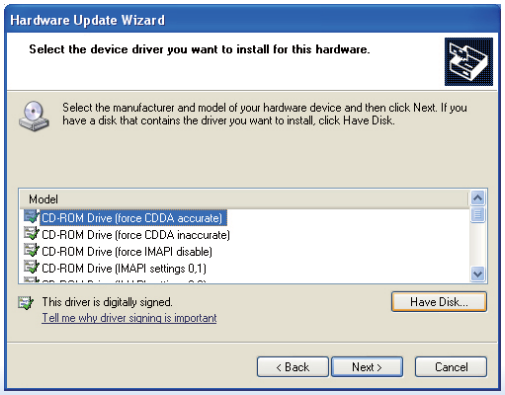
3. Choose the option "Don't search. I will choose the driver to install" in order to select the device driver from a list, and click "Next."



4. Select a hardware type: DVD/CD-ROM drives. Then, click "Next."



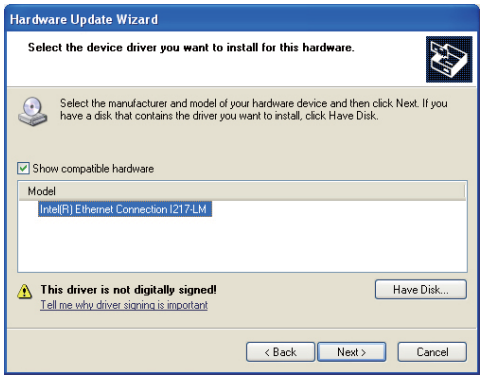
5. Select your hardware disk and then click "Have Disk..."



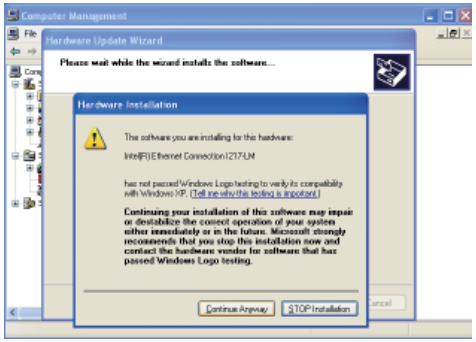
6. Insert the installation disk and make sure the selected drive is correct.

(For 32-bit, the file name is “e1d5132.inf”.)

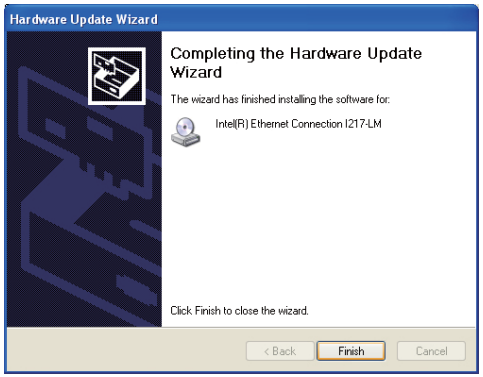
7. Select the device driver you want to install for this hardware and then click "Next."



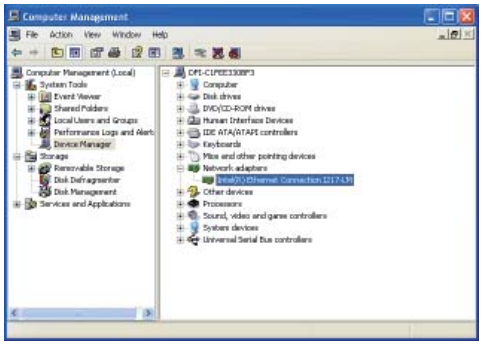
8. Check the software you are installing, Then, click "Continue Anyway" to start the installation.



9. Click "Finish" to close the wizard.



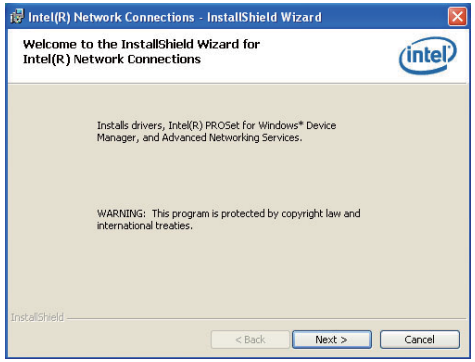
10. After completing the installation, the Network adapters "Intel(R) Ethernet Connection I217LM" will appear on the computer management list.



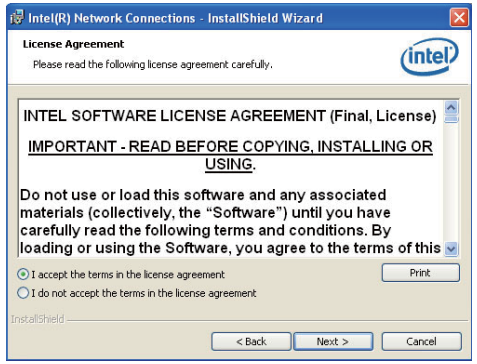
Intel LAN Drivers (For Windows 7/8)

To install the driver, click “Intel LAN Drivers” on the main menu.

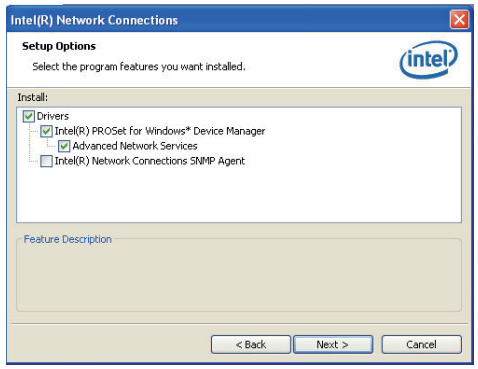
1. Setup is ready to install the driver. Click Next.



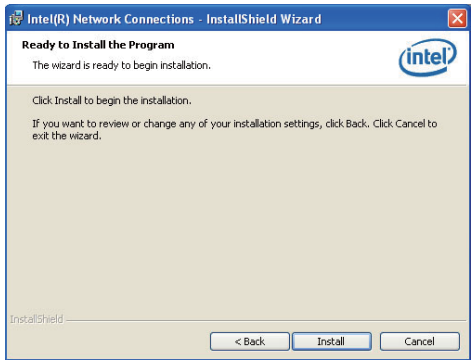
2. Click “I accept the terms in the license agreement” then click “Next”.



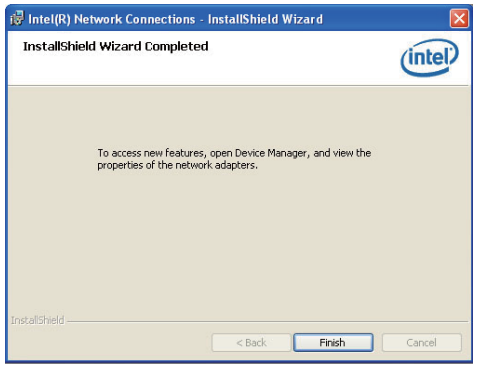
3. Select the program featuers you want installed then click Next.



4. Click Install to begin the installation.



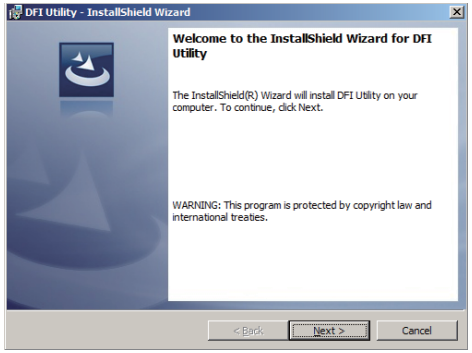
5. After completing installation, click Finish.



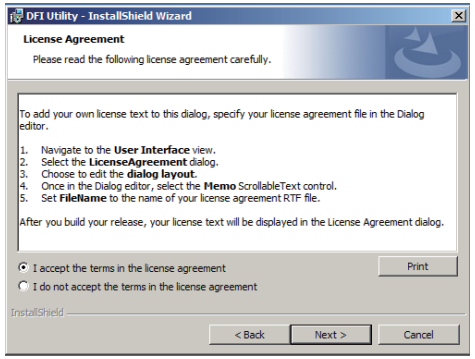
DFI Utility

DFI Utility provides information about the board, HW Health, Watchdog and DIO. To access the utility, click “DFI Utility” on the main menu.

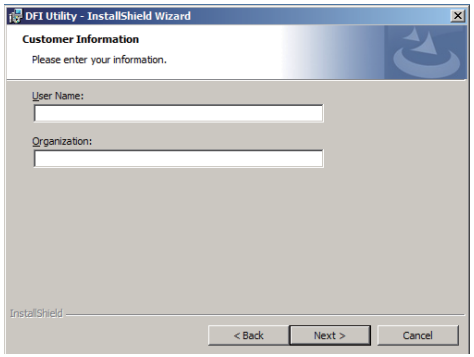
1. Setup is ready to install the DFI Utility drifer. Click Next.



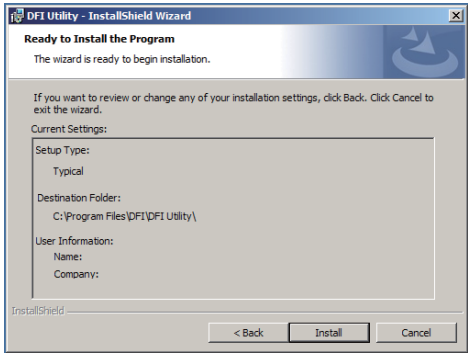
2. Click “I accept the terms in the license agreement” and then click Next.



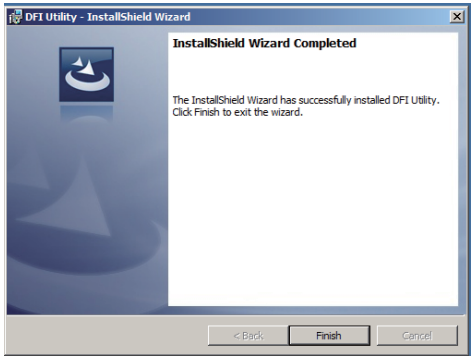
3. Enter “User Name” and “Organization” information and then click Next.



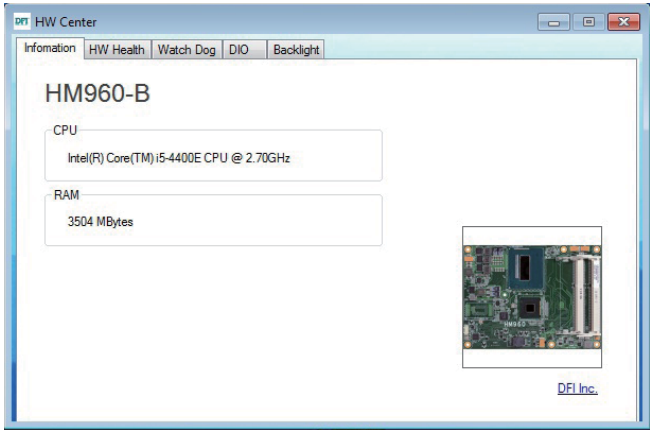
4. Click Install to begin the installation.



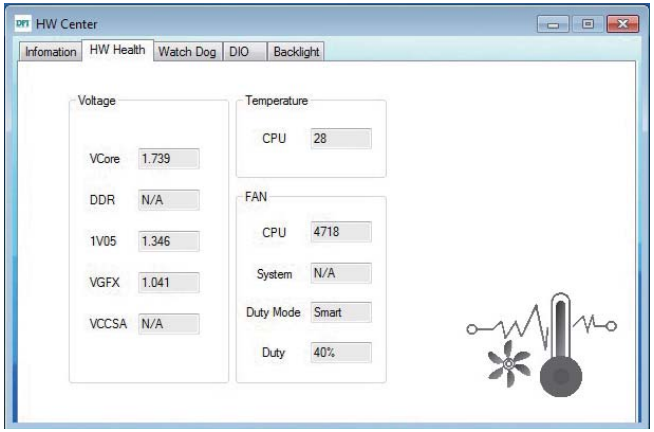
5. After completing installation, click Finish.



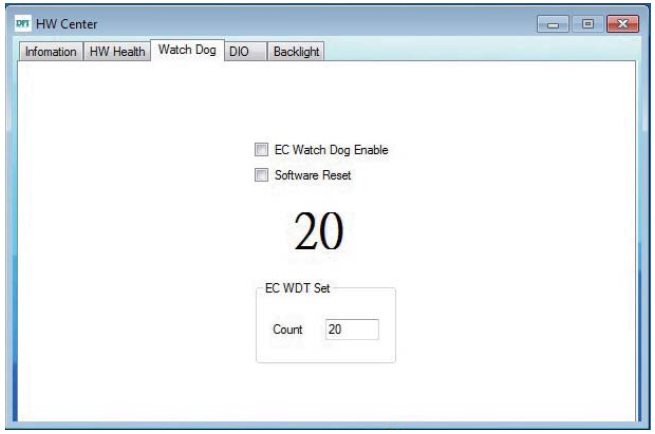
The DFI Utility icon will appear on the desktop. Double-click the icon to open the utility.



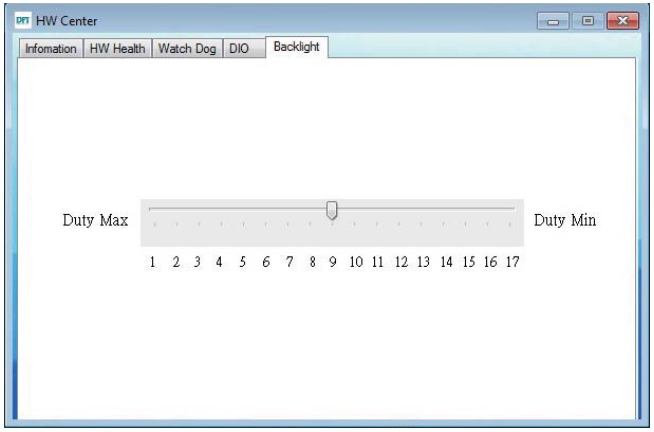
Information



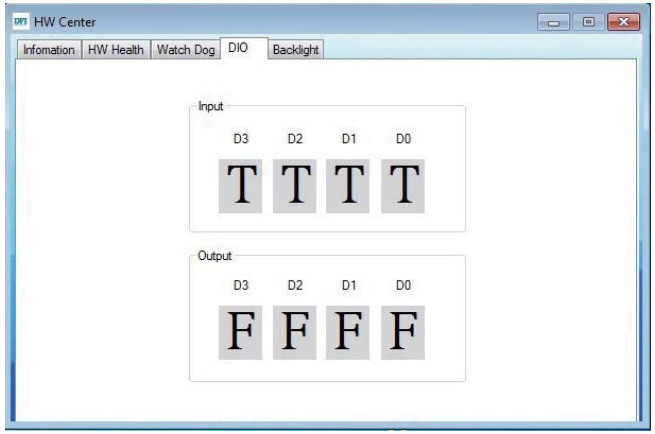
HW Health



WatchDog



Backlight

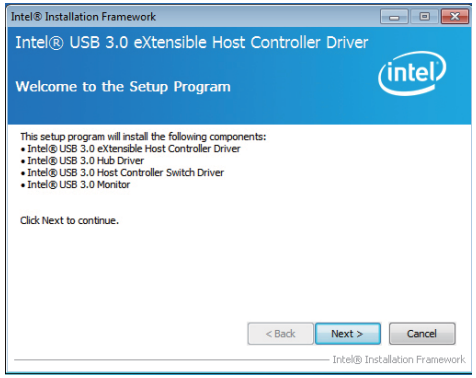


DIO

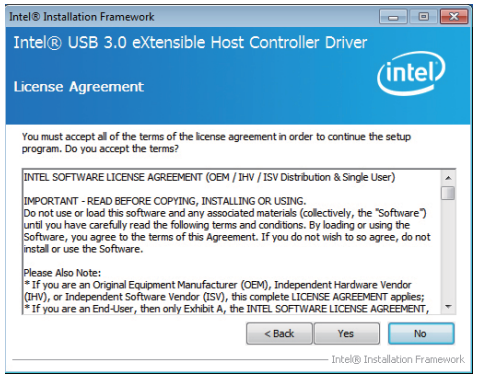
Intel USB 3.0 Drivers (For Windows 7 only)

To install the driver, click “Intel USB 3.0 Driver” on the main menu.

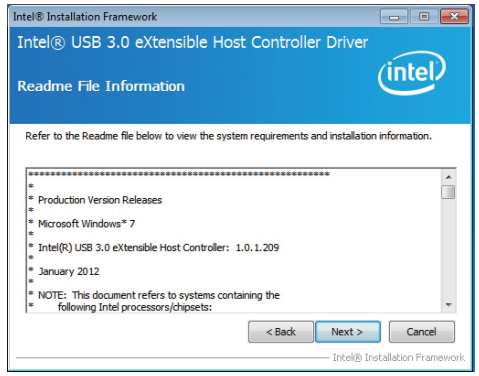
1. Setup is ready to install the driver. Click Next.



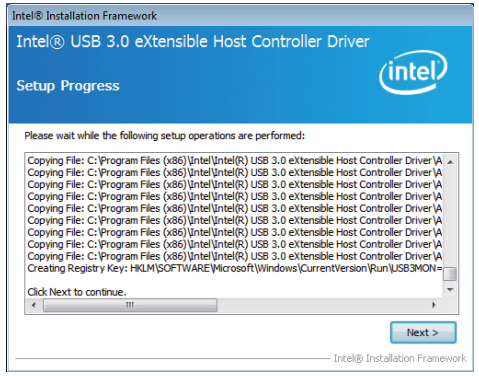
2. Read the license agreement then click Yes.



3. Go through the readme document for more installation tips then click Next.



4. Setup is currently installing the driver. After installation has completed, click Next.



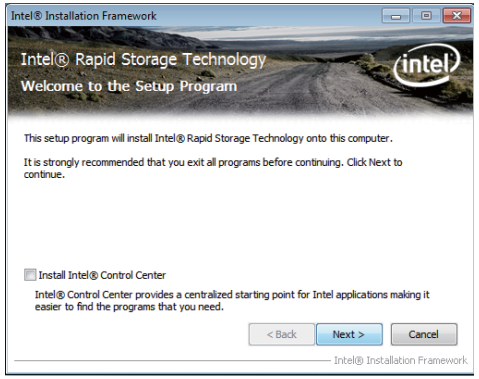
5. After completing installation, click Finish.

Intel Rapid Storage Technology

The Intel Rapid Storage Technology is a utility that allows you to monitor the current status of the SATA drives. It enables enhanced performance and power management for the storage subsystem.

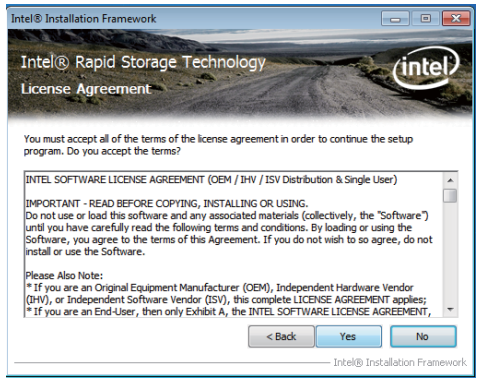
To install the driver, click “Intel Rapid Storage Technology” on the main menu.

1. Setup is now ready to install the utility. Click Next.

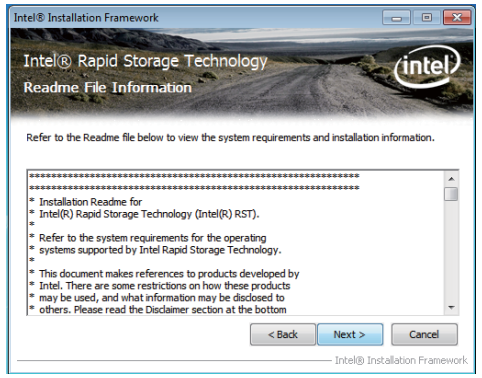


2. Read the warning then click Yes.

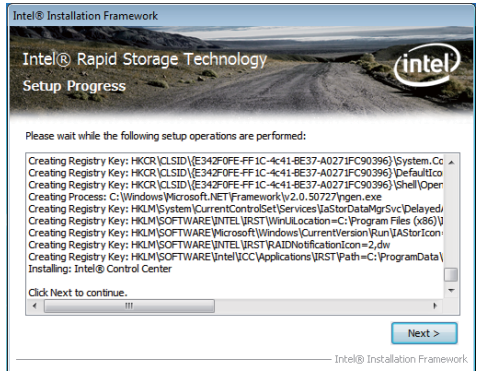
3. Read the license agreement then click Yes.



4. Go through the readme document for system requirements and installation tips then click Next.



5. Setup is now installing the utility. Click Next to continue.



6. Click “Yes, I want to restart my computer now” then click Finish.

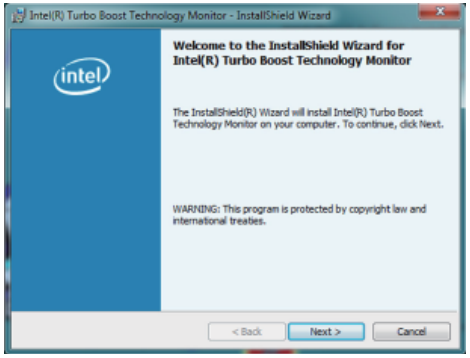
Restarting the system will allow the new software installation to take effect.

Intel Turbo Boost Monitor (For Windows 7/8)

To install the driver, click “Intel Turbo Boost Monitor” on the main menu.

1. The setup program is configuring the new software installation.

2. Click Next.

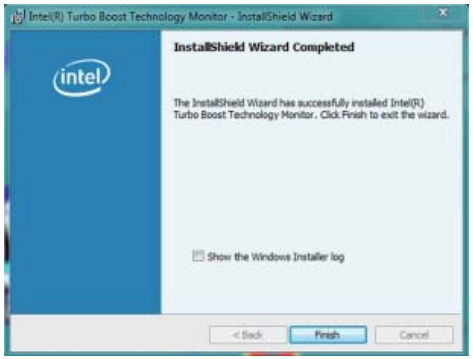


3. Read the license agreement and then click “I accept the terms in the license agreement”. Click Next.

4. Click Install.

5. The setup program is currently installing the software.

6. Click Finish.

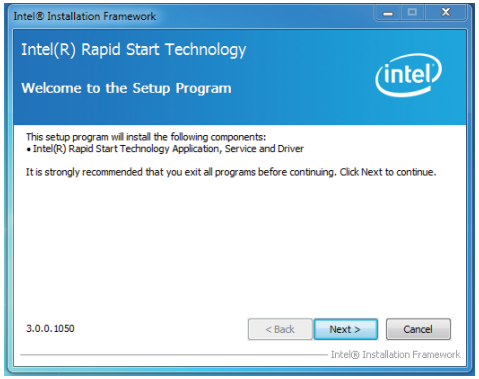


Intel Rapid Start Technology (For Windows 7/8)

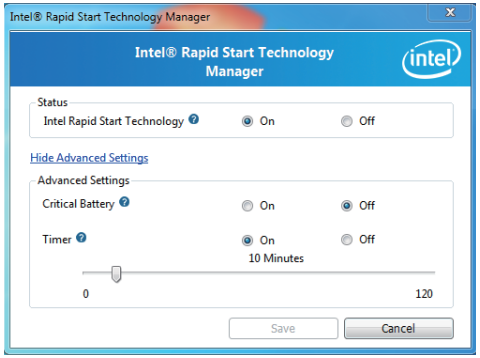
The Intel Rapid Start Technology is a utility that allows your system to wake up and run faster.

To install the driver, click “Intel Rapid Start Technology” on the main menu.

1. Setup is now ready to install the utility. Click Next.



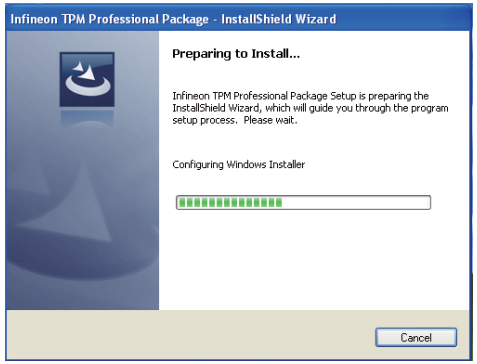
2. Click ON and select the Advanced Settings to enable the Intel Rapid Start Technology. Then, click Save.



Infineon TPM Drivers and Tools (option)

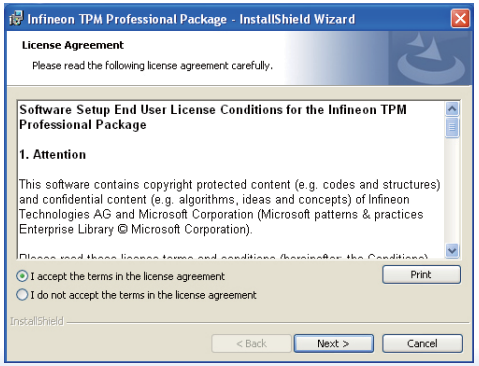
To install the driver, click “Infineon TPM driver and tool (option)” on the main menu.

1. The setup program is preparing to install the driver.

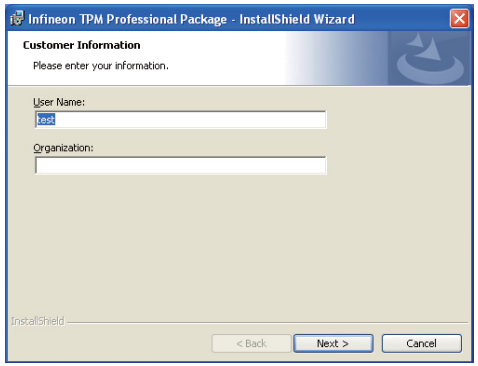


2. The setup program is now ready to install the utility. Click Next.

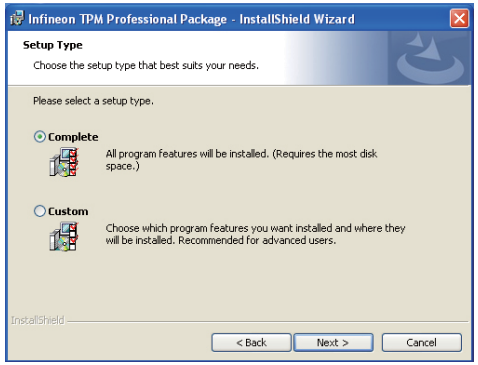
3. Click “I accept the terms in the license agreement” and then click “Next”.



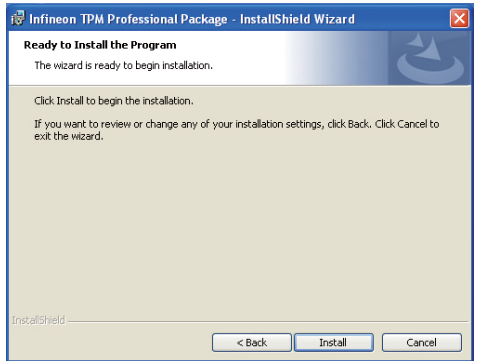
4. Enter the necessary information and then click Next.



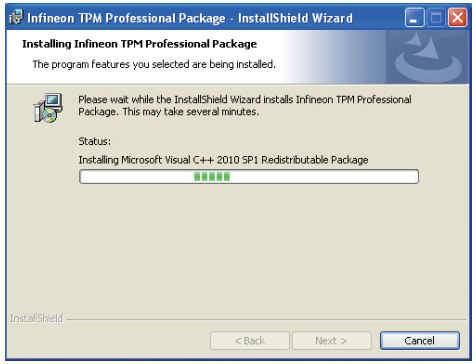
5. Select a setup type and then click Next.



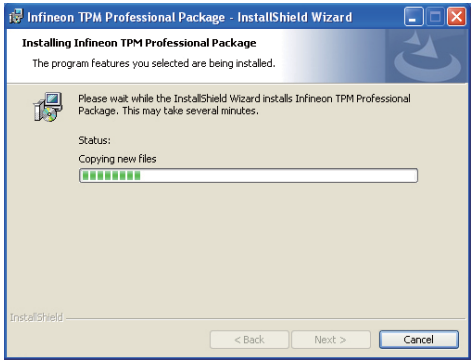
6. Click Install.



7. TPM requires installing the Microsoft Visual C++ package prior to installing the utility. Click Install.

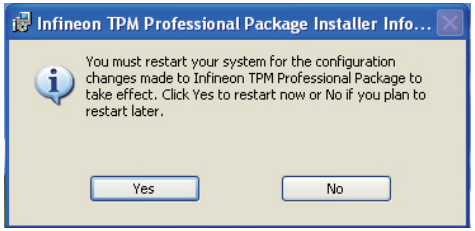


8. The setup program is currently installing the Microsoft Visual C++ package.



9. Click Finish.

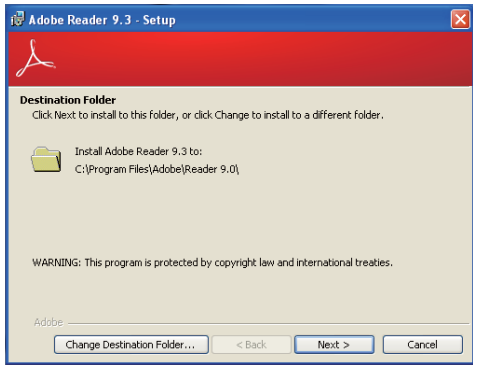
10. Click “Yes“ to restart your system.



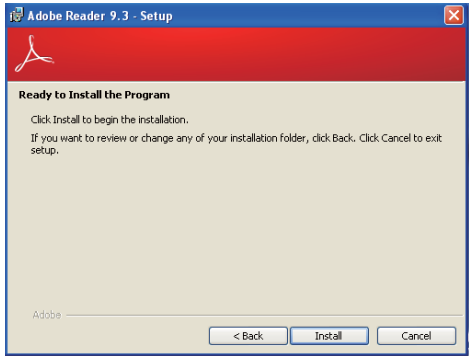
Adobe Acrobat Reader 9.3

To install the reader, click “Adobe Acrobat Reader 9.3” on the main menu.

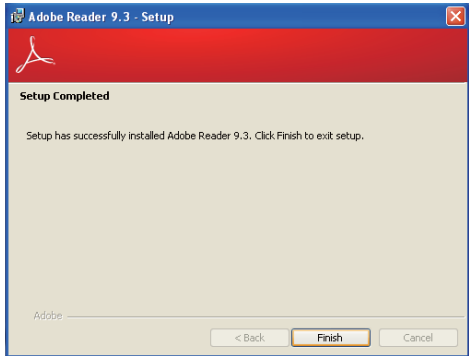
1. Click Next to install or click Change Destination Folder to select another folder.



2. Click Install to begin installation.



3. Click Finish to exit installation.



Chapter 6 - GPIO Programming Guide

Function Description

Get_EC_Data (unsigned char ucData): Read a Byte data from EC.
Write_EC_Data (unsigned char ucData, unsigned char Data): Write a Byte data to EC.

Sample Code

GPIO Input Process

```
EC_DIO_Read_Input()
{
      BYTE Data;

      //Pin0-3 Input Mode
      Data = Get_EC_Data(0xBA);
      Data |= 0x80;
      Write_EC_Data(0xBA, Data);
      while(((Get_EC_Data(0xBA) >> 7)&0x01))
     {
      Data = Get_EC_Data(0xBA);
     }

      Return Data ;
}
```

GPIO Output Process

```
EC_DIO_Write_Output(unsigned char udata)
{
        //Pin4-7 Output Mode
        udata <<= 4;
        udata |= 0x01;
        Write_EC_Data(0xBB, udata);

        return 0;

EC_DIO_Read_Output()
{
         BYTE Data;

        //Pin4-7 Output Mode
        Write_EC_Data(0xBB, 0x02);
        Delay;
        Data = Get_EC_Data(0xBB);
        Data >>= 4;
        Return Data ;
}
```

Chapter 7 - RAID (HM960-QM87)

The system board allows configuring RAID on Serial ATA drives. It supports RAID 0, RAID 1, RAID 5 and RAID 10.

RAID Levels

RAID 0 (Striped Disk Array without Fault Tolerance)

RAID 0 uses two new identical hard disk drives to read and write data in parallel, interleaved stacks. Data is divided into stripes and each stripe is written alternately between two disk drives. This improves the I/O performance of the drives at different channel; however it is not fault tolerant. A failed disk will result in data loss in the disk array.

RAID 1 (Mirroring Disk Array with Fault Tolerance)

RAID 1 copies and maintains an identical image of the data from one drive to the other drive. If a drive fails to function, the disk array management software directs all applications to the other drive since it contains a complete copy of the drive's data. This enhances data protection and increases fault tolerance to the entire system. Use two new drives or an existing drive and a new drive but the size of the new drive must be the same or larger than the existing drive.

RAID 5

RAID 5 stripes data and parity information across hard drives. It is fault tolerant and provides better hard drive performance and more storage capacity.

RAID 10 (Mirroring and Striping)

RAID 10 is a combination of data striping and data mirroring providing the benefits of both RAID 0 and RAID 1. Use four new drives or an existing drive and three new drives for this configuration.

Settings

To enable the RAID function, the following settings are required.

1. Connect the Serial ATA drives.
2. Configure Serial ATA in the AMI BIOS.
3. Configure RAID in the RAID BIOS.
4. Install the RAID driver during OS installation.
5. Install the Intel Rapid Storage Drivers.

Step 1: Connect the Serial ATA Drives

Refer to chapter 2 for details on connecting the Serial ATA drives.

Important:

1. Make sure you have installed the Serial ATA drives and connected the data cables otherwise you won't be able to enter the RAID BIOS utility.
2. Treat the cables with extreme caution especially while creating RAID. A damaged cable will ruin the entire installation process and operating system. The system will not boot and you will lost all data in the hard drives. Please give special attention to this warning because there is no way of recovering back the data.

Step 2: Configure Serial ATA in the AMI BIOS

1. Power-on the system then press <Del> to enter the main menu of the AMI BIOS.
2. Configure Serial ATA in the appropriate fields.
3. Save the changes in the Save & Exit menu.
4. Reboot the system.

Step 3: Configure RAID in the RAID BIOS

When the system powers-up and all drives have been detected, the Intel RAID BIOS status message screen will appear. Press the <Ctrl> and <I> keys simultaneously to enter the utility. The utility allows you to build a RAID system on Serial ATA drives.

Step 4: Install the RAID Driver During OS Installation

The RAID driver must be installed during the Windows® XP or Windows® 2000 installation using the F6 installation method. This is required in order to install the operating system onto a hard drive or RAID volume when in RAID mode or onto a hard drive when in AHCI mode.

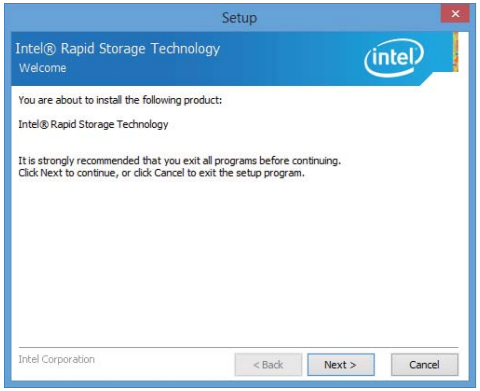
1. Start Windows Setup by booting from the installation CD.
2. Press <F6> when prompted in the status line with the 'Press F6 if you need to install a third party SCSI or RAID driver' message.
3. Press <S> to "Specify Additional Device".
4. At this point you will be prompted to insert a floppy disk containing the RAID driver. Insert the RAID driver diskette.
5. Locate for the drive where you inserted the diskette then select RAID or AHCI controller that corresponds to your BIOS setup. Press <Enter> to confirm.

You have successfully installed the driver. However you must continue installing the OS. Leave the floppy disk in the floppy drive until the system reboots itself because Windows setup will need to copy the files again from the floppy disk to the Windows installation folders. After Windows setup has copied these files again, remove the floppy diskette so that Windows setup can reboot as needed.

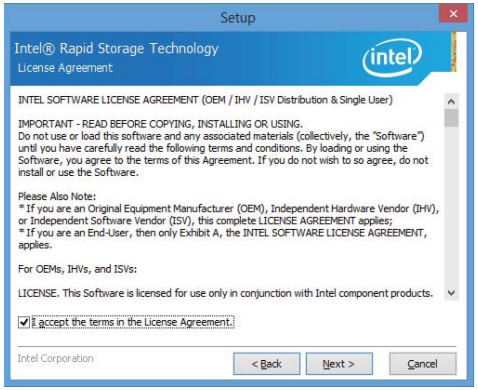
Step 5: Install the Intel Rapid Storage Technology Utility

The Intel Rapid Storage Technology Utility can be installed from within Windows. It allows RAID volume management (create, delete, migrate) from within the operating system. It will also display useful SATA device and RAID volume information. The user interface, tray icon service and monitor service allow you to monitor the current status of the RAID volume and/or SATA drives. It enables enhanced performance and power management for the storage subsystem.

1. Insert the provided CD into an optical drive.
2. Click "Intel Rapid Storage Technology Utility" on the main menu.
3. Setup is ready to install the utility. Click Next.

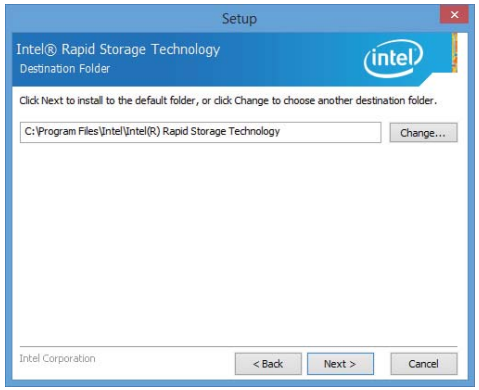


4. Read the license agreement and click "I accept the terms in the License Agreement." Then, click Next.

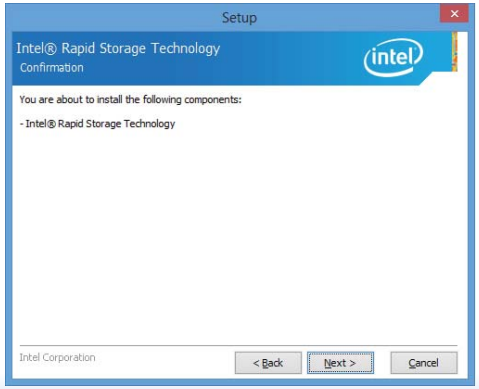


5. Go through the readme document to view system requirements and installation information then click Next.

6. Click Next to install to the default folder or click change to choose another destination folder.



7. Confirm the installation and click Next.



8. Click “Yes, I want to restart this computer now” to complete the installation and then click Finish.

Chapter 8 - Intel AMT Settings (HM960-QM87)

Overview

Intel Active Management Technology (Intel® AMT) combines hardware and software solution to provide maximum system defense and protection to networked systems.

The hardware and software information are stored in non-volatile memory. With its built-in manageability and latest security applications, Intel® AMT provides the following functions.

• Discover

Allows remote access and management of networked systems even while PCs are powered off; significantly reducing desk-side visits.

• Repair

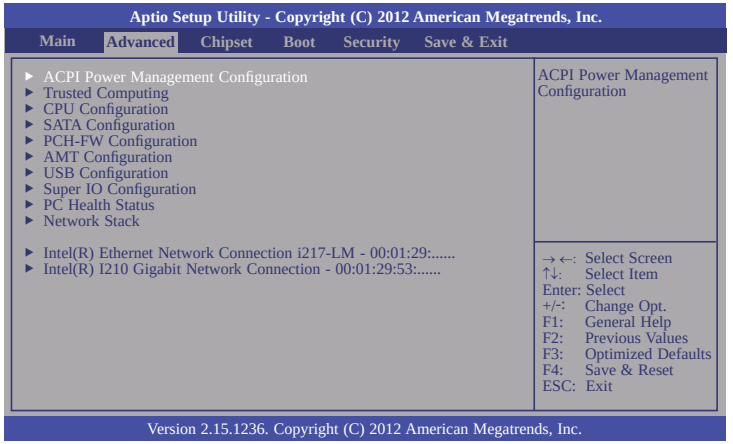
Remotely repair systems after OS failures. Alerting and event logging help detect problems quickly to reduce downtime.

• Protect

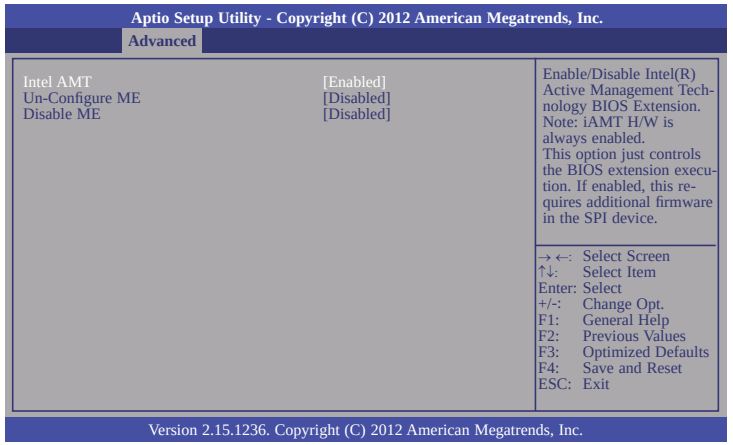
Intel AMT's System Defense capability remotely updates all systems with the latest security software. It protects the network from threats at the source by proactively blocking incoming threats, reactively containing infected clients before they impact the network, and proactively alerting when critical software agents are removed.

Enable Intel® AMT in the AMI BIOS

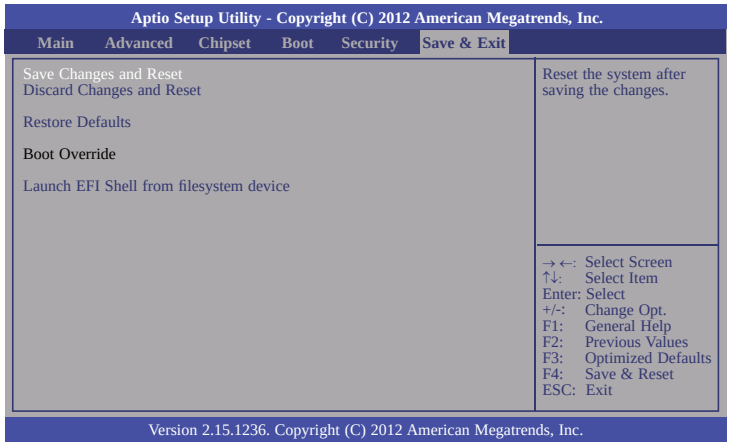
1. Power-on the system then press <Del> to enter the main menu of the AMI BIOS.
2. In the **Advanced** menu, select **AMT Configuration**.



3. In the **Advanced** menu, select **Enable** in the **AMT** field.



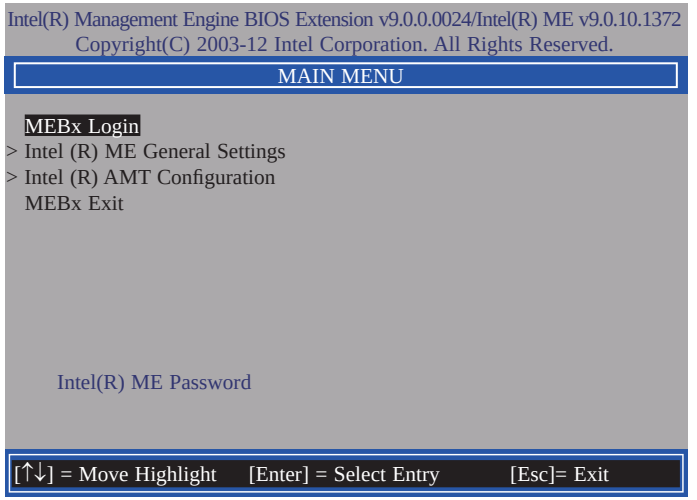
4. In the **Save & Exit** menu, select **Save Changes and Reset** then select **OK**.



Enable Intel® AMT in the Intel® Management Engine BIOS Extension (MEBX) Screen

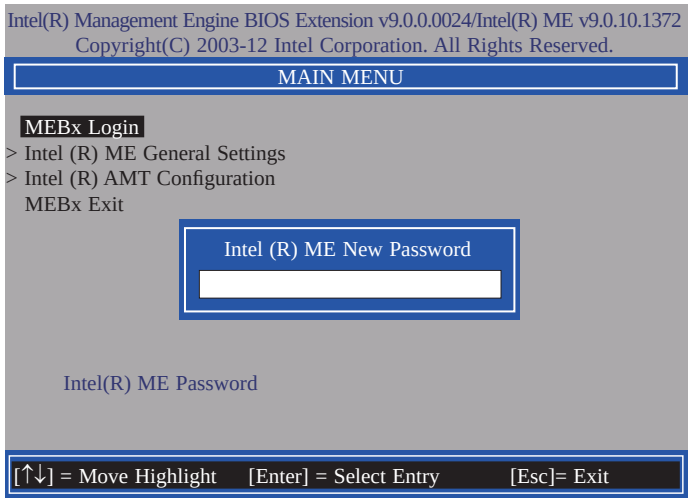
1. When the system reboots, the following message will be displayed. Press **<Ctrl-P>** as soon as the message is displayed; as this message will be displayed for only a few seconds.

2. You will be prompted for a password. The default password is "**admin**". Enter the default password in the space provided under Intel(R) ME Password then press Enter.

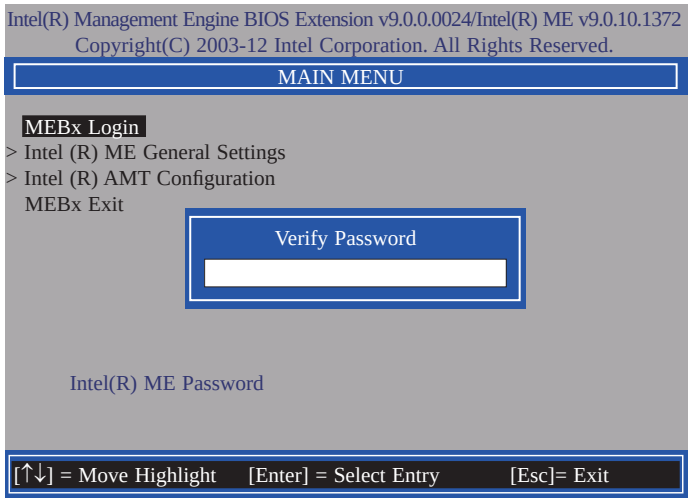


3. Enter a new password in the space provided under Intel(R) ME New Password then press Enter. The password must include:

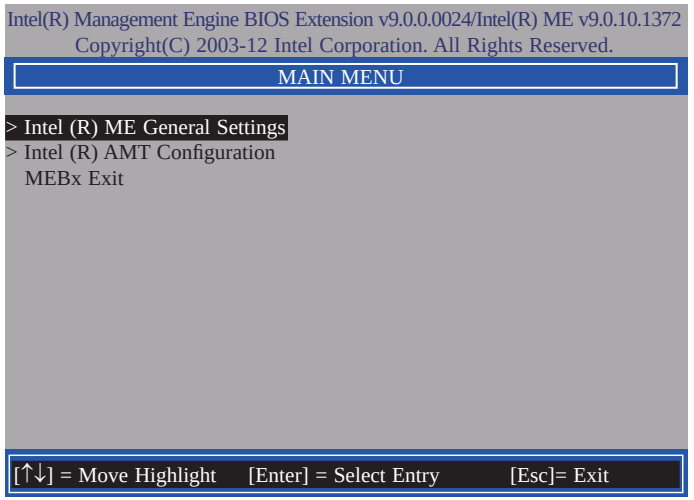
   - 8-32 characters
   - Strong 7-bit ASCII characters excluding **: ,** and **"** characters
   - At least one digit character (0, 1, ...9)
   - At least one 7-bit ASCII non alpha-numeric character, above 0x20, (e.g. !, $, ;)
   - Both lower case and upper case characters



4. You will be asked to verify the password. Enter the same new password in the space provided under Verify Password then press Enter.



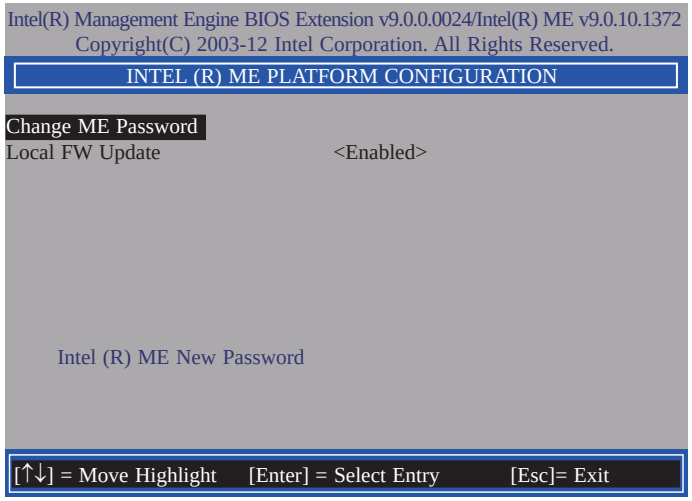
5. Select **Intel(R) ME General Settings** then press Enter.



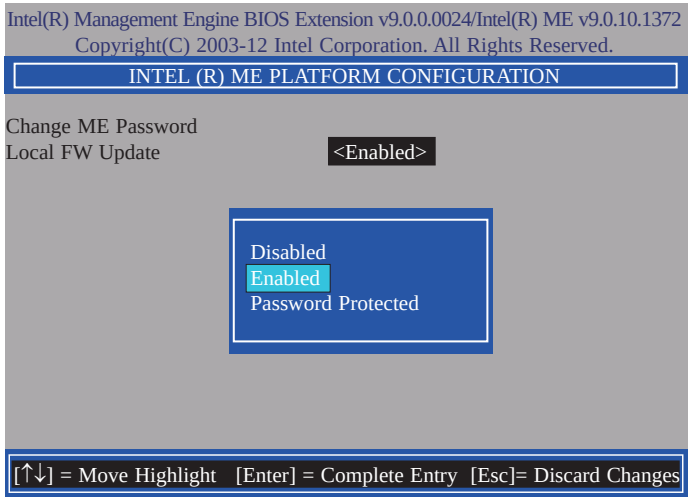
6. Select **Change Intel(R) ME Password** then press Enter.

   You will be prompted for a password. The default password is "**admin**". Enter the default password in the space provided under Intel(R) ME New Password then press Enter.

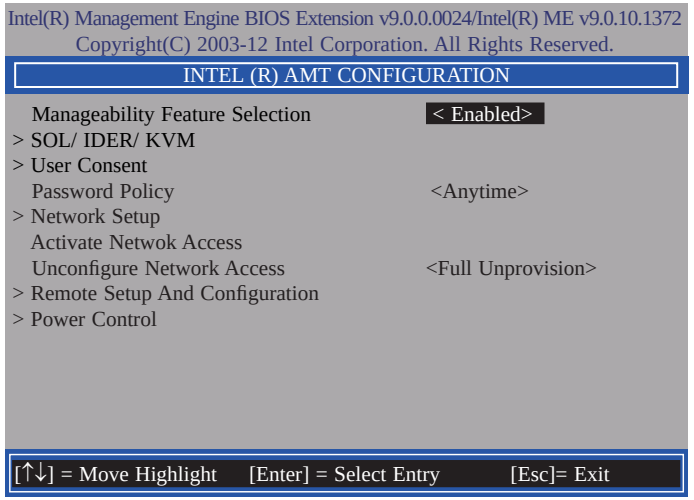
   - 8-32 characters
   - Strong 7-bit ASCII characters excluding **: ,** and **"** characters
   - At least one digit character (0, 1, ...9)
   - At least one 7-bit ASCII non alpha-numeric character, above 0x20, (e.g. !, $, ;)
   - Both lower case and upper case characters



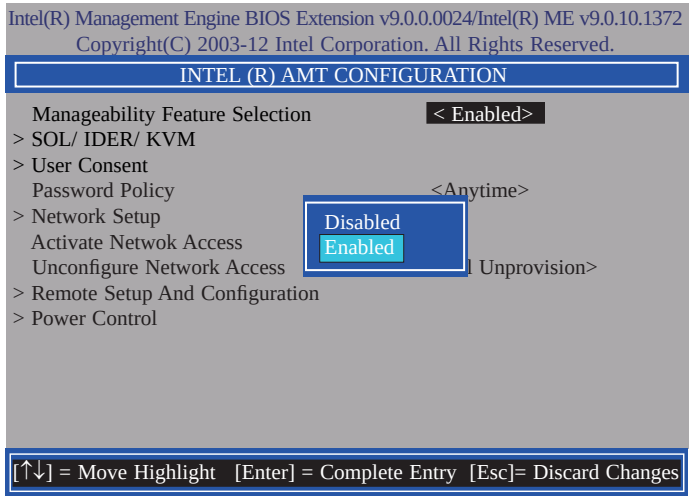
7. Select **Local FW Update** then press Enter. Select **Enabled** then press Enter.



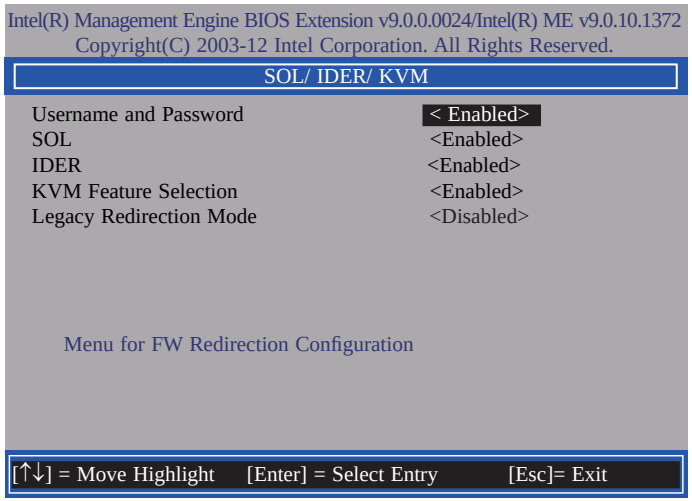
8. Select Previous Menu until you return to the **Main Menu**. Select **Intel(R) AMT Configuration** then press Enter.



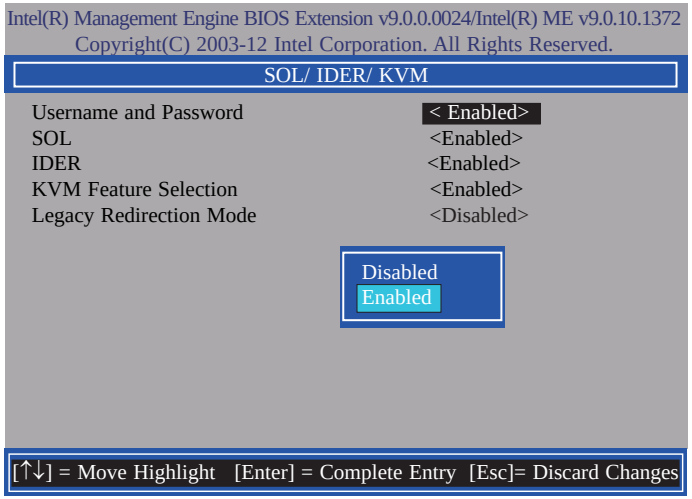
9. In the **Intel(R) AMT Configuration** menu, select **Manageability Feature Selection** then press Enter. Select **Disabled** then press Enter.



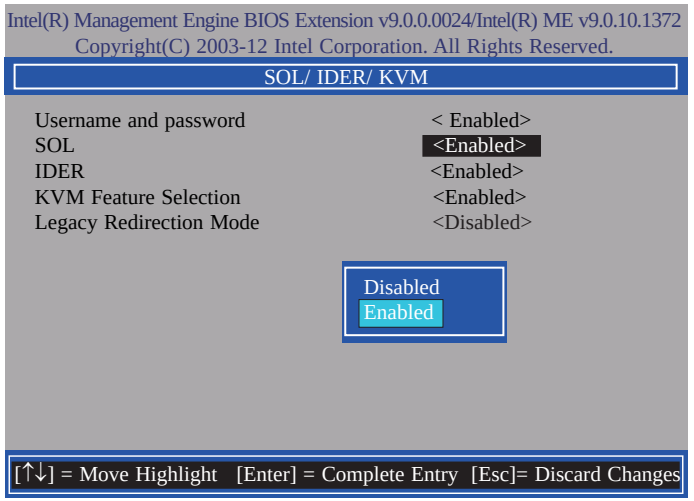
10. In the **Intel(R) AMT Configuration** menu, select **SOL/IDER/KVM** then press Enter.



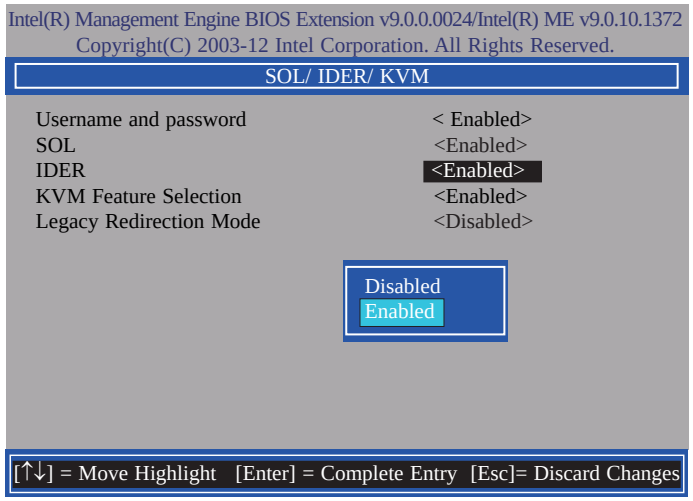
11. In the **SOL/IDER/KVM** menu, select **Username and Password** then press Enter. Select **Disabled** then press Enter.



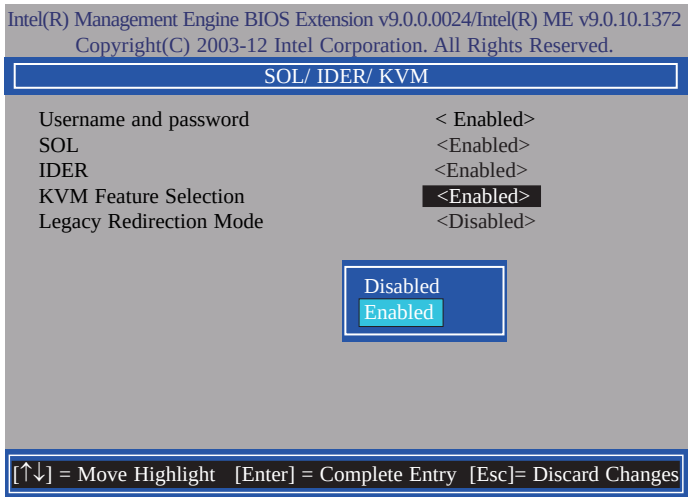
12. In the **SOL/IDER/KVM** menu, select **SOL** then press Enter. Select **Disabled** then press Enter.



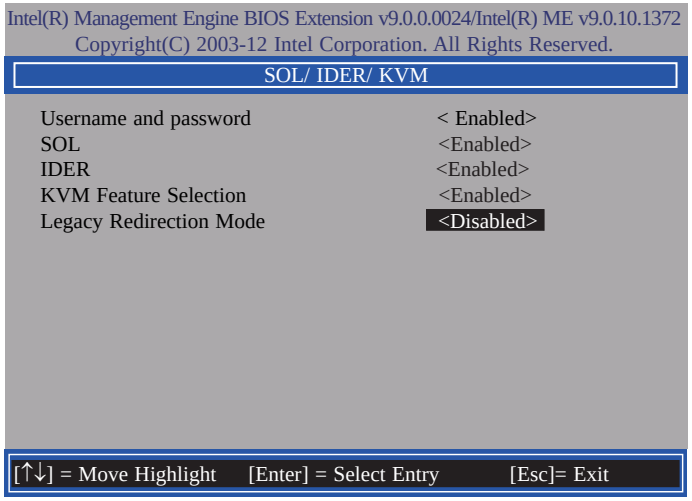
13. In the **SOL/IDER/KVM** menu, select **IDER** then press Enter. Select **Disabled** then press Enter.



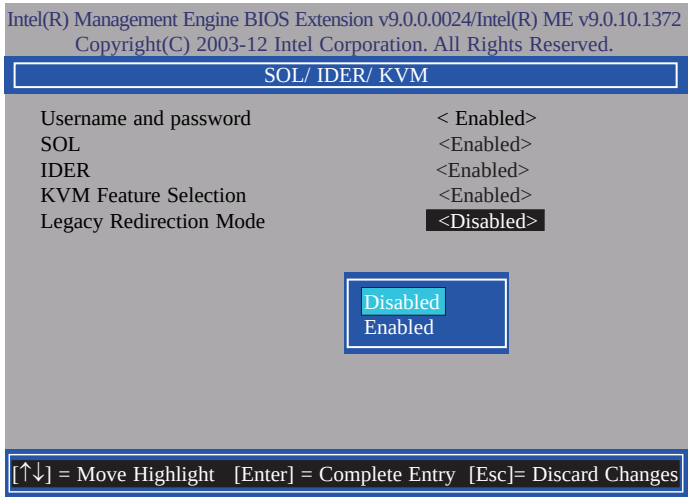
14. In the **SOL/IDER/KVM** menu, select **KVM Feature Selection** then press Enter. Select **Disabled** then press Enter.



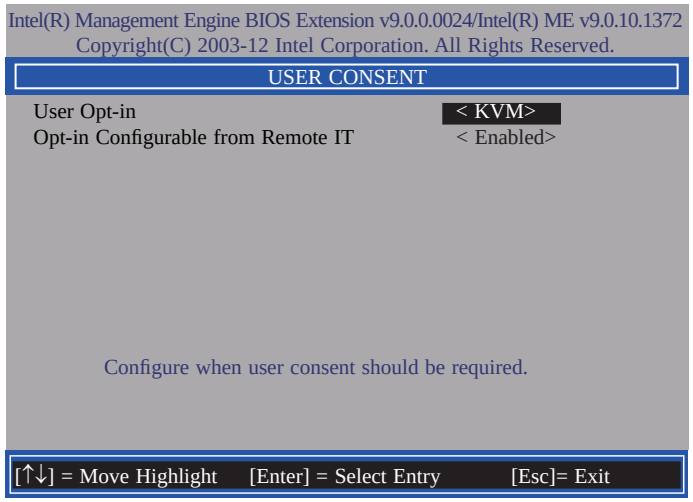
15. In the **SOL/IDER/KVM** menu, select **Legacy Redirection Mode** then press Enter.



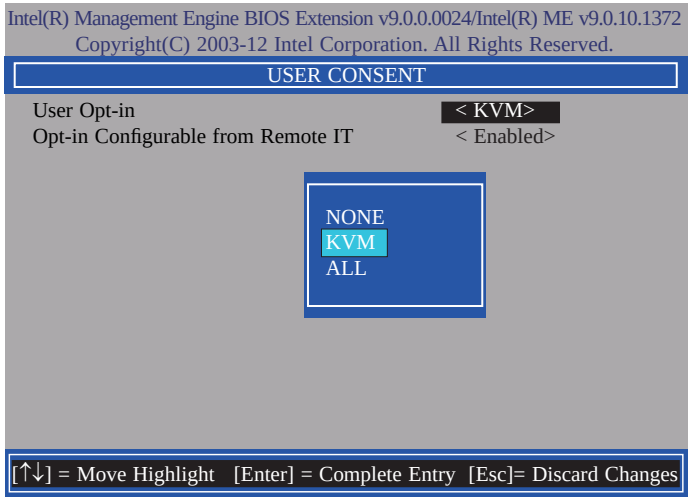
16. Select **Enabled** then press Enter.



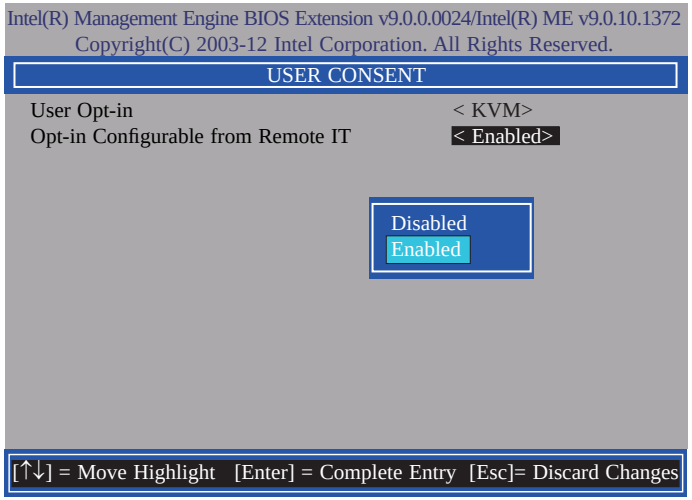
17. Select Previous Menu until you return to the **Intel(R) AMT Configuration** menu. Select **User Consent** then press Enter.



18. In the **User Consent** menu**,** select **User Opt-in** then press Enter. Select **None** then press Enter.

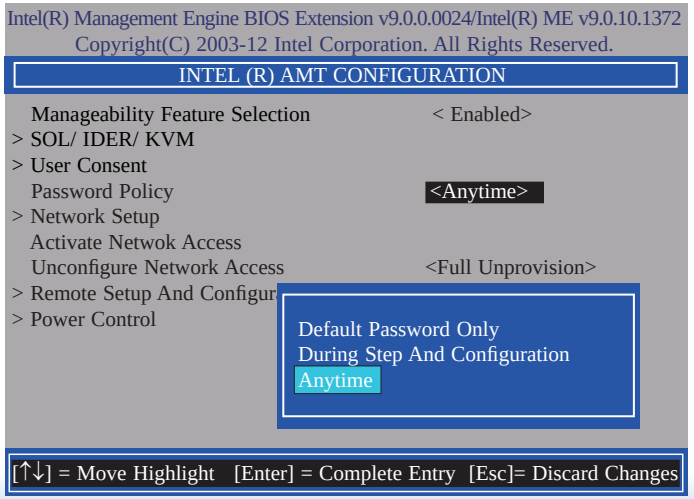


19. In the **User Consent** menu**,** select **Opt-in Configurable from Remote IT** then press Enter. Select **Disable Remote Control of KVM Opt-in Policy** then press Enter.

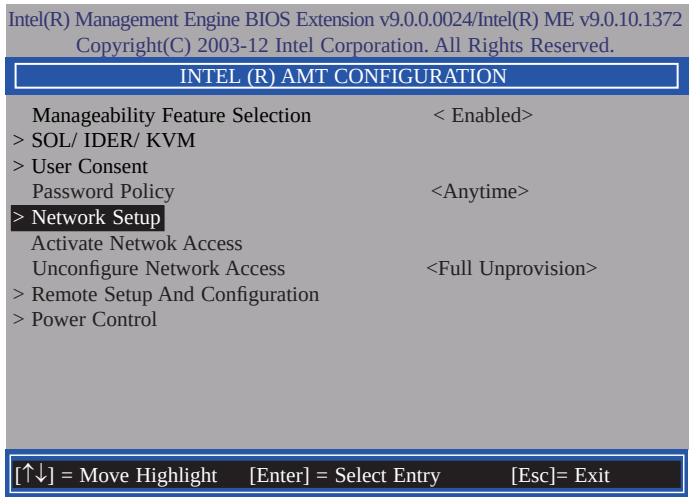


20. Select Previous Menu until you return to the **Intel(R) AMT Configuration** menu. Select **Password Policy** then press Enter.

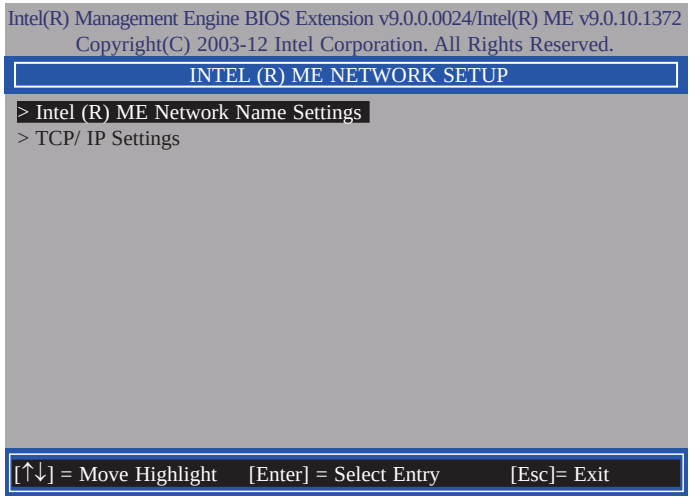
You may choose to use a password only during setup and configuration or to use a password anytime the system is being accessed.



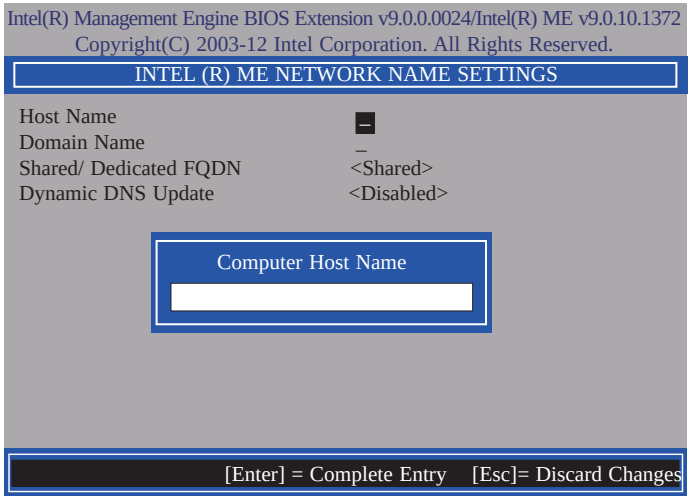
21. In the **Intel(R) AMT Configuration** menu**,** select **Network Setup** then press Enter.



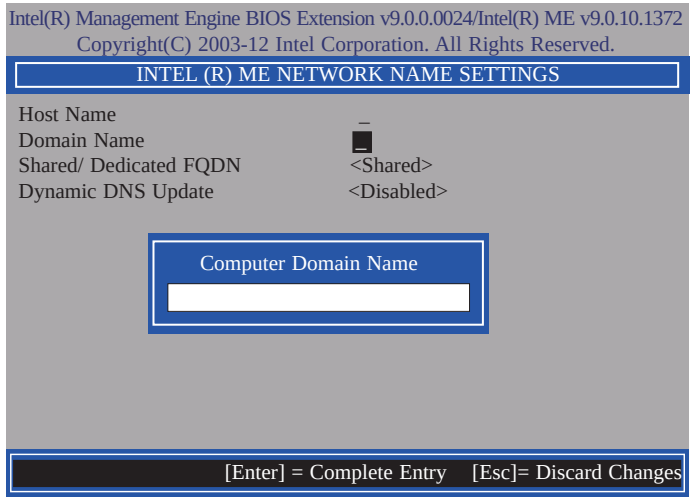
22. In the **Intel(R) ME Network Setup** menu, select **Intel(R) ME Network Name Settings** then press Enter.



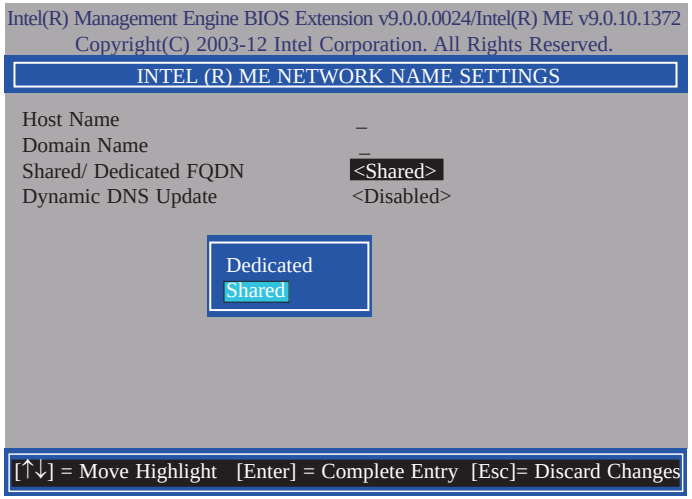
23. In the **Intel(R) ME Network Name Settings** menu, select **Host Name** then press Enter. Enter the computer's host name then press Enter.



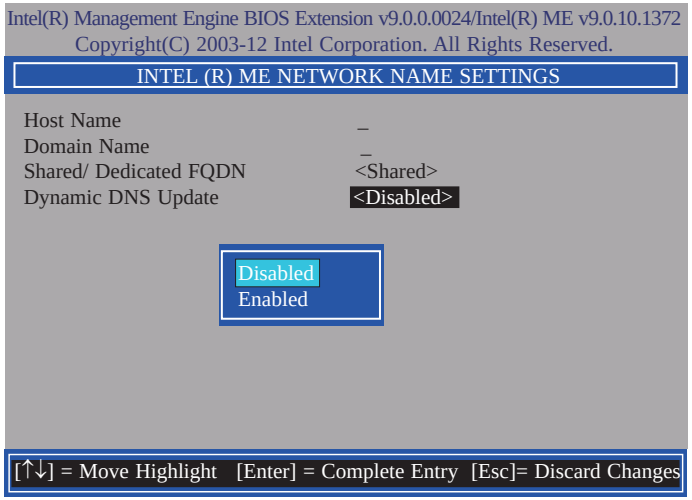
24. Select **Domain Name** then press Enter. Enter the computer's domain name then press Enter.



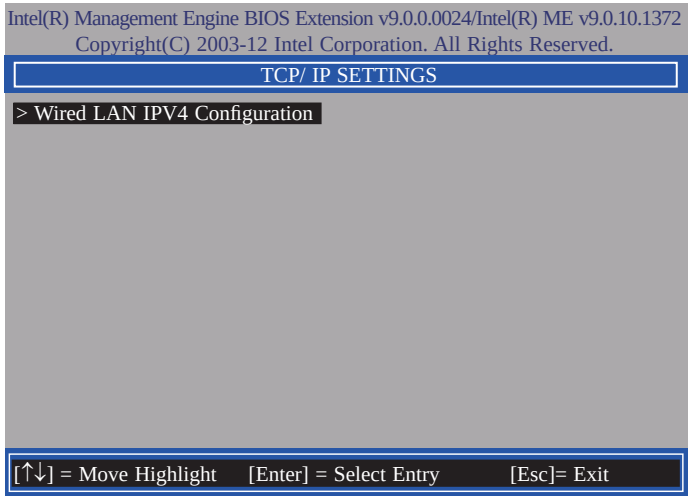
25. Select **Shared/Dedicated FQDN** then press Enter. Select **Shared** or **Dedicated** then press Enter.



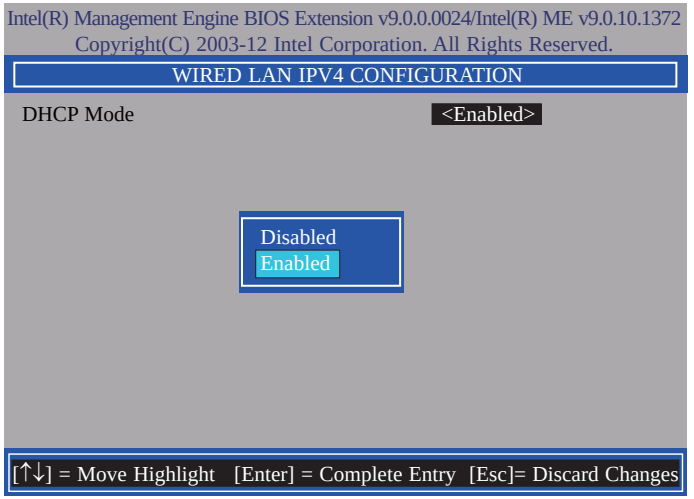
26. Select **Dynamic DNS Update** then press Enter. Select **Enabled** or **Disabled** then press Enter.



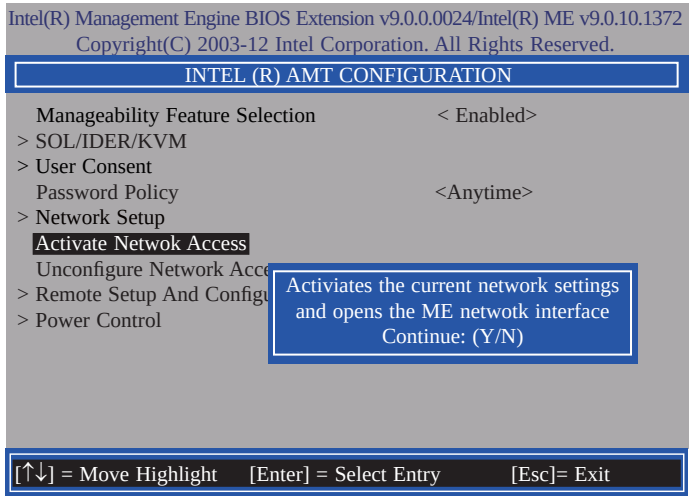
27. Select Previous Menu until you return to the **Intel(R) ME Network Setup** menu. Select **TCP/IP Settings** then press Enter.



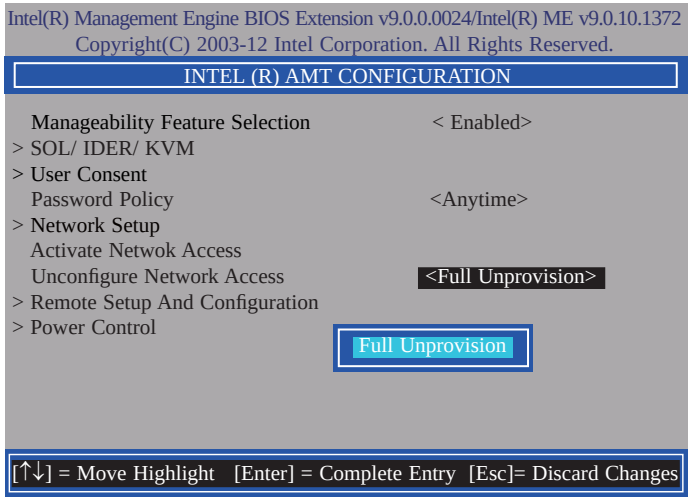
28. In the **TCP/IP Settings** menu, select **Wired LAN IPV4 Configuration** then press Enter.



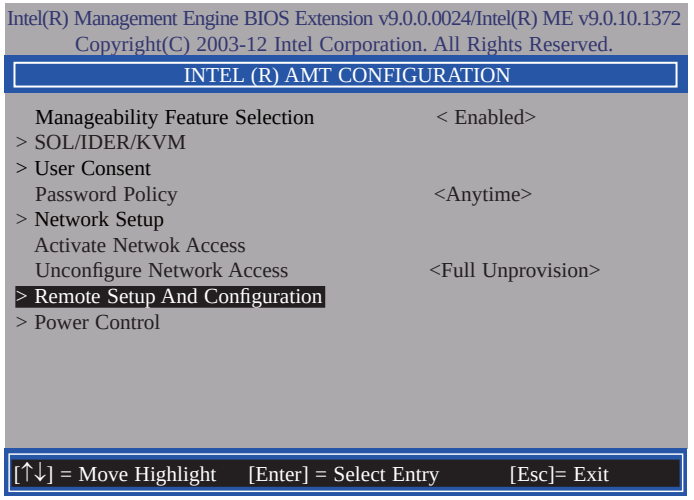
29. Select Previous Menu until you return to the **Intel(R) AMT Configuration** menu. Select **Activate Network Access** then press Enter. Type **Y** then press Enter.



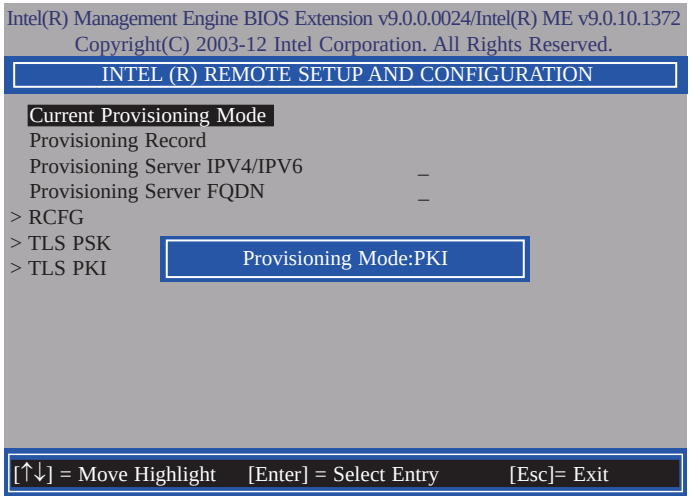
30. In the **Intel(R) AMT Configuration** menu, select **Unconfigure Network Access** then press Enter.



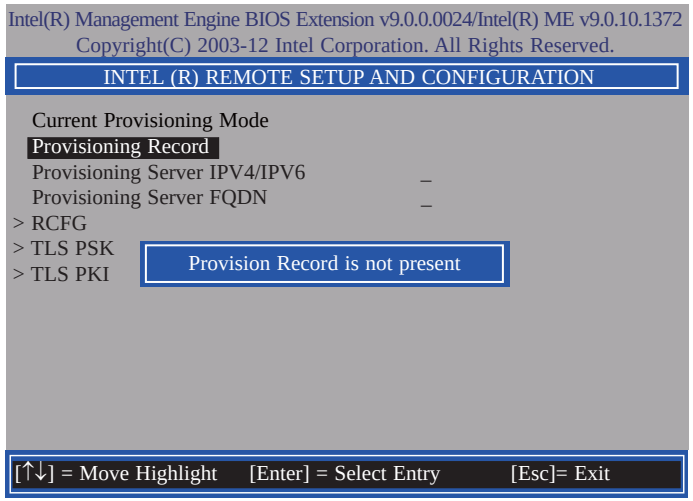
31. In the **Intel(R) AMT Configuration** menu, select **Remote Setup And Configuration** then press Enter.



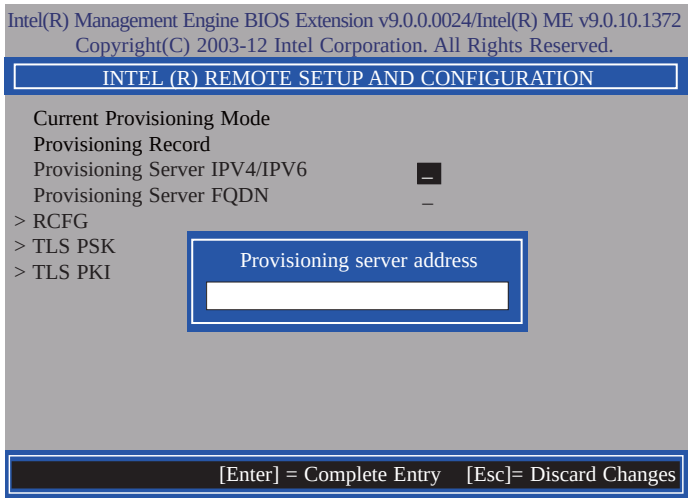
32. In the **Intel(R) Remote Setup And Configuration** menu**,** select **Current Provisioning Mode** then press Enter.



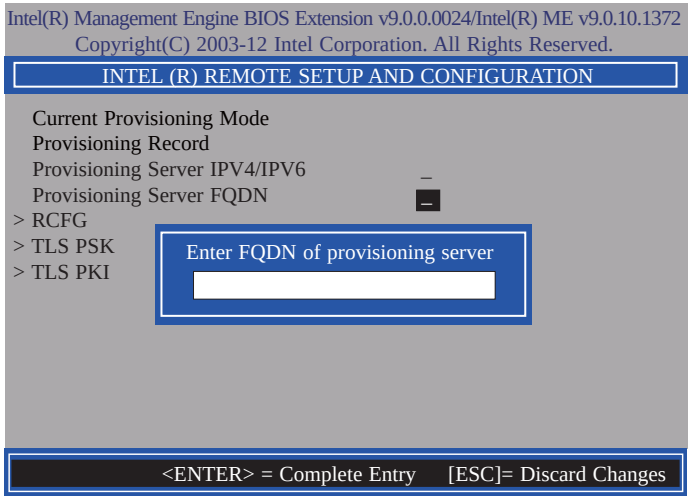
33. In the **Intel(R) Remote Setup And Configuration** menu, select **Provisioning Record** then press Enter.



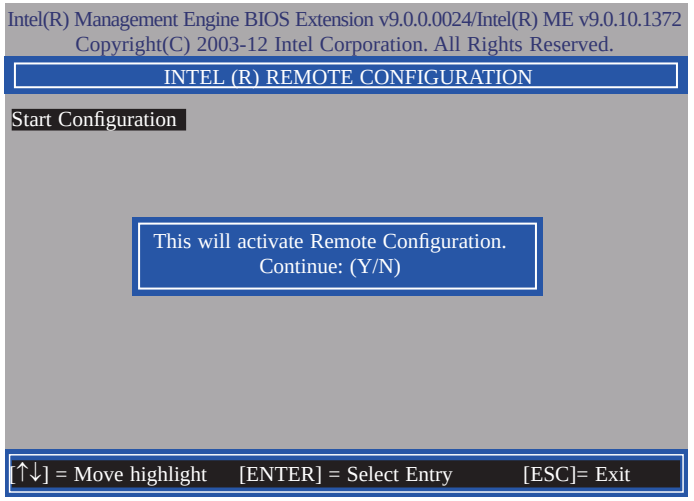
34. Select Previous Menu until you return to the **Intel(R) Remote Setup And Configuration** menu. Select **Provisioning Server IPV4/IPV6** then press Enter. Type server address then press Enter.



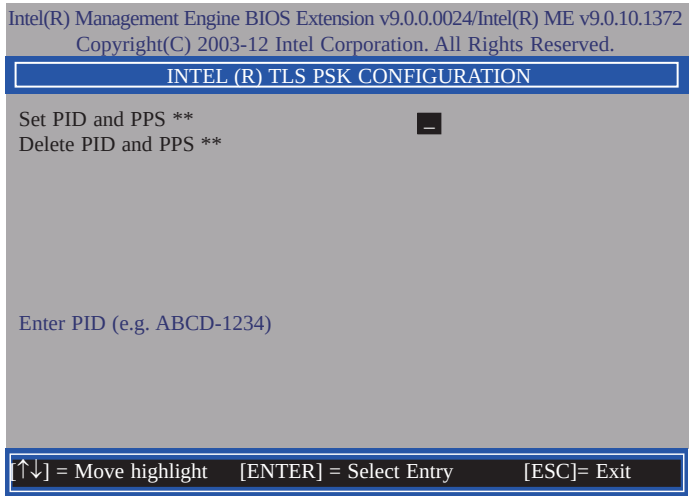
35. In the **Intel(R) Remote Automated Setup And Configuration** menu, select **Provisioning Server FQDN** then press Enter. Type FQDN of provisioning server then press Enter.



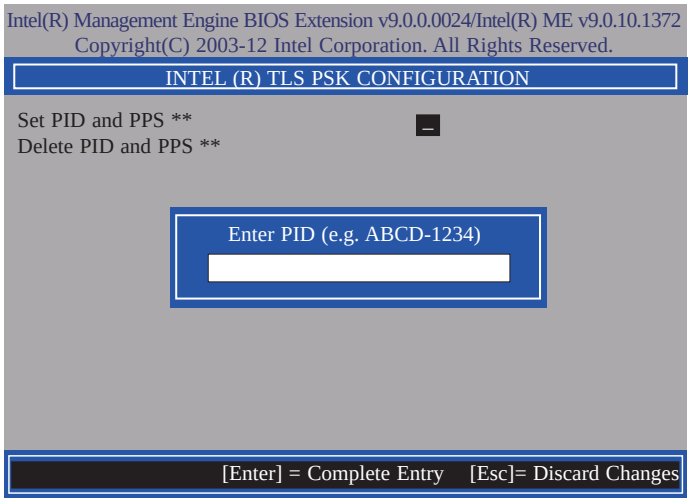
36. In the **Intel(R) Remote Automated Setup And Configuration** menu, select **RCFG** then press Enter. Select **Start Configuration**, and type **Y** then press Enter.



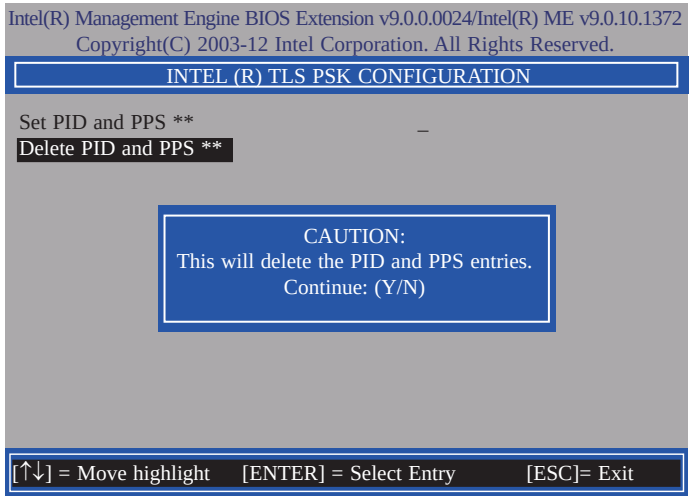
37. In the **Intel(R) Remote Automated Setup And Configuration** menu, select **TLS PSK** then press Enter.



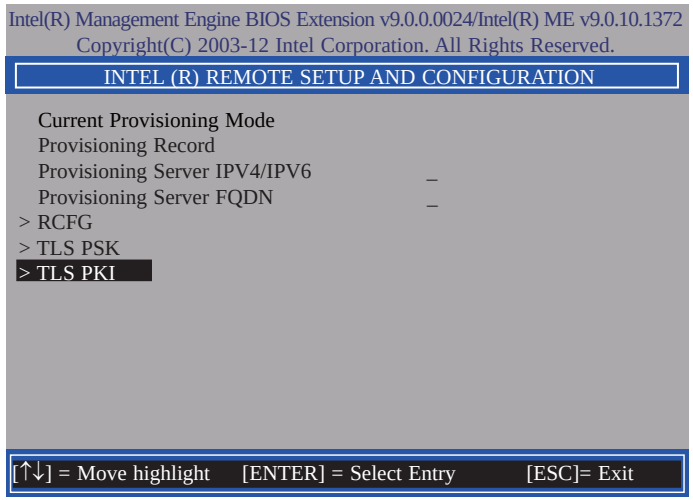
38. In the **Intel(R) TLS PSK Configuration** menu, select **Set PID and PPS **** then press Enter. Type PID code then press Enter.



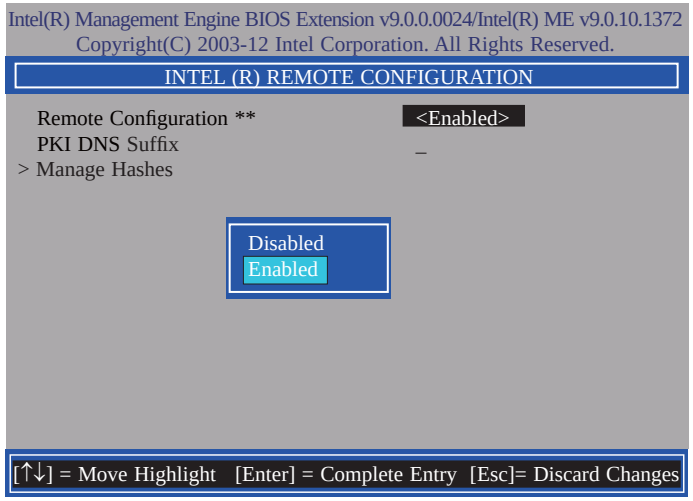
39. In the **Intel(R) TLS PSK Configuration** menu, select **Delete PID and PPS **** then press Enter. Type **Y** then press Enter.



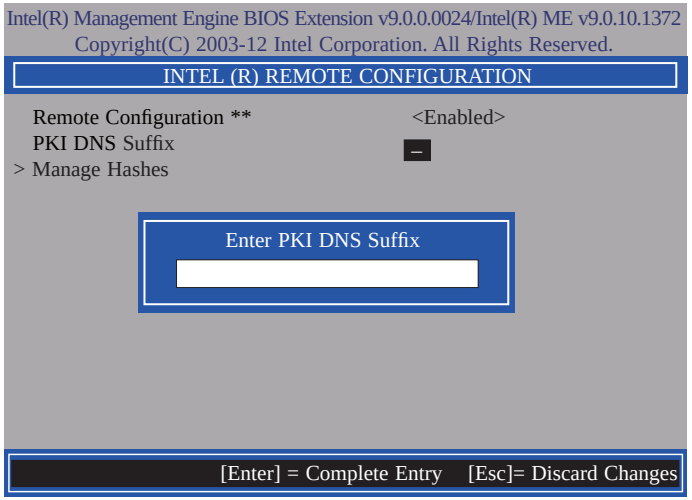
40. Select Previous Menu until you return to the **Intel(R) Remote Setup And Configuration** menu. Select **TLS PKI** then press Enter.



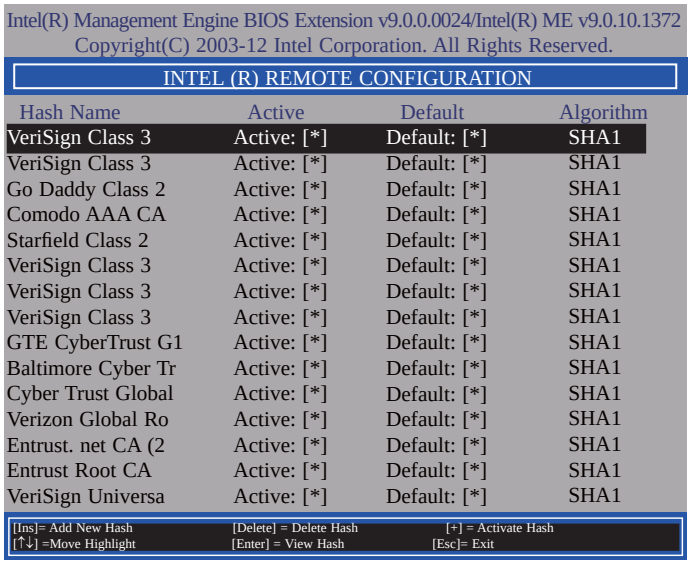
41. In the **Intel(R) Remote Configuration** menu, select **Remote Configuration **** then press Enter. Select **Disabled** then press Enter.



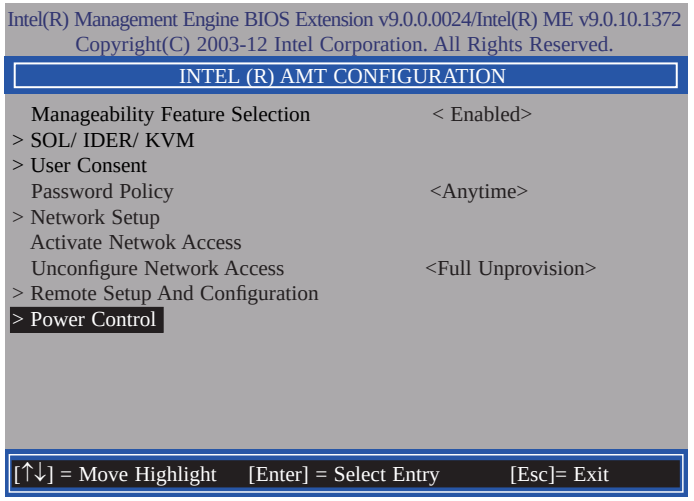
42. In the **Intel(R) Remote Configuration** menu, select **PKI DNS Suffix** then press Enter. Type PKI DNS Suffix then press Enter.



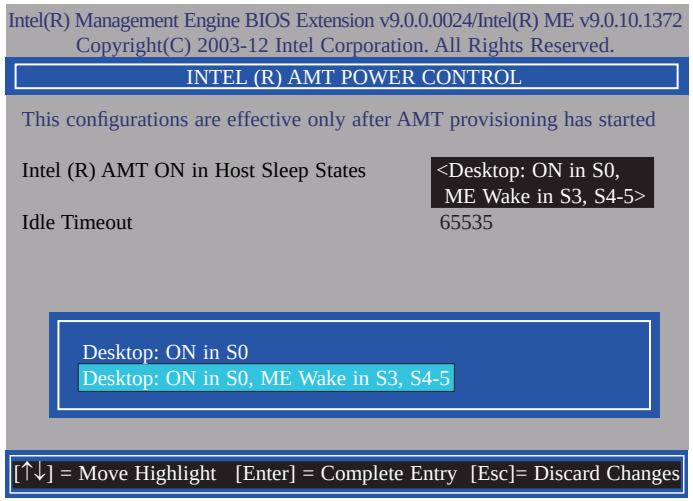
43. In the **Intel(R) Remote Configuration** menu, select **Manage Hashes** then press Enter.



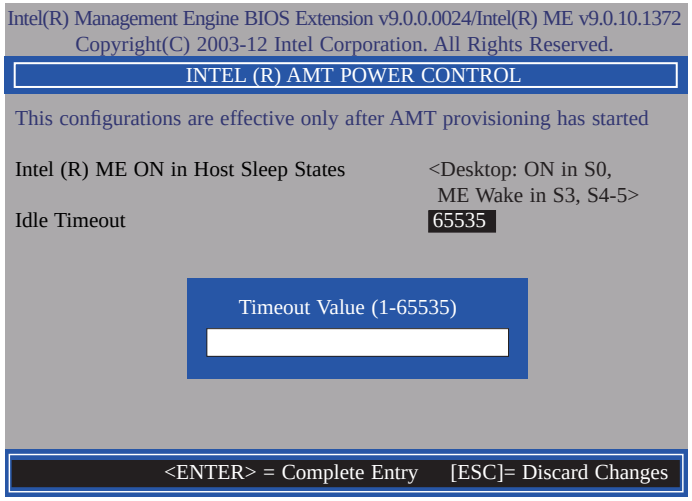
44. In the **Intel(R) AMT Configuration** menu**,** select **Power Control** then press Enter.



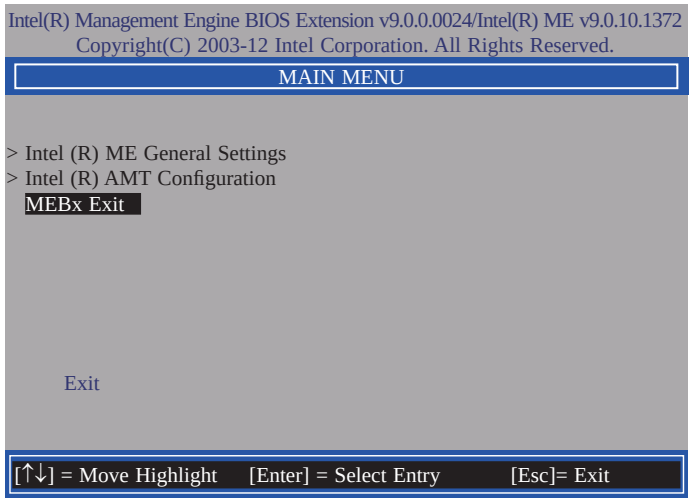
45. In the **Intel(R) AMT Power Control** menu, select **Intel(R) AMT ON in Host Sleep States** then press Enter. Select an option then press Enter.



46. In the **Intel(R) AMT Power Control** menu, select **Idle Timeout** then press Enter. Enter the timeout value (1-65535).



47. Select Previous Menu until you return to the **Main Menu**. Select **Exit** then press Enter. Type **Y** then press Enter.



Appendix A - Watchdog Sample Code

```
#include <stdio.h>
//----------------------------------------------------------------
#define EC_EnablePort 0x66
#define EC_DataPort 0x62
//----------------------------------------------------------------
void WriteEC(char,int);
void SetWDTime(int,int);
int  GetWDTime(void);
//----------------------------------------------------------------
main()
{
  unsigned int countdown;
  unsigned int input,count_h,count_l;

  printf("Input WD Time: ");
  scanf("%d",&input);
  printf("\n");
  count_h=input>>8;
  count_l=input&0x00FF;
  SetWDTime(count_h,count_l);

  while(1)
  {
        countdown = GetWDTime();
        delay(100);
        printf("\rTime Remaining: %d ",countdown);
  }
}
//----------------------------------------------------------------
void SetWDTime(int count_H,int count_L)
{
  //Set Count
  WriteEC(0xB5,count_H); //High Byte
  WriteEC(0xB6,count_L); //Low  Byte
  //Enable Watch Dog Timer
  WriteEC(0xB4,0x01);
}
//----------------------------------------------------------------
int GetWDTime(void)
{
  int sum,data_h,data_l;
  //Select EC Read Type
  outportb(EC_EnablePort,0x80);
  delay(5);
  //Get Remaining Count High Byte
  outportb(EC_DataPort,0xF4);
  delay(5);
  data_h=inportb(EC_DataPort);
  delay(5);
  //Select EC Read Type
  outportb(EC_EnablePort,0x80);
  delay(5);
  //Get Remaining Count Low Byte
  outportb(EC_DataPort,0xF5);
  delay(5);
  data_l=inportb(EC_DataPort);
  delay(5);

  data_h<<=8;
  data_h&=0xFF00;
  sum=data_h|data_l;
  return sum;
}
//----------------------------------------------------------------
void WriteEC(char EC_Addr, int data)
{
  //Select EC Write Type
  outportb(EC_EnablePort,0x81);
  delay(5);
  outportb(EC_DataPort,EC_Addr);
  delay(5);
  outportb(EC_DataPort,data);
  delay(5);
}
//----------------------------------------------------------------
```

Appendix B - System Error Message

When the BIOS encounters an error that requires the user to correct something, either a beep code will sound or a message will be displayed in a box in the middle of the screen and the message, PRESS F1 TO CONTINUE, CTRL-ALT-ESC or DEL TO ENTER SETUP, will be shown in the information box at the bottom. Enter Setup to correct the error.

Error Messages

One or more of the following messages may be displayed if the BIOS detects an error during the POST. This list indicates the error messages for all Awards BIOSes:

CMOS BATTERY HAS FAILED

The CMOS battery is no longer functional. It should be replaced.

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

CMOS CHECKSUM ERROR

Checksum of CMOS is incorrect. This can indicate that CMOS has become corrupt. This error may have been caused by a weak battery. Check the battery and replace if necessary.

DISPLAY SWITCH IS SET INCORRECTLY

The display switch on the motherboard can be set to either monochrome or color. This indicates the switch is set to a different setting than indicated in Setup. Determine which setting is correct, either turn off the system and change the jumper or enter Setup and change the VIDEO selection.

Appendix C - Troubleshooting

Troubleshooting Checklist

This chapter of the manual is designed to help you with problems that you may encounter with your personal computer. To efficiently troubleshoot your system, treat each problem individually. This is to ensure an accurate diagnosis of the problem in case a problem has multiple causes.

Some of the most common things to check when you encounter problems while using your system are listed below.

1. The power switch of each peripheral device is turned on.

2. All cables and power cords are tightly connected.

3. The electrical outlet to which your peripheral devices are connected is working. Test the outlet by plugging in a lamp or other electrical device.

4. The monitor is turned on.

5. The display's brightness and contrast controls are adjusted properly.

6. All add-in boards in the expansion slots are seated securely.

7. Any add-in board you have installed is designed for your system and is set up correctly.

Monitor / Display

If the display screen remains dark after the system is turned on:

1. Make sure that the monitor's power switch is on.

2. Check that one end of the monitor's power cord is properly attached to the monitor and the other end is plugged into a working AC outlet. If necessary, try another outlet.

3. Check that the video input cable is properly attached to the monitor and the system's display adapter.

4. Adjust the brightness of the display by turning the monitor's brightness control knob.

The picture seems to be constantly moving.

1. The monitor has lost its vertical sync. Adjust the monitor's vertical sync.

2. Move away any objects, such as another monitor or fan, that may be creating a magnetic field around the display.

3. Make sure your video card's output frequencies are supported by this monitor.

The screen seems to be constantly wavering.

1. If the monitor is close to another monitor, the adjacent monitor may need to be turned off. Fluorescent lights adjacent to the monitor may also cause screen wavering.

Power Supply

When the computer is turned on, nothing happens.

1. Check that one end of the AC power cord is plugged into a live outlet and the other end properly plugged into the back of the system.

2. Make sure that the voltage selection switch on the back panel is set for the correct type of voltage you are using.

3. The power cord may have a "short" or "open". Inspect the cord and install a new one if necessary.

Hard Drive

Hard disk failure.

1. Make sure the correct drive type for the hard disk drive has been entered in the BIOS.

2. If the system is configured with two hard drives, make sure the bootable (first) hard drive is configured as Master and the second hard drive is configured as Slave. The master hard drive must have an active/bootable partition.

Excessively long formatting period.

If your hard drive takes an excessively long period of time to format, it is likely a cable connection problem. However, if your hard drive has a large capacity, it will take a longer time to format.

Serial Port

The serial device (modem, printer) doesn't output anything or is outputting garbled characters.

1. Make sure that the serial device's power is turned on and that the device is on-line.

2. Verify that the device is plugged into the correct serial port on the rear of the computer.

3. Verify that the attached serial device works by attaching it to a serial port that is working and configured correctly. If the serial device does not work, either the cable or the serial device has a problem. If the serial device works, the problem may be due to the onboard I/O or the address setting.

4. Make sure the COM settings and I/O address are configured correctly.

Keyboard

Nothing happens when a key on the keyboard was pressed.

1. Make sure the keyboard is properly connected.

2. Make sure there are no objects resting on the keyboard and that no keys are pressed during the booting process.

System Board

1. Make sure the add-in card is seated securely in the expansion slot. If the add-in card is loose, power off the system, re-install the card and power up the system.

2. Check the jumper settings to ensure that the jumpers are properly set.

3. Verify that all memory modules are seated securely into the memory sockets.

4. Make sure the memory modules are in the correct locations.

5. If the board fails to function, place the board on a flat surface and seat all socketed components. Gently press each component into the socket.

6. If you made changes to the BIOS settings, re-enter setup and load the BIOS defaults.